

Number	Algebra	Geometry & Measures	Probability & Statistics
<u>Rounding and Estimation</u>	<u>Indices</u>	<u>Scale Drawings and Constructions</u>	<u>Averages and Spread</u>
<u>Calculations (inc. use of calculator)</u>	<u>Expanding Brackets</u>	<u>Compound Measures</u>	<u>Frequency Charts</u>
<u>Fractions</u>	<u>Factorising</u>	<u>Similarity</u>	<u>Scatter Diagrams</u>
<u>Percentages</u>	<u>Changing the Subject</u>	<u>Congruency</u>	<u>Histograms</u>
<u>Ratio</u>	<u>Sequences</u>	<u>Angles (inc. Circle Theorems)</u>	<u>Cumulative Frequency & Box Plots</u>
<u>Proportion</u>	<u>Linear Equations</u>	<u>Perimeter and Area</u>	<u>Capture-Recapture</u>
<u>Factors, Multiples, Primes</u>	<u>Quadratic Equations</u>	<u>Volume and Surface Area</u>	<u>Probability</u>
<u>Recurring Decimals</u>	<u>Simultaneous Equations</u>	<u>Real-Life Graphs</u>	<u>Venn Diagrams</u>
<u>Indices</u>	<u>Inequalities</u>	<u>3D Drawings</u>	<u>Product Rule for Counting</u>
<u>Surds</u>	<u>Algebraic Fractions</u>	<u>Transformations</u>	
<u>Standard Form</u>	<u>Linear Graphs</u>	<u>Pythagoras</u>	

Exam Series included:

- Summer 2017
- November 2017
- Summer 2018
- November 2018
- Summer 2019
- November 2019
- Summer 2020
(these exams were postponed to October due to Covid-19)
- November 2021

<u>Non-Linear Graphs</u>	<u>Trigonometry</u>
<u>Solving Equations with Graphs</u>	<u>Bounds</u>
<u>Completing the Square</u>	<u>Vectors</u>
<u>Functions</u>	<u>Area & Gradient, Graphs</u>
<u>Transformations of Graphs</u>	
<u>Proof</u>	
<u>Equations of Circles & Tangents</u>	
<u>Iteration</u>	



Video Solutions

Number



Algebra



Geometry & Measures



Probability & Statistics



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HOME

Number

Rounding and Estimation

Estimating
Answers

Error Intervals



Number
Rounding and Estimation
<i>Estimating answers</i>

8 (a) Work out an estimate for the value of $\sqrt{63.5 \times 101.7}$

 **Video Solutions**

(2 marks)

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HOME

Number
Rounding and Estimation
<i>Estimating answers</i>

8	(a)	75 to 81	B2	for answer in the range 75 to 81
			(B1	for 60 or 100 or 6000 or 6400 or $\sqrt{64 \times 100}$)

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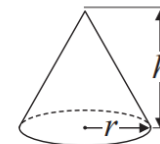


Number
Rounding and Estimation
<i>Estimating answers, substitution</i>

- 15 A cone has a volume of 98 cm^3 .
The radius of the cone is 5.13 cm .

(a) Work out an estimate for the height of the cone.

$$\text{Volume of cone} = \frac{1}{3} \pi r^2 h$$



(3 marks)

John uses a calculator to work out the height of the cone to 2 decimal places.

- (b) Will your estimate be more than John's answer or less than John's answer?
Give reasons for your answer.

 **Video Solutions**

(1 mark)



Number
Rounding and Estimation
<i>Estimating answers, substitution</i>

15	(a)	3.5 to 4.5	M1	substitution into formula $\frac{1}{3}\pi r^2 h$ of chosen values for r and V (accept $r = 5.13$ and $V = 98$) and starts rearrangement e.g. multiplies by 3, divides by π or divides by r^2 (both sides)
			M1	uses estimates in calculation e.g. $\frac{3 \times 100}{3 \times 25}$ (or in rearranged formula) or $\frac{12}{\pi}$
			A1	arrives at a single value from estimate in the range 3.5 to 4.5
	(b)	more	C1	ft e.g. more since number in numerator goes up; numbers in denominator go down.



Summer 2018 Paper 1H (Non-Calc)

Number
Rounding and Estimation
<i>Estimating answers, speed/dist/time</i>

4 A cycle race across America is 3069.25 miles in length.

Juan knows his average speed for his previous races is 15.12 miles per hour.
For the next race across America he will cycle for 8 hours per day.

(a) Estimate how many days Juan will take to complete the race.

(3 marks)

Juan trains for the race.
The average speed he can cycle at increases.
It is now 16.27 miles per hour.

(b) How does this affect your answer to part (a)?

 **Video Solutions**

(1 mark)

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HOME

Number
Rounding and Estimation
<i>Estimating answers, speed/dist/time</i>

4	(a)	Estimated value	P1	for using a rounded value in a correct process eg $3000 \div 15$ or 15×8 or 20×8	Their rounded value must be used in a calculation Rounding may appear after a correct process eg $15.12 \times 8 = 120.96 \approx 100$ followed by eg $3069.25 \div 100$ Accept $3069.25 \div 15.12 \div 8$ oe
			P1	for a full process to find the number of days eg “3000” $\div$ “15” $\div$ “10” (= 20) or “3000” $\div$ “15” $\div$ 8 (= 25)	
			A1	for a correct answer following through their rounded values	
	(b)	Explanation	C1	eg less days required or it doesn’t affect the answer because I would still round 16.27 down to 15 (or up to 20)	Refers to time taken



November 2018 Paper 1H (Non-Calc)

- 5 A plane travels at a speed of 213 miles per hour.
- (a) Work out an estimate for the number of seconds the plane takes to travel 1 mile.

Number
Rounding and Estimation
<i>Estimating answers, speed/dist/time</i>

..... seconds
(3)

- (b) Is your answer to part (a) an underestimate or an overestimate?
Give a reason for your answer.

.....
.....
(1)

 **Video Solutions**

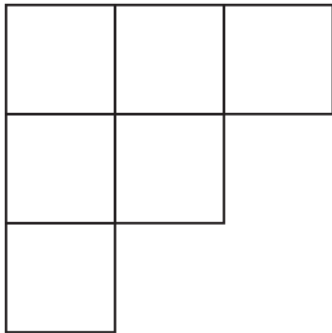


Number
Rounding and Estimation
<i>Estimating answers, speed/dist/time</i>

5	(a)	16 to 20	P1	for using time = $\frac{\text{distance}}{\text{speed}}$, eg $\frac{1}{200}$ or $\frac{1}{213}$ or for 1 hour = $60 \times 60 (= 3600)$ seconds	Calculation could be done in stages.
			P1	complete process, eg $\frac{1}{200} \times 60 \times 60$ oe or $\frac{1}{213} \times 60 \times 60$ oe	
			A1	for answer in range 16 to 20	
	(b)	decision with reason	C1	(dep on correct use of time = $\frac{\text{distance}}{\text{speed}}$) for reason related to their response to part(a), eg overestimate as speed rounded down	



10 The diagram shows a shape made from 6 identical squares.



The total area of the shape is 5406 cm²

- (a) Find an estimate for the length of one side of each square.
Give your answer correct to the nearest whole number.

(3 marks)

- (b) Is your answer to part (a) an underestimate or an overestimate?
You must give a reason for your answer.

(1 mark)

Number
Rounding and Estimation
Estimating answers, area



Number
Rounding and Estimation
<i>Estimating answers, area</i>

10	(a)	30	P1	for a start to the process, eg $5406 \div 6 (= 901)$ or $5400 \div 6 (= 900)$ or $5000 \div 6 (= 833.33..)$ or $5410 \div 6 (= 901.66..)$	
			P1	for a process to find the length of one side, eg $\sqrt{901}$ or $\sqrt{900}$ or $\sqrt{833.33..}$ or $\sqrt{901.66..}$	
			A1	for 30	
	(b)	Explanation	C1	for a correct explanation based on their working in (a), eg underestimate because I rounded the total area down	Must be based on the use of a rounded value in a calculation



Number
Rounding and Estimation
Error intervals

7 A number, n , is rounded to 2 decimal places.
The result is 4.76

Using inequalities, write down the error interval for n .

 **Video Solutions**

(2 marks)



Number
Rounding and Estimation
Error intervals

7		$4.755 \leq n < 4.765$	B2 [B1	for $4.755 \leq n < 4.765$ for 4.755 or 4.765 or 4.7649]
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 **Video Solutions**



Number
Rounding and Estimation
Error intervals

- 5 (a) Find the value of the reciprocal of 1.6
Give your answer as a decimal.

.....
(1)

Jess rounds a number, x , to one decimal place.
The result is 9.8

- (b) Write down the error interval for x .

.....
(2)



 **Video Solutions**



Number
Rounding and Estimation
Error intervals

5	(a)		0.625	B1	cao
	(b)		$9.75 \leq x < 9.85$	B2	for $9.75 \leq x < 9.85$
				[B1	for 9.75 or 9.85 (or 9.849)]



Summer 2019 Paper 2H (Calc)

- 9 Martin truncates the number N to 1 digit.
The result is 7

Write down the error interval for N .

Number

Rounding and
Estimation

Error intervals

 **Video Solutions**

(2 marks)

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Number
Rounding and Estimation
Error intervals

9	$7 \leq N < 8$	M1	for identifying the key numbers 7 and 8	Ignore any inequality symbols used at this stage Accept 7.9 (recurring) for 8 as shown by 7.999 or 7.9... or recurring notation (or words)
		A1	cao	



Summer 2019 Paper 2H (Calc)

6 Sally used her calculator to work out the value of a number y .

The answer on her calculator display began

8.3

Complete the error interval for y .

..... $\leq y <$

Number
Rounding and Estimation
Error intervals

 **Video Solutions**

(2 marks)



Number
Rounding and Estimation
<i>Error intervals</i>

6

8.3 and 8.4

B1

for 8.3 in the correct position

B1

for 8.4 in the correct position

Accept 8.39 or 8.399...

 **Video Solutions**



HOME

Number
Rounding and Estimation
<i>Error intervals</i>

- 2 The length of a pencil is 128 mm correct to the nearest millimetre.
- Complete the error interval for the length of the pencil.

..... mm $\leq$ length < mm

 **Video Solutions**

(2 marks)



Number
Rounding and Estimation
Error intervals

2	127.5 and 128.5	B1	for 127.5 in the correct position	
		B1	for 128.5 in the correct position	Accept 128.49 or 128.499...

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Summer 2020 Paper 3H (Calc)

3 A number, m , is rounded to 1 decimal place.
The result is 9.4

Complete the error interval for m .

Number
Rounding and Estimation
Error intervals

..... $\leq m <$

 **Video Solutions**

(2 marks)



Number
Rounding and Estimation
<i>Error intervals</i>

3	9.35, 9.45	B1	for 9.35 in the correct position	
		B1	for 9.45 in the correct position	Accept 9.449 oe or 9.4499...oe

 **Video Solutions**



Number
Rounding and Estimation
<i>Error intervals</i>

11 Freya writes down the value of x , correct to 1 decimal place.

She writes $x = 6.4$

Complete the error interval for x .

..... $\leq x <$

(2 marks)



Number
Rounding and Estimation
<i>Error intervals</i>

11	6.35, 6.45	B1	for 6.35 in the correct position	
		B1	for 6.45 in the correct position	Accept 6.449 oe or 6.4499... oe



Number

Calculations

Non-Calculator

Calculator



Summer 2017 Paper 1H (Non-Calc)

3 Work out 54.6×4.3

Number

Calculations

*Multiplying decimals
without a calculator*

 **Video Solutions**

(3 marks)

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HOME

Number
Calculations
<i>Multiplying decimals without a calculator</i>

3	21840 1638 23478 <table><tr><td></td><td>5</td><td>4</td><td>6</td><td></td></tr><tr><td>2</td><td><table><tr><td>2</td><td>0</td></tr><tr><td>1</td><td>5</td></tr></table></td><td><table><tr><td>1</td><td>6</td></tr><tr><td>1</td><td>2</td></tr></table></td><td><table><tr><td>2</td><td>4</td></tr><tr><td>1</td><td>8</td></tr></table></td><td>4</td></tr><tr><td>3</td><td>4</td><td>7</td><td>8</td><td>3</td></tr></table> <table><tr><td></td><td>500</td><td>40</td><td>6</td></tr><tr><td>40</td><td>20000</td><td>1600</td><td>240</td></tr><tr><td>3</td><td>1500</td><td>120</td><td>18</td></tr></table> 20000 + 1600 + 240 + 1500 + 120 + 18 = 23478		5	4	6		2	<table><tr><td>2</td><td>0</td></tr><tr><td>1</td><td>5</td></tr></table>	2	0	1	5	<table><tr><td>1</td><td>6</td></tr><tr><td>1</td><td>2</td></tr></table>	1	6	1	2	<table><tr><td>2</td><td>4</td></tr><tr><td>1</td><td>8</td></tr></table>	2	4	1	8	4	3	4	7	8	3		500	40	6	40	20000	1600	240	3	1500	120	18	234.78	M1 for complete method with relative place value correct including addition of all the appropriate elements of the calculation e.g. two lines of 1st method, internal numbers of grids, or complete structure shown of partitioning methods A1 for digits 23478 A1 (ft dep M1) for correct placement of the decimal point into their final answer
	5	4	6																																							
2	<table><tr><td>2</td><td>0</td></tr><tr><td>1</td><td>5</td></tr></table>	2	0	1	5	<table><tr><td>1</td><td>6</td></tr><tr><td>1</td><td>2</td></tr></table>	1	6	1	2	<table><tr><td>2</td><td>4</td></tr><tr><td>1</td><td>8</td></tr></table>	2	4	1	8	4																										
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3	1500	120	18																																							



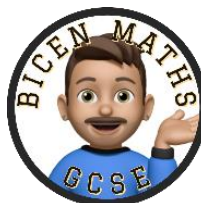
1 (a) Work out 3.67×4.2

Number
Calculations
<i>Multiplying/dividing decimals without a calculator</i>

(3 marks)

(b) Work out $59.84 \div 1.6$

(3 marks)



Number
Calculations
<i>Multiplying/dividing decimals without a calculator</i>

1	(a)	15.414	M1	for a complete method with relative place value correct including intention to add all the appropriate elements of the calculation eg 2 lines of the 1 st method, internal numbers of grids, or complete structure shown of partitioning methods.
			A1	for digits 15414
			A1	(ft) dep on M1 for correct placement of the decimal point into their final answer
	(b)	37.4	M1	for a start to a method, eg $598.4 \div 16$ (or $59.84 \div 1.6$) = 3 (as a first digit)
			A1	for digits 374
			A1	(ft) dep on M1 for correct placement of the decimal point into their final answer

14680
734
15414

367

122

48

50

61

12

44

414

	300	60	7
40	12000	2400	280
2	600	120	14

12000 + 2400 + 280 + 600 + 120 + 14 =
15414

A start to a repeated subtraction method or build-up method is acceptable if a correct first digit of 3 is found



Number
Calculations
<i>... with decimal places</i>

8 Use your calculator to work out $\sqrt{\frac{\sin 25^\circ + \sin 40^\circ}{\cos 25^\circ - \cos 40^\circ}}$

(a) Write down all the figures on your calculator display.

.....
(2)

(b) Write your answer to part (a) correct to 2 decimal places.

.....
(1)

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Number
Calculations
<i>... with decimal places</i>

8 (a)		2.7560...	M1	for 1.0654(059...), 0.1402(633...), 7.5957(541...), 2.756 truncated or rounded to no less than 2dp
			A1	for 2.7560(....)
(b)		2.76	B1	for 2.76 ft from (a)

 **Video Solutions**



Number
Calculations
... with significant figures

1 (a) Write 7357 correct to 3 significant figures.

.....
(1)

(b) Work out $\frac{\sqrt{17 + 4^2}}{7.3^2}$

Write down all the figures on your calculator display.

.....
(2)

 **Video Solutions**



Number
Calculations
<i>... with significant figures</i>

1	(a)	7360	B1	cao
	(b)	0.1077981356	B2	for 0.1077(981...)
			(B1	for 5.74(45626...) or 53.29 or 0.11 or 0.107 or 0.108)

Answer must be given to at least 4 decimal places rounded or truncated
Accept a clear indication of the decimal point.
Check first four decimal places only



Summer 2019 Paper 3H (Calc)

7 Work out

$$\sqrt{\frac{2.5 \times \sin 43^\circ}{8.2^2 - 50.5}}$$

Give your answer correct to 3 significant figures.

Number

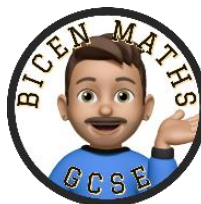
Calculations

... with significant
figures

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(2 marks)

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Number
Calculations
<i>... with significant figures</i>

7	0.319	M1 A1	for partial method eg 1.70(499...) or 16.74 or $\frac{837}{50}$ or 0.101(8516...) or 0.102 or 0.32 for 0.319(1419...)	Accept 0.319 or better. Condone incorrect digits after the 0.319; isw incorrect rounding if 0.319(1419...) is shown in working.
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Number
Calculations
... with significant figures

2 (a) Use your calculator to work out $\frac{29^2 - 4.6}{\sqrt{35 - 1.9^3}}$

Write down all the figures on your calculator display.

(2 marks)

(b) Write your answer to part (a) correct to 4 significant figures.

 **Video Solutions**

(1 mark)



Number
Calculations
<i>... with significant figures</i>

2	(a)	157.668(255)	M1	for 836.4 or 5.304(809139) or 28.141 or a truncated or rounded version of 157.668255 to no less than 3 sf	Answer must be given to at least 3 decimal places rounded or truncated Accept a clear indication of the decimal point. Check first 3 decimal places only
			A1	for 157.668(255)	
	(b)	157.7	B1	ft from part (a) provided answer to (a) has at least 5 sf	



Number

Fractions

Adding/Subtracting
Mixed Numbers

Multiplying/Dividing
Mixed Numbers



Summer 2018 Paper 1H (Non-Calc)

1 (a) Work out $2\frac{1}{7} + 1\frac{1}{4}$

Number
Fractions
<i>Adding and Dividing Mixed Numbers</i>

(2 marks)

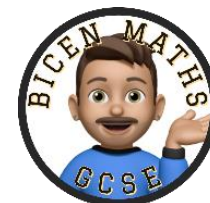
(b) Work out $1\frac{1}{5} \div \frac{3}{4}$

Give your answer as a mixed number in its simplest form.

 **Video Solutions**

(2 marks)

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Number
Fractions
<i>Adding and Dividing Mixed Numbers</i>

1	(a)	$\frac{95}{28}$	M1	for a method to add using common denominators with at least one fraction correct (matching numerator with common denominator) eg $\frac{60}{28} + \frac{35}{28}$ or $(2)\frac{4}{28} + (1)\frac{7}{28}$	Use of decimals gets no credit unless it leads to a correct fraction
			A1	$\frac{95}{28}$ oe eg $3\frac{11}{28}$	
	(b)	$1\frac{3}{5}$	M1	for $\frac{6}{5} \times \frac{4}{3}$ or $\frac{24}{20} \div \frac{15}{20}$ or $\frac{8}{5}$ oe eg $1\frac{9}{15}$	Use of decimals gets no credit unless it leads to a correct fraction
			A1	cao	



3 Work out $4\frac{1}{5} - 2\frac{2}{3}$

Give your answer as a mixed number.

Number

Fractions

*Subtracting Mixed
Numbers*

(3 marks)



HOME

Number
Fractions
<i>Subtracting Mixed Numbers</i>

3

$1\frac{8}{15}$

- M2
for a complete method,
eg $4 - 2 + \frac{3}{15} - \frac{10}{15}$ condoning error with one numerator
or for $\frac{21}{5} - \frac{8}{3} = \frac{63}{15} - \frac{40}{15} (= \frac{23}{15})$ with no more than one error
- (M1
for finding two fractions with a correct common denominator, with at least one correct corresponding numerator, eg $\frac{3}{15}, \frac{10}{15}$
or for converting both to improper fractions, eg $\frac{21}{5}, \frac{8}{3}$)
- A1
 $1\frac{8}{15}$ oe

At least one improper fraction must be correct
Any equivalents must be a mixed number



9 Work out $3\frac{1}{2} \times 1\frac{3}{5}$

Give your answer as a mixed number in its simplest form.

Number

Fractions

*Multiplying Mixed
Numbers*

 **Video Solutions**

(3 marks)

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Number
Fractions
<i>Multiplying Mixed Numbers</i>

9	$5\frac{3}{5}$	M1	for writing as improper fractions with at least one correct, eg $\frac{7}{2} \times \frac{8}{5}$ oe
		M1	(dep) for multiplying improper fractions, eg $\frac{"56"}{"10"}$ or $5\frac{6}{10}$ or $\frac{28}{5}$ oe
		A1	cao



Number
Fractions
<i>Multiplying Mixed Numbers</i>

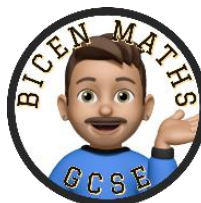
3 Work out $1\frac{3}{4} \times 1\frac{1}{3}$

Give your answer as a mixed number.

 **Video Solutions**

(3 marks)

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HOME

Number
Fractions
<i>Multiplying Mixed Numbers</i>

3	$2\frac{1}{3}$	M1	for either $\frac{7}{4}$ oe or $\frac{4}{3}$ oe
		M1	for method to find the product, eg. $\frac{7 \times 4}{4 \times 3}$ or $\frac{21 \times 16}{12 \times 12}$ oe or for $\frac{28}{12}$ or $\frac{7}{3}$ oe
		A1	for $2\frac{1}{3}$ or an equivalent mixed number



Number
Fractions
<i>Multiplying Mixed Numbers</i>

2 Show that

$$2\frac{1}{3} \times 3\frac{3}{4} = 8\frac{3}{4}$$

 **Video Solutions**

(3 marks)

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Number
Fractions
<i>Multiplying Mixed Numbers</i>

2	Shown	M1	for conversion to improper fractions eg. $\frac{7}{3}$ or $\frac{15}{4}$	Need not be shown with operators
		M1	(dep) for method to multiply fractions, eg. $\frac{7 \times 15}{3 \times 4} (= \frac{105}{12})$ or $\frac{28 \times 45}{12 \times 12} (= \frac{1260}{144})$ oe	
		C1	for complete working showing each stage as far as $\frac{35}{4}$ or $8\frac{9}{12}$	

 **Video Solutions**



Number

Percentages

<u>Percentage Increase/Decrease</u>	<u>Percentage Change</u>	<u>Reverse Percentages</u>
<u>Compound Interest (simple)</u>	<u>Compound Interest (harder)</u>	<u>Problem Solving</u>



Summer 2018 Paper 2H (Calc)

4 Raya buys a van for £8500 plus VAT at 20%

Raya pays a deposit for the van.
She then pays the rest of the cost in 12 equal payments of £531.25 each month.
Find the ratio of the deposit Raya pays to the total of the 12 equal payments.
Give your answer in its simplest form.

Number
Percentages
<i>Percentage Increase</i>

 **Video Solutions**

(5 marks)

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HOME

Number
Percentages
Percentage Increase

4	3 : 5	P1 for process to find 20% or 120% of the cost, eg 8500×0.2 (= 1700) oe or 8500×1.2 (= 10 200) oe P1 for process to find total cost of payments, eg 12×531.25 (= 6375) P1 for complete process to find value of deposit, eg “10 200” – “6375” (= 3825) or $8500 - “6375”$ (=2125) and “2125” + “1700” (=3825) OR the deposit as a proportion of the total cost, eg $1 - \frac{“6375”}{“10200”}$ ($=\frac{3}{8}$) P1 for finding a correct un-simplified ratio, eg “3825” : “6375” oe or 5:3 or 1.6 : 1 or $\frac{5}{3} : 1$ A1 Accept 1: 1.6, 1: $\frac{5}{3}$	When partitioning all figures quoted must be correct or a full method shown eg 10% = $8500 \div 10$ (=850) and 20% = “850” + “850” (=1700) May be seen as a fraction of the total eg $\frac{3825}{10200}$ ($=\frac{3}{8}$) Figures at this stage must be expressed as part of a ratio eg 51:85, $\frac{3}{8} : \frac{5}{8}$ Ignore consistent units
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Number
Percentages
<i>Percentage Increase and Decrease</i>

- 4 At the end of 2017
the value of Tamara's house was £220 000
the value of Rahim's house was £160 000

At the end of 2019
the value of Tamara's house had decreased by 20%
the value of Rahim's house had increased by 30%

At the end of 2019, whose house had the greater value?
You must show how you get your answer.

(4 marks)



Number
Percentages
<i>Percentage Increase and Decrease</i>

4

Rahim and correct figures	P1 for start to the process to find 20% for Tamara, eg 220000×0.2 oe (= 44000) or 30% for Rahim, eg 160000×0.3 oe (= 48000) OR for $1 - 0.2$ (= 0.8) or $100 - 20$ (= 80) or $1 + 0.3$ (= 1.3) or $100 + 30$ (= 130) P1 for a complete process to find at least one new value, eg $220000 - "44000"$ (= 176 000) or $160000 + "48000"$ (=208 000) OR $220000 \times "0.8"$ (=176 000) or $160000 \times "1.3"$ (= 208 000) A1 for one correct value, 176 000 or 208 000 C1 for correct conclusion supported by correct figures eg Rahim, 176 000 and 208 000
---------------------------	--

Build up processes are acceptable but must be complete and correct

Award 0 marks for a correct answer with no supportive working



Summer 2018 Paper 1H (Non-Calc)

- 3 Renee buys 5 kg of sweets to sell.
She pays £10 for the sweets.

Renee puts all the sweets into bags.
She puts 250 g of sweets into each bag.
She sells each bag of sweets for 65p.

Renee sells all the bags of sweets.

Work out her percentage profit.

Number
Percentages
<i>Percentage Change</i>

 **Video Solutions**

(4 marks)

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Number
Percentages
Percentage Change

3	30	P1	for full process to find the number of bags sold eg $5 \times 1000 \div 250 (= 20)$ OR for process to find selling price of 1 kg of sweets eg $0.65 \times 4 (= 2.60)$	This could be by repeated addition Calculations can be in £ or pence
		P1	for [number of bags] $\times 0.65$ or “20” $\times 0.65 (= 13)$ or “2.60” $\times 5 (= 13)$ OR for $10 \div \text{“20”}$ oe $(= 0.50)$ OR for $0.65 \times 4 (= 2.60)$ and $10 \div 5 (= 2)$	[number of bags] can only come from $5 \times 10 \div 250 (= 0.2)$ or $5 \times 100 \div 250 (= 2)$ or $5 \div 250 (= 0.02)$
		P1	(dep on previous P1) for a process to find the percentage profit eg $(\text{“13”} - 10) \div 10 \times 100$ or $(0.65 - \text{“0.50”}) \div \text{“0.50”} \times 100$ or $(\text{“2.60”} - \text{“2”}) \div \text{“2”} \times 100$ OR $\text{“13”} \div 10 \times 100 (= 130)$ oe	3/10 or 0.3 is not enough but should be awarded 2 marks Award P3 for 130(%)
		A1	cao	



- 2 Last year Jo paid £245 for her car insurance.
This year she has to pay £883 for her car insurance.

Work out the percentage increase in the cost of her car insurance.

Number

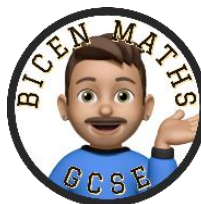
Percentages

Percentage Change

 **Video Solutions**

(3 marks)

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HOME

Number
Percentages
Percentage Change

2	260 to 260.5	M1	for $883 - 245 (=638)$ or $883 \div 245 (=3.60..)$ or $883 \div 245 \times 100 (=360(.408...))$ oe
		M1	for a complete method to find the percentage increase eg “638” $\div 245 \times 100 (=260(.408..))$ or $883 \div 245 \times 100 - 100 (=260(.408..))$ oe
		A1	Accept answers in the range 260 to 260.5



November 2018 Paper 2H (Calc)

- 10 Robert makes 50 litres of green paint by mixing litres of yellow paint and litres of blue paint in the ratio 2 : 3

Yellow paint is sold in 5 litre tins.

Each tin of yellow paint costs £26

Blue paint is sold in 10 litre tins.

Each tin of blue paint costs £48

Robert sells all the green paint he makes in 10 litre tins.

He sells each tin of green paint for £66.96

Work out Robert's percentage profit on each tin of green paint he sells.

Number

Percentages

Percentage Change

 **Video Solutions**

(5 marks)

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Number
Percentages
Percentage Change

10	35	P1	use of ratio 2:3 and tin quantities to find overall ratio of litres eg 4:3 or 4 tins : 3 tins or 20 litres (Y) & 30 litres (B)	
		P1	calculates total cost of making paint eg $4 \times 26 + 3 \times 48$ (50 litres) or $104+144$ (=248)	Could be multiples 4 & 3 (for an amount which is a multiple of 50 litres). "248" is the total cost for making 50 litres
		A1	calculates comparable cost eg 10 litres (1 tin) green paint made as 49.6 or differences (profit) for 1 tin as 17.36 or 5 tins as 86.8 or total comparable costs for 50 litres as 334.8 and 248, for 25 litres as 167.4 and 124 or 1 litres as 33.48 and 24.8	"248" $\div 5 = 49.6$ for 10 litre (1 tin) green paint made Profit on 10 litres is $66.96 - 49.60 = 17.36$ Profit on 50 litres is $304.8 - 248 = 86.8$ 334.8 comes from 5×66.96 and is the selling price for 50 litres green paint
		P1	for percentage calculation eg $\frac{1736}{4960} \times 100$, $\frac{"334.8" - "248"}{"248"} \times 100$	
		A1	cao	



Number
Percentages
<i>Percentage Change</i>

- 2 Emily buys a pack of 12 bottles of water.
The pack costs £5.64

Emily sells all 12 bottles for 50p each.

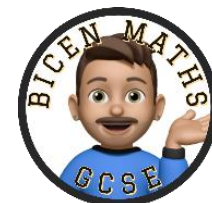
Work out Emily's percentage profit.

Give your answer correct to 1 decimal place.

 **Video Solutions**

(3 marks)

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Number
Percentages
Percentage Change

2	$\pounds 6 - \pounds 5.64 = 36\text{p}$ or $50\text{p} - 47\text{p} = 3\text{p}$	6.4	P1	for a strategy to compare the same number of bottles e.g. $\pounds 5.64 \div 12$ (= 47 or 0.47) or $12 \times 50\text{p}$ (= 6 or 600) or 36 or 0.36 or 3 or 0.03
			P1	for start of process to find percentage profit e.g. $\frac{36}{564}$ or $\frac{3}{47}$ or $\frac{6}{5.64}$ or $\frac{50}{47}$ or
	6.3829787...%		A1	with consistent units
				for answer in the range 6.3 to 6.4



Summer 2020 Paper 1H (Non-Calc)

- 5 Sean pays £10 for 24 chocolate bars.
He sells all 24 chocolate bars for 50p each.
Work out Sean's percentage profit.

Number

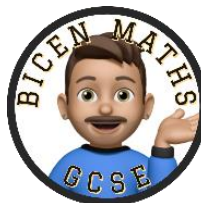
Percentages

Percentage Change

 **Video Solutions**

(3 marks)

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Number
Percentages
Percentage Change

5	20	P1	for process to find SP of 24 chocolate bars, eg. $0.50 \times 24 (= 12)$ oe or for process to find the overall profit eg $(24 \times 0.5) - 10 (= 2)$ or for process to find CP of one chocolate bar, eg. $1000 \div 24 (= 41.66\dots)$ oe
		P1	(dep) for start to a process to find percentage profit, eg. using $\frac{"12"-10}{10}$ or $\frac{"12"}{10}$ or $\frac{50 - "41.66\dots"}{"41.66\dots"}$ oe with consistent units
		A1	cao

Working can be carried out in either pounds or pence.



Number
Percentages
Reverse Percentages

9 Jules buys a washing machine.

20% VAT is added to the price of the washing machine.
Jules then has to pay a total of £600

What is the price of the washing machine with **no** VAT added?

 **Video Solutions**

(2 marks)



Number
Percentages
<i>Reverse Percentages</i>

9		500	M1 A1	recognition of 1.2 or 120% oe eg $600 \div 1.2$ oe or $x \times 1.2 = 600$ oe or $120\% = 600$ cao
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 **Video Solutions**



Number
Percentages
<i>Reverse Percentages</i>

11 In 2003, Jerry bought a house.

In 2007, Jerry sold the house to Mia.
He made a profit of 20%

In 2012, Mia sold the house for £162 000
She made a loss of 10%

Work out how much Jerry paid for the house in 2003

 **Video Solutions**

(3 marks)



Number
Percentages
<i>Reverse Percentages</i>

11	150 000	P1	for process to find cost in 2007, eg $162\,000 \div 0.9 (= 180\,000)$ oe	Award 2 marks for $162\,000 \div 1.08$ oe
		P1	for process to find cost in 2003, eg $[\text{cost in 2007}] \div 1.2 (= 150\,000)$ oe	
		A1	cao	



Number
Percentages
<i>Reverse Percentages</i>

- 10** Marie invests £8000 in an account for one year.
At the end of the year, interest is added to her account.

Marie pays tax on this interest at a rate of 20%
She pays £28.80 tax.

Work out the percentage interest rate for the account.

 **Video Solutions**

(3 marks)

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Number
Percentages
Reverse Percentages

10	1.8	P1	process to find the amount of interest before tax eg $28.80 \div 20 \times 100 (= 144)$ OR for equation which would lead to $(x =) 0.018, 1.8$ or 1.018 eg $0.2 \times 8000 \times x = 28.8$ or $\frac{8000(100+x)}{100} = 8144$	These numerical expressions may be seen multiplied by 100, eg $\frac{144}{8000} \times 100$
		P1	process to find the interest rate eg $\frac{"144"}{8000} (= 0.018)$ or $\frac{"8144"}{8000} (= 1.018)$	
		A1	cao	



Summer 2017 Paper 2H (Calc)

6 Anil wants to invest £25 000 for 3 years in a bank.

Personal Bank

Compound Interest

2% for each year

Secure Bank

Compound Interest

4.3% for the first year
0.9% for each extra year

Number

Percentages

Compound Interest

Which bank will give Anil the most interest at the end of 3 years?
You must show all your working.

 **Video Solutions**

(3 marks)

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  **HOME**

Number
Percentages
<i>Compound Interest</i>

6		Secure Bank (supported)	P1	for a process to work out the interest after one year e.g. $0.02 \times 25000 (=500)$ or $0.043 \times 25000 (=1075)$ or for 1.02 or 25500 or 1.043 or 26075
			P1	for process to find value of the investment after 3 years or the multiplicative factor for 3 years at one of the banks, e.g. $25000 \times 1.02 \times 1.02 \times 1.02$ oe (= 26530...) or $1.02^3 (= 1.0612...)$ or $25000 \times 1.043 \times 1.009 \times 1.009$ oe (= 26546...) or $1.043 \times 1.009 \times 1.009 (= 1.0618.....)$ [accept total interest of 1530.. or 1546.. if final values of investment are not found]
			C1	for Secure Bank from correct figures, eg. 26530.. and 26546.. or 1530... and 1546... or 1.0612... and 1.0618...



November 2018 Paper 2H (Calc)

- 4 Northern Bank has two types of account.
Both accounts pay compound interest.

Cash savings account
Interest
2.5% per annum

Shares account
Interest
3.5% per annum

Number
Percentages
<i>Compound Interest</i>

Ali invests £2000 in the cash savings account.
Ben invests £1600 in the shares account.

- (a) Work out who will get the most interest by the end of 3 years.
You must show all your working.

(4 marks)

In the 3rd year the rate of interest for the shares account is changed to 4% per annum.

- (b) Does this affect who will get the most interest by the end of 3 years?
Give a reason for your answer.

 **Video Solutions**

(1 mark)



Number
Percentages
Compound Interest

4	(a)	Ben (supported)	P1 shows how to work interest out for one year eg $2000 \times 0.025 (= 50)$ or $1600 \times 0.035 (= 56)$ or 150 or 168 or $2000 \times 1.025 (= 2050)$ or $1600 \times 1.035 (= 1656)$ P1 shows compound interest calculation for one account eg $2050 \rightarrow 51.25$ or $2101.25 \rightarrow 52.53$ or $1656 \rightarrow 57.96$ or $1713.96 \rightarrow 59.99$ eg $2000 \times 1.025^3 (= 2153.78)$ or $1600 \times 1.035^3 (= 1773.95)$ P1 shows complete compound interest calculation for both accounts eg $2000 \times 1.025^3 (= 2153.78)$ and $1600 \times 1.035^3 (= 1773.95)$ OR one interest stated correctly eg 153.78 or 173.95 C1 Ben (shares) supported by 153.78 and 173.95	Throughout accept figures ± 1 pence which do not need to be presented in money notation (to 2dp) or with monetary symbols. Award mark for a correct process shown, for which these figures can be taken as implying the process. As above, award mark for both correct processes shown for both accounts, which these figures can be taken as implying the process. Accept an answer of “shares”.
4	(b)	conclusion	C1 conclusion (ft) eg no change, shares now 182.5... Acceptable examples no since shares/Ben now 182.5 Still Ben since $182.5 > \text{Ali}$ No; he only gets 8.57 more No; he gets 68.56 instead of 59.98 (3rd yr) No; Ben already gets more interest, he would just get even more Not acceptable examples no shares now 182.5 Still Ben since less than Ali $182.5 > 153.78$ no; he needs 20.17 more	Conclusion needs to be supported. ft is from part (a); calculations carried out as part of (b) need to be correct for the comparison to be valid.



Number
Percentages
<i>Compound Interest</i>

- 2 Katy invests £200 000 in a savings account for 4 years.
The account pays compound interest at a rate of 1.5 % per annum.

Calculate the total amount of interest Katy will get at the end of 4 years.

 **Video Solutions**

(3 marks)

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Number
Percentages
<i>Compound Interest</i>

2	12272.70 12272.71 or 12272.72	M1	for evidence of using a correct first step eg $200000 \times 0.015 (= 3000)$ or $200000 \times 1.015 (= 203000)$	values may be rounded or truncated to 2 dp
		M1	for evidence of a compound interest method eg $203000 \times 0.015 (= 3045)$ or $203000 \times 1.015 (= 206045)$ or $206045 \times 0.015 (= 3090.675)$ or $206045 \times 1.015 (= 209135.675)$ or $209135.675 \times 0.015 (= 3137.035\dots)$ or $209135.675 \times 1.015 (= 212272.710\dots)$ or $200000 \times 1.015^t, t \geq 2$	
		A1	for 12272.7(0) or 12272.71 or 12272.72 SC B2 for 212272.7(0) or 212272.71 or 212272.72	



Summer 2017 Paper 3H (Calc)

10 Naoby invests £6000 for 5 years.

The investment gets compound interest of $x\%$ per annum.

At the end of 5 years the investment is worth £8029.35

Work out the value of x .

Number

Percentages

*Percentage Change,
Compound Interest*

 **Video Solutions**

(3 marks)

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Number
Percentages
<i>Percentage Change, Compound Interest</i>

10		6 (%)	P1 P1 A1	for y^5 or $8029.35 \div 6000$ for a process to find $1+x$ e.g. $\sqrt[5]{(8029.35 \div 6000)}$ or 1.06 or 1.0599.. 5.99 to 6
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 **Video Solutions**



Number
Percentages
Percentage Change, Compound Interest

9 Jean invests £12 000 in an account paying compound interest for 2 years.

In the first year the rate of interest is $x\%$

At the end of the first year the value of Jean’s investment is £12 336

In the second year the rate of interest is $\frac{x}{2}\%$

What is the value of Jean’s investment at the end of 2 years?

 **Video Solutions**

(4 marks)



Number
Percentages
Percentage Change, Compound Interest

9	12 508.7(0)	P1 for start of process to find interest rate for year 1 eg $12336 \div 12000 (=1.028)$ or $(12336 - 12000) \div 12000 (=0.028)$ OR forms a suitable equation, eg $12000 \times (1 + \frac{x}{100}) = 12336$ P1 for complete process to find the interest rate for year 1 eg $(“1.028” - 1) \times 100 (=2.8)$ or $“0.028” \times 100 (=2.8)$ OR correct process to solve correct equation eg $(12336 - 12000) \div 120 (=2.8)$ P1 for complete process to find the value at the end of 2 years eg $(“2.8” \div 2 + 100) \div 100 \times 12336$ A1 accept 12508.7 to 12508.71 or 12509	Rate of interest = 2.8, or $x = 2.8$ implies P2 12509 must come from correct working
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November 2017 Paper 2H (Calc)

13 At the beginning of 2009, Mr Veale bought a company.
The value of the company was £50 000

Each year the value of the company increased by 2%.

- (a) Calculate the value of the company at the beginning of 2017
Give your answer correct to the nearest £100

(2 marks)

At the beginning of 2009 the value of a different company was £250 000
In 6 years the value of this company increased to £325 000

This is equivalent to an increase of $x\%$ each year.

- (b) Find the value of x .
Give your answer correct to 2 significant figures.

Number
Percentages
<i>Percentage Change, Compound Interest</i>

 **Video Solutions**

(3 marks)

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Number
Percentages
Percentage Change, Compound Interest

13 (a)		58600	M1	for a complete method, eg $50000 \times 1.02^8 (= 58582(.969\dots))$ or for finding the increase in value of the company after 8 years, eg 8582(.969...) or 8600
			A1	cao
(b)		4.5	P1	for a process to find multiplier for 6 year period, eg $325 \div 250$ oe ($= 1.3$) or 130(%) or for $250000 \times y^6 = 325000$
			P1	for a process to find multiplier for one year, eg $(1.3)^{\frac{1}{6}}$ or 1.044...or 1.045
			A1	4.4 – 4.5



Number
Percentages
<i>Percentage Change, Compound Interest</i>

13 Sakira invested £3550 in a savings account for 3 years.

She was paid 2.6% per annum compound interest for each of the first 2 years.
She was paid $R\%$ interest for the third year.

Sakira had £3819.21 in her savings account at the end of the 3 years.

Work out the value of R .

Give your answer correct to 1 decimal place.

 **Video Solutions**

(3 marks)

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Number
Percentages
<i>Percentage Change, Compound Interest</i>

13	2.2	P1	works out interest for one year, eg $3550 \times 0.026 (= 92.3(0))$ or $3550 \times 1.026 (=3642.3(0))$	
		P1	for compound interest calculation, eg $3550 \times 1.026^2 (= 3736.9\dots)$ or for an answer given as 0.0219... or 1.0219...	
		A1	answer in range 2.19 to 2.2	If an answer in the range is seen in working and then incorrectly rounded award full marks



Number
Percentages
<i>Reverse Percentage, Compound Interest</i>

8 Tariq buys a laptop.

He gets a discount of 5% off the normal price.
Tariq pays £551 for the laptop.

(a) Work out the normal price of the laptop.

(2 marks)

Joan invests £6000 in a savings account.
The savings account pays compound interest at a rate of
2.4% for the first year
1.7% for each extra year.

(b) Work out the value of Joan's investment at the end of 3 years.

(3 marks)



 **Video Solutions**



Number
Percentages
<i>Reverse Percentage, Compound Interest</i>

8	(a)	580	M1	for method to find value before increase eg $551 \div 0.95$
			A1	cao
	(b)	6354.67	M1	for 6000×1.024 oe (= 6144)
			M1	for “6144” $\times 1.017^2$ oe
			A1	for 6354.66 or 6354.67 or 6354.68

$6000 \times 1.024 \times 1.017^2$ scores M2

If correct answer is stated then subsequently rounded isw and award 3 marks
If correct answer stated and then interest only given as the answer award M2A0



November 2021 Paper 2H (Calc)

- 10 Louise invests £ x in Better Investments for 3 years.
Sadiq invests £ x in County Bank for 3 years.

Better Investments

Compound Interest

2.5% per annum

County Bank

Compound Interest

2% per annum for the first two years
3.5% per annum for each extra year

At the end of the 3 years, the value of Louise’s investment is £344 605

Work out the value of Sadiq’s investment at the end of the 3 years.

Number
Percentages
<i>Reverse Percentage, Compound Interest</i>



Number
Percentages
<i>Reverse Percentage, Compound Interest</i>

10

344 580.48

- P1 for a start to the process to find the initial investment
eg $344\,605 \div 1.025$ oe (= 336 200)
or for 1.025^3 (= 1.07689....)
- P1 for complete process to find original investment,
eg $344\,605 \div 1.025^3$ oe (= 319 078 to 320 265)
- P1 for [initial investment] $\times 1.02^2 \times 1.035$ oe
- A1 for answer in the range 343 587 to 344 581

[initial investment] must be clearly what they believe to be that and cannot be 344605



Number
Percentages
<i>Depreciation, reverse percentages</i>

9 Jack bought a new boat for £12 500

The value, £ V , of Jack's boat at the end of n years is given by the formula

$$V = 12\,500 \times (0.85)^n$$

- (a) At the end of how many years was the value of Jack's boat first less than 50% of the value of the boat when it was new?

(2 marks)

A savings account pays interest at a rate of $R\%$ per year.

Jack invests £5500 in the account for one year.

At the end of the year, Jack pays tax on the interest at a rate of 40%.

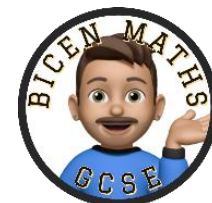
After paying tax, he gets £79.20

- (b) Work out the value of R .

 **Video Solutions**

(3 marks)

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Number
Percentages
<i>Depreciation, reverse percentages</i>

9	(a)		5	M1	evaluates $(0.85)^n$ or $12\,500 \times (0.85)^n$ for at least one value of n
				A1	cao
	(b)		2.4	P1	for a process to find the amount of interest before tax, eg $79.20 \div 0.6$ ($= 132$)
				P1	for a process to find value of R , eg “132” $\div 5500 \times 100$
				A1	cao



11 Jack and Sadia work for a company that sells boxes of breakfast cereal.

The company wants to have a special offer.

Here is Jack's idea for the special offer.

Put 25% more cereal into each box and do **not** change the price.

Here is Sadia's idea.

Reduce the price and do **not** change the amount of cereal in each box.

Sadia wants her idea to give the same value for money as Jack's idea.

By what percentage does she need to reduce the price?

Number
Percentages
<i>Problem Solving</i>

11

20

P1

for start of process, eg $\frac{125}{100}$ oe or $\frac{100}{125}$ oe or $\frac{25}{125}$

P1

for a suitable process to develop a percentage, either 80% or 20%
eg. $\frac{100}{125} = \frac{x}{100}$ or $\frac{125-100}{125} = \frac{x}{100}$ or $\frac{p}{1.25m} = \frac{xp}{m}$ or $\frac{0.25p}{1.25m} = \frac{xp}{m}$

A1

cao

Values of amount of cereal and cost may be used,
eg. 100g of cereal costing £10
An acceptable start of a process would then be:
125g of cereal costing £10 using Jack's idea



November 2018 Paper 1H (Non-Calc)

- 3 A bonus of £2100 is shared by 10 people who work for a company.
40% of the bonus is shared equally between 3 managers.
The rest of the bonus is shared equally between 7 salesmen.

One of the salesmen says,

“If the bonus is shared equally between all 10 people I will get 25% more money.”

Is the salesman correct?

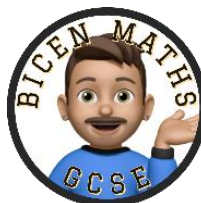
You must show how you get your answer.

Number
Percentages
<i>Problem Solving</i>

 **Video Solutions**

(5 marks)

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  **HOME**

Number
Percentages
Problem Solving

3	No (supported)	P1 P1 P1 P1 A1	for start to process, eg. $2100 \times \frac{40}{100} (= 840)$ or $100 - 40 (= 60)$ for process to find the 7 salesmen's share of bonus, eg $2100 - "840" (= 1260)$ or $2100 \times \frac{60}{100} (= 1260)$ for process to find bonus amount each salesman gets eg $"1260" \div 7 (= 180)$ OR process to find the total bonus for all salesmen if shared equally, eg $\frac{2100}{10} \times 7 (= 1470)$ for process to compare what a single salesman gets under each scheme, eg $"180" \times \frac{25}{100} (= 45)$ and $"\frac{2100}{10}" - "180" (= 30)$ or $"180" \times \frac{25}{100} (= 45)$ and $"180" + "45" (= 225)$ oe and $\frac{2100}{10} (= 210)$ or $(\frac{2100}{10} - "180") \div "180" \times 100 (= 16.6...)$ OR process to compare what all salesmen gets under each scheme, eg $"1260" \times \frac{25}{100} (= 315)$ and $"1470" - "1260" (= 210)$ or $"1260" \times \frac{25}{100} (= 315)$ and $"1260" + "315" (= 1575)$ oe and $"1470"$ or $(\frac{2100}{10} - "1260") \div "1260" \times 100 (= 16.6...)$ 'No' supported by correct figures, eg 45 and 30, 225 and 210, 315 and 210 or 1575 and 1470 or 16.6...)(% and 25%)	May compare bonus shares of a single salesman or total bonus share for all 7 salesmen. Do not award unless correct figures have been shown to support a statement made that the salesman was not correct.
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Number

Ratio

<u>Fractions, % and Ratio</u>	<u>Sharing Problems</u>	<u>$1 : n$</u>	<u>Combining Ratios</u>
<u>Changing Ratios</u>	<u>Fractions of Fractions</u>	<u>... with probability</u>	<u>... with algebra</u>



Summer 2017 Paper 3H (Calc)

Number
Ratio
Fractions, Percentages, Ratio

4 Daniel bakes 420 cakes.

He bakes only vanilla cakes, banana cakes, lemon cakes and chocolate cakes.

$\frac{2}{7}$ of the cakes are vanilla cakes.

35% of the cakes are banana cakes.

The ratio of the number of lemon cakes to the number of chocolate cakes is 4:5

Work out the number of lemon cakes Daniel bakes.

 **Video Solutions**

(5 marks)

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HOME

Number
Ratio
Fractions, Percentages, Ratio

4		68	P1 for a process to find the number of vanilla cakes, eg $420 \times 2 \div 7$ oe (= 120) P1 for a process to find the number of banana cakes, eg 420×0.35 oe (= 147) P1 (dep P1) for a full process to find the number of lemon/chocolate cakes eg $420 - (\text{vanilla cakes}) - (\text{banana cakes})$ (= 153) P1 (dep on previous P1) for a process to find the number of lemon cakes eg "153" $\div 9 \times 4$ oe (= 68) A1 cao OR P1 for writing two proportions in the same format P1 for combining the proportions of vanilla and banana cakes eg $2/7 + 7/20$ (= $89/140$) P1 (dep P1) for a full process to find the proportion or number of lemon/chocolate cakes eg $1 - "89/140"$ (= $51/140$) P1 (dep on previous P1) for a process to find the number of lemon cakes eg "$51/140$" $\times 420 \div 9 \times 4$ (= 68) A1 cao
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Summer 2017 Paper 2H (Calc)

- 2 On Saturday, some adults and some children were in a theatre.
The ratio of the number of adults to the number of children was 5 : 2
- Each person had a seat in the Circle or had a seat in the Stalls.
- $\frac{3}{4}$ of the children had seats in the Stalls.
117 children had seats in the Circle.
- There are exactly 2600 seats in the theatre.
- On this Saturday, were there people on more than 60% of the seats?
You must show how you get your answer.

Number
Ratio
Fractions, Percentages, Ratio

 **Video Solutions**

(5 marks)

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HOME

Number
Ratio
Fractions, Percentages, Ratio

2		Yes (supported)	P1 for process to work out the total number of children, e.g. $117 \times 4 (= 468)$ P1 (dep P1) for process to work out total number of adults or the total number of people, e.g. $"468" \times 5 \div 2 (= 1170)$ or $"468" \times 7 \div 2 (= 1638)$ A1 for 1170 or 1638 P1 for process to work out the percentage of theatre full, e.g. $\frac{"468"+"1170"}{2600} \times 100 (= 63)$ or for a process to work out 60% of 2600 ($= 1560$) C1 for a correct conclusion supported by correct figures e.g. 63% or 1560 and 1638 OR P1 for a process to work out 60% of 2600, eg. $\frac{60}{100} \times 2600 (= 1560)$ P1 (dep P1) for process to work out this total number of children, e.g. $"1560" \times 2 \div 7 (= 445(.7...))$ A1 for 445(.7...) P1 for process to work out children in the circle, eg. $"445(.7...)" \div 4 (= 111 \text{ to } 112)$ C1 for a correct conclusion supported by correct figures e.g. 111 to 112 [Where appropriate accept rounded or truncated values] OR P1 for a process to find the maximum number of children, eg. $2600 \times 2 \div 7 (= 742(.8...))$ P1 for process to work out the total number of children, e.g. $117 \times 4 (= 468)$ A1 for 468 and 742(.8...) P1 for $\frac{"468"}{"742(.8...)} \times 100 (= 63)$ or process to work out 60% of $"742(.8...)" (= 445(.7...))$ C1 for a correct conclusion supported by correct figures e.g. 63% or 468 and 445(.7...) [Where appropriate accept rounded or truncated values]
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Summer 2018 Paper 1H (Non-Calc)

- 8 The perimeter of a right-angled triangle is 72 cm.
The lengths of its sides are in the ratio 3 : 4 : 5

Work out the area of the triangle.

Number
Ratio
<i>Sharing, Problem Solving</i>

 **Video Solutions**

(4 marks)

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HOME

Number
Ratio
Sharing, Problem Solving

8	216	P1	for process to work with ratio eg $72 \div (3 + 4 + 5) (= 6)$ or $72 \div 12 (= 6)$
		P1	for process to find length of base or height of triangle eg $3 \times "6" (= 18)$ or $4 \times "6" (= 24)$ OR process to find area scale factor eg $"6" \times "6" (= 36)$
		P1	complete process to find the area of the triangle eg $\frac{1}{2} \times "18" \times "24"$ or $\frac{1}{2} \times 3 \times 4 \times "6"{}^2$
		A1	cao



Number
Ratio
<i>Sharing, Problem Solving</i>

7 £360 is shared between Abby, Ben, Chloe and Denesh.

The ratio of the amount Abby gets to the amount Ben gets is 2 : 7

Chloe and Denesh each get 1.5 times the amount Abby gets.

Work out the amount of money that Ben gets.

 **Video Solutions**

(4 marks)

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Number
Ratio
Sharing, Problem Solving

7	168	P1	for working with ratio to find the amount for C or D eg $1.5 \times 2 (=3)$ or (A, B, C, D =) 2 , 7 , 3 , 3 oe OR for suitable expressions linking A with C or D, eg. $A = x, C = 1.5x$
		P1	for “2 + 3 + 3 + 7” (=15) OR adds 4 suitable expressions, eg. “ $x + 3.5x + 1.5x + 1.5x$ ” (= 7.5x)
		P1	for a complete process to find the amount of money eg $360 \div “15” \times 7$ OR $360 \div “7.5” \times 3.5$
		A1	cao



Summer 2018 Paper 1H (Non-Calc)

2 In a village

the number of houses and the number of flats are in the ratio 7 : 4
the number of flats and the number of bungalows are in the ratio 8 : 5

There are 50 bungalows in the village.
How many houses are there in the village?

Number
Ratio
<i>Sharing, Problem Solving</i>

 **Video Solutions**

(3 marks)

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HOME

Number
Ratio
<i>Sharing, Problem Solving</i>



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Summer 2019 Paper 2H (Calc)

Number
Ratio
<i>Sharing, Problem Solving</i>

- 17 There are some small cubes and some large cubes in a bag.
The cubes are red or the cubes are yellow.
- The ratio of the number of small cubes to the number of large cubes is 4:7
- The ratio of the number of red cubes to the number of yellow cubes is 3:5
- (a) Explain why the least possible number of cubes in the bag is 88

(1 mark)

.....

.....

.....

All the small cubes are yellow.

- (b) Work out the least possible number of large yellow cubes in the bag.

(3 marks)

 **Video Solutions**



Number
Ratio
Sharing, Problem Solving

17	(a)	Explanation	C1	For stating the LCM of (4+7) and (5+3) is 88 or there is no smaller multiple of 8 and 11 (than 88)	
	(b)	23	P1	for using a scale factor appropriately eg $4 \times 8 (=32)$ or $3 \times 11 (=33)$ or $7 \times 8 (=56)$ or $5 \times 11 (=55)$ or for writing a pair of suitable fractions, eg $\frac{7}{11}$ and $\frac{3}{8}$ or $\frac{4}{11}$ and $\frac{5}{8}$ or $\frac{3}{8}$ and $\frac{4}{11}$	May be seen in a two-way table or probability tree
			P1	for finding the number of large cubes and red cubes or small and yellow or small and red eg $7 \times 8 (=56)$ and $3 \times 11 (=33)$ or $4 \times 8 (=32)$ and $5 \times 11 (=55)$ or $4 \times 8 (=32)$ and $3 \times 11 (=33)$ OR a suitable fractional equation, eg $\frac{7}{11} - x = \frac{3}{8}$ or $\frac{5}{8} - x = \frac{4}{11}$ or $x = 1 - \frac{3}{8} - \frac{4}{11}$ OR a suitable pair of probabilities with a common denominator, eg $\frac{56}{88}$ and $\frac{33}{88}$ or $\frac{32}{88}$ and $\frac{55}{88}$ or $\frac{33}{88}$ and $\frac{32}{88}$	May be seen in a two-way table or probability tree
			A1	cao	$\frac{23}{88}$ scores P2A0



Summer 2019 Paper 1H (Non-Calc)

6 A shop sells packs of black pens, packs of red pens and packs of green pens.

There are

- 2 pens in each pack of black pens
- 5 pens in each pack of red pens
- 6 pens in each pack of green pens

On Monday,

$$\begin{array}{l} \text{number of packs} \\ \text{of black pens sold} \end{array} : \begin{array}{l} \text{number of packs} \\ \text{of red pens sold} \end{array} : \begin{array}{l} \text{number of packs} \\ \text{of green pens sold} \end{array} = 7:3:4$$

A total of 212 pens were sold.

Work out the number of green pens sold.

Number
Ratio
<i>Sharing, Problem Solving</i>

 **Video Solutions**

(4 marks)

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Number
Ratio
Sharing, Problem Solving

6	96	P1	for process to find the ratio of the number of pens of each colour sold, eg $2 \times 7 : 5 \times 3 : 6 \times 4$ ($= 14 : 15 : 24$)	Does not have to be seen as a ratio but all three needed
		P1	for process to find the proportion of green pens sold, eg $\frac{212}{"14"+"15"+"24"}$ or $\frac{"24"}{"14"+"15"+"24"}$	
		P1	for a complete process to find the number of green pens sold, eg $\frac{212}{"14"+"15"+"24"} \times "24"$ or $\frac{"24"}{"14"+"15"+"24"} \times 212$	P3 can be implied by the values 56, 60 and 96
		A1	cao	



3 Carlo puts tins into small boxes and into large boxes.

He puts 6 tins into each small box.

He puts 20 tins into each large box.

Carlo puts a total of 3000 tins into the boxes so that

number of tins in small boxes : number of tins in large boxes = 2 : 3

Carlo says that less than 30% of the boxes filled with tins are large boxes.

Is Carlo correct?

You must show all your working.

Number
Ratio
Sharing, Problem Solving

 **Video Solutions**

(5 marks)



Number
Ratio
<i>Sharing, Problem Solving</i>



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HOME

Number
Ratio
<i>Sharing, Problem Solving</i>

5 Rosie, Matilda and Ibrahim collect stickers.

number of stickers : number of stickers : number of stickers
Rosie has : Matilda has : Ibrahim has = 4:7:15

Ibrahim has 24 more stickers than Matilda.

Ibrahim has more stickers than Rosie.

How many more?

(3 marks)



Number
Ratio
<i>Sharing, Problem Solving</i>

5	33	P1 for relating 24 to 8 parts or (1 part =) $24 \div 8 (= 3)$ or for $15 - 7 (= 8)$ or starts to use a build-up method, eg (8 :) 14 : 30 P1 for $15 - 4 (= 11)$ and $24 \div 8 (= 3)$ or $15 \times 3 (= 45)$ and $4 \times 3 (= 12)$ or for 12 (: 21) : 45 A1 cao	8 parts = 24
---	----	--	--------------



2 Natalie makes potato cakes in a restaurant.

She mixes potato, cheese and onion so that

weight of potato : weight of cheese : weight of onion = 9 : 2 : 1

Natalie needs to make 6000 g of potato cakes.

Cheese costs £2.25 for 175 g.

Work out the cost of the cheese needed to make 6000 g of potato cakes.

Number
Ratio
<i>Sharing, Problem Solving</i>

(4 marks)



Number
Ratio
<i>Sharing, Problem Solving</i>

2	12.85 or 12.86 or 13.5(0)	P1	for $9 + 2 + 1 (= 12)$	Award this mark for sight of 4500, 1000 or 500 Process may lead to 5 or 6 instead of 5.71... “5.71...” (ft) may be rounded or truncated.eg “6”
		P1	for working out how many lots of 175g are needed eg $6000 \div “12” \times 2 \div 175 (= 5.71\dots)$	
		P1	for a complete process eg $“5.71\dots” \times 2.25 (= 12.857\dots)$	
		A1	for 12.85 or 12.86 or 13.5(0)	



November 2021 Paper 3H (Calc)

14 Olivia and Jessica have in total half as many sweets as Fran and Gary have in total.

Fran and Gary share their sweets in the ratio 2:3

Olivia and Jessica share their sweets in the ratio 9:1

Fran got w sweets.

Gary got x sweets.

Olivia got y sweets.

Jessica got z sweets.

Find, in its simplest form, $w:x:y:z$

Number
Ratio
<i>Sharing, Problem Solving</i>

(4 marks)



Number
Ratio
<i>Sharing, Problem Solving</i>

14	8 : 12 : 9 : 1	P1 for $2 + 3 (= 5)$ and $9 + 1 (= 10)$ OR for assigning a total number of sweets for $F + G$ and $O + J$ eg $F + G = 100$, $O + J = 50$ P1 for finding correct multiplier for relationship between totals for $F + G$ and $O + J$ eg $\times 4$ to get from 5, 10 to 20, 10 OR for working out the number of sweets from their totals for F, G eg 40, 60 or for O, J, eg 45, 5 P1 for $2 \times 4 (= 8)$ and $3 \times 4 (= 12)$ OR for ratio in unsimplified form, eg 40 : 60 : 45 : 5 A1 cao	May be in algebraic form, eg $2a + 3a (= 5a)$ and $9a + 1a (= 10a)$ May be in algebraic form, eg $F + G = 5a$, $O + J = 2.5a$
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- 2 There are 60 people in a choir.
Half of the people in the choir are women.

The number of women in the choir is 3 times the number of men in the choir.
The rest of the people in the choir are children.

the number of children in the choir : the number of men in the choir = $n : 1$

Work out the value of n .

You must show how you get your answer.

Number
Ratio
<i>Writing ratio, 1:n</i>

2	2 (supported)	P1	for a process to find the number of men, eg. $(60 \div 2) \div 3 (= 10)$	
		P1	for a process to find the number of children, eg. $60 - "30" - "10" (= 20)$	$60 \div 3 = 20$ scores no marks
		P1	for a start of a process to find the value of n , eg. $("20" : "10") \div 5$ or $20 : 10 = 10 : 5$ or $"20" \div "10"$	Any ratio must come from correct processes to find the number of children and the number of men
		A1	for 2 with supportive working	Award 0 marks for 2 with no correct supportive working Award full marks for 2 : 1 given as a final answer from correct supportive working



Number
Ratio
<i>Combining ratios</i>

- 4 There are only blue pens, green pens and red pens in a box.

The ratio of the number of blue pens to the number of green pens is 2 : 5

The ratio of the number of green pens to the number of red pens is 4 : 1

There are less than 100 pens in the box.

What is the greatest possible number of red pens in the box?

 **Video Solutions**

(3 marks)

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Number
Ratio
<i>Combining ratios</i>

4		15	P1	strategy to start the problem, eg 8 : 20 and 20 : 5
			P1	process to solve the problem, eg $\frac{5}{33} \times 100$ or 24 : 60 : 15
			A1	cao



12 The points A , B , C and D lie in order on a straight line.

$$AB:BD = 1:5$$

$$AC:CD = 7:11$$

Work out $AB:BC:CD$

Number
Ratio
<i>Combining ratios</i>

 **Video Solutions**

(3 marks)

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Number
Ratio
<i>Combining ratios</i>

12		3 : 4 : 11	P1	Makes a start e.g. by using multipliers e.g. $1 + 5 = 6$ and $7 + 11 = 18$ and $6 \times 3 = 18$ or $AB:BD = 3:15$ or $x=3y$ (appropriate x and y shown) or $\frac{1}{6} = \frac{3}{18}$
			P1	Complete process to find ratios e.g. $(7 + 11) \div (1 + 5) = 3$ and $1 \times \text{"3"} : 7 - (\text{"3"} \times 1) : 11$
			A1	oe

 **Video Solutions**



10 Given that $\frac{a}{b} = \frac{2}{5}$ and $\frac{b}{c} = \frac{3}{4}$

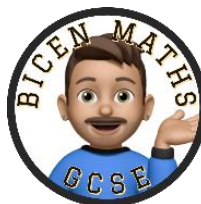
find $a:b:c$

Number
Ratio
<i>Combining ratios, fractions</i>

 **Video Solutions**

(3 marks)

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Number
Ratio
Combining ratios, fractions

10	6 : 15 : 20	P1 chooses a multiplier to equate the two fractions in terms of b eg $\frac{2}{5} \times \frac{3}{3} (= \frac{6}{15})$ or $\frac{3}{4} \times \frac{5}{5} (= \frac{15}{20})$ or lists equivalent fractions to $\frac{2}{5}$ up to at least $\frac{6}{15}$, eg. $\frac{2}{5}, \frac{4}{10}, \frac{6}{15}, \dots$ or lists equivalent fractions to $\frac{3}{4}$ up to at least $\frac{15}{20}$, eg. $\frac{3}{4}, \frac{6}{8}, \frac{9}{12}, \frac{12}{16}, \frac{15}{20}, \dots$ or $(a : b =) 2 : 5$ and $(b : c =) 3 : 4$ or for 6 : 15 or 15 : 20 seen P1 puts into related terms ready for ratio eg $\frac{2}{5} \times \frac{3}{3} = \frac{6}{15}$ and $\frac{3}{4} \times \frac{5}{5} = \frac{15}{20}$ or for $(a : b =) 6 : 15$ and $(b : c =) 15 : 20$ or lists equivalent ratios up to a common element for b, eg $a : b = 2 : 5, 4 : 10, 6 : 15$ and $b : c = 3 : 4, 6 : 8, 9 : 12, 12 : 16, 15 : 20$ A1 for 6 : 15 : 20 oe	Need not be written in ratio form Accept equivalent ratios Accept $a = 6, b = 15$ and $c = 20$
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November 2019 Paper 2H (Calc)

Number
Ratio
<i>Changing ratios</i>

- 3 Tom and Adam have a total of 240 stamps.
The ratio of the number of Tom's stamps to the number of Adam's stamps is $3:7$
- Tom buys some stamps from Adam.
The ratio of the number of Tom's stamps to the number of Adam's stamps is now $3:5$
- How many stamps does Tom buy from Adam?
You must show all your working.

 **Video Solutions**

(4 marks)

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Number
Ratio
<i>Changing ratios</i>

3	18	P1	for $240 \div 10 (= 24)$ or $240 \div 8 (= 30)$	Accept $3 + 7$ for 10, $3 + 5$ for 8
		P1	for $3 \times "24" (= 72)$ or $7 \times "24" (= 168)$ or $3 \times "30" (= 90)$ or $5 \times "30" (= 150)$	
		P1	for $3 \times "24" (= 72)$ and $3 \times "30" (= 90)$ or $7 \times "24" (= 168)$ and $5 \times "30" (= 150)$	
		A1	Cao	



Summer 2017 Paper 1H (Non-Calc)

- 14 White shapes and black shapes are used in a game.
Some of the shapes are circles.
All the other shapes are squares.

The ratio of the number of white shapes to the number of black shapes is $3:7$

The ratio of the number of white circles to the number of white squares is $4:5$

The ratio of the number of black circles to the number of black squares is $2:5$

Work out what fraction of all the shapes are circles.

Number
Ratio
<i>Fractions of fractions</i>

 **Video Solutions**

(4 marks)

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HOME

Number
Ratio
<i>Fractions of fractions</i>

14

		$\frac{1}{3}$	P1	process to solve the problem e.g. $\frac{3}{10} \times \frac{4}{9} (= \frac{12}{90} = \frac{2}{15})$ OR finds the number of white circles for their chosen number OR for 9 : 21 (or a multiple of 9 : 21)
			P1	second step of the process e.g. $\frac{7}{10} \times \frac{2}{7} (= \frac{14}{70} = \frac{2}{10} = \frac{1}{5})$ OR finds the number of black circles for their chosen number OR for a multiple of 2 : 5 where the ratio parts sum to “21”
			P1	for complete process e.g. $\frac{2}{15} + \frac{1}{5} (= \frac{4}{30} + \frac{6}{30})$ OR finds the total number of circles for their chosen number OR for 3 ratios that could be used to solve the problem eg 9 : 21 with 4 : 5 with 6 : 15
			A1	for $\frac{1}{3}$ oe



- 14 A group of people went to a restaurant.
Each person chose one starter and one main course.

starter	main course
soup	lasagne
prawns	curry

the number of people who chose soup : the number of people who chose prawns = 2 : 3

Of those who chose soup,
the number of people who chose lasagne : the number of people who chose curry = 5 : 3

Of those who chose prawns,
the number of people who chose lasagne : the number of people who chose curry = 1 : 5

What fraction of the people chose curry?
You must show how you get your answer.

Number
Ratio
Fractions of fractions



Number
Ratio
Fractions of fractions

14	$\frac{13}{20}$	P1 for finding the fraction who chose either soup ($\frac{2}{5}$ oe) or chose prawns ($\frac{3}{5}$ oe) or for process to share any number in the ratio 2 : 3 eg $100 \div (2 + 3) \times 2$ (=40) P1 for a process that could lead to the proportion who chose lasagne or curry for either starter, eg sharing 40% (soup) in the ratio 5 : 3 or sharing 60% (prawns) in the ratio 1 : 5 or $\frac{2}{5} \times \frac{5}{8}$ or $\frac{2}{5} \times \frac{3}{8}$ or $\frac{3}{5} \times \frac{1}{6}$ or $\frac{3}{5} \times \frac{5}{6}$ or for continuing the process with their starting number to find the number who chose lasagne or curry for either starter P1 for a complete process to find the proportion who chose curry for both starters, eg($\frac{2}{5} \times \frac{3}{8}$) + ($\frac{3}{5} \times \frac{5}{6}$) or to find the number who chose curry for both starter for their starting number A1 $\frac{13}{20}$ or equivalent fraction	Starting number 100 Soup : Prawn 40:60 L:C L:C 25:15 10:50 15 + 50 =65 and $\frac{15+50}{100}$
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Summer 2020 Paper 1H (Non-Calc)

23 There are four types of cards in a game.

Each card has a black circle or a white circle or a black triangle or a white triangle.



number of cards with a black shape : number of cards with a white shape = 3 : 5

number of cards with a circle : number of cards with a triangle = 2 : 7

Express the total number of cards with a black shape as a fraction of the total number of cards with a triangle.

Number
Ratio
<i>Fractions of fractions</i>

 **Video Solutions**

(3 marks)

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HOME

Number
Ratio
Fractions of fractions

23	$\frac{27}{56}$	P1 for $\frac{3}{8}$ and $\frac{7}{9}$ OR uses a total of 72 cards and shows a process to find the number of cards with a black shape or the number of cards with a triangle, eg $72 \div 8 \times 3 (=27)$ or $72 \div 9 \times 7 (=56)$ P1 for process shown to divide fractions $\frac{3}{8} \div \frac{7}{9}$ or $\frac{3}{8} \times \frac{9}{7}$ OR for $\frac{3}{8} \times \frac{9}{9} (= \frac{27}{72})$ and $\frac{7}{9} \times \frac{8}{8} (= \frac{56}{72})$ OR uses a total of 72 cards and shows a process to find the number of cards with a black shape and the number of cards with a triangle, eg $72 \div 8 \times 3 (=27)$ and $72 \div 9 \times 7 (=56)$ A1 for $\frac{27}{56}$ or any other equivalent fraction	72 or any multiple of 72 Could be seen in a ratio, eg 27 : 45 or 16 : 56 Accept the division shown as $\frac{\frac{3}{8}}{\frac{7}{9}}$ Could be seen in ratios, eg 27 : 45 and 16 : 56 Answer of 27 : 56 gets P2A0
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Number
Ratio
<i>Simple problem solving, probability</i>

4 There are only blue cubes, yellow cubes and green cubes in a bag.

There are

twice as many blue cubes as yellow cubes
and four times as many green cubes as blue cubes.

Hannah takes at random a cube from the bag.

Work out the probability that Hannah takes a yellow cube.

 **Video Solutions**

(3 marks)



Number
Ratio
<i>Simple problem solving, probability</i>

4		$\frac{1}{11}$	P1 for starting the process, eg by writing down a correct ratio or using a given number of cubes for one relationship, eg 2B 1Y or B:Y = 2:1 or 4G 1B or G:B = 4:1 or 8G, 1Y or G:Y = 8:1 oe or yellow = 2, blue = 4, or states 2:1:8 oe in any order (can be algebraic) P1 for complete process to find possible number of each colour or equivalent ratio, eg 8G 2B 1Y or G:B:Y = 8:2:1 oe or yellow = 2, blue = 4, green = 16 oe (can be algebraic) A1 $\frac{1}{11}$ oe
---	--	----------------	---



Summer 2018 Paper 1H (Non-Calc)

Number
Ratio
<i>Problem solving, probability</i>

- 16** There are only red counters, blue counters and purple counters in a bag.
The ratio of the number of red counters to the number of blue counters is 3 : 17
- Sam takes at random a counter from the bag.
The probability that the counter is purple is 0.2
- Work out the probability that Sam takes a red counter.

 **Video Solutions**

(3 marks)

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HOME

Number
Ratio
<i>Problem solving, probability</i>



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November 2018 Paper 2H (Calc)

17 p and q are two numbers such that $p > q$

When you subtract 5 from p and subtract 5 from q the answers are in the ratio 5 : 1

When you add 20 to p and add 20 to q the answers are in the ratio 5 : 2

Find the ratio $p : q$

Give your answer in its simplest form.

Number
Ratio
<i>... with algebra, simultaneous equations</i>

 **Video Solutions**

(4 marks)

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HOME

Number
Ratio
<i>... with algebra, simultaneous equations</i>

17

4 : 1

P1	for associating algebraic expressions with the correct ratio eg $p - 5 : q - 5$ ($= 5 : 1$) or $p + 20 : q + 20$ ($= 5 : 2$)
P1	for $\frac{p+20}{q+20} = \frac{5}{2}$ or $\frac{p-5}{q-5} = \frac{5}{1}$ oe or $p - 5 = 5(q - 5)$ or $2(p + 20) = 5(q + 20)$ oe
M1	for a complete method shown to find p or q
M1	for a complete method shown to find p and q or two values for p and q that are in the ratio 4 : 1 or an unsimplified ratio 4 : 1 (eg 80 : 20) or an answer of 1 : 4
A1	cao

Award for one of the two simultaneous equations
eg $5q - p = 20$, $5q - 2p = -60$ oe

Award for a simultaneous equation method to
eliminate one variable leading to either $p = 80$ or
 $q = 20$

Award for a simultaneous equation method to
eliminate both variables leading to either $p = 80$
and $q = 20$

 **Video Solutions**

(4 marks)



HOME

Number
Ratio
... with algebra, quadratics

17 Given that

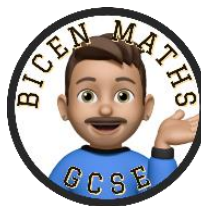
$$x^2 : (3x + 5) = 1 : 2$$

find the possible values of x .

 **Video Solutions**

(4 marks)

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HOME

Number
Ratio
... with algebra, quadratics

17	-1, 2.5	P1	for process to form an equation, eg $\frac{x^2}{3x+5} = \frac{1}{2}$ or $2x^2 = 3x + 5$
		P1	for writing in a suitable form ready for solution, eg $2x^2 - 3x - 5 (= 0)$ or $-2x^2 + 3x + 5 (= 0)$
		P1	(dep 1st P1) for process to solve quadratic equation of form $ax^2 + bx + c (= 0)$ eg $(2x - 5)(x + 1) (= 0)$ or $\frac{- -3 \pm \sqrt{(-3)^2 - 4 \times 2 \times -5}}{2 \times 2}$
		A1	for -1, 2.5 oe



Summer 2020 Paper 3H (Calc)

21 $5c + d = c + 4d$

(a) Find the ratio $c : d$

Number
Ratio
... with algebra, factorising

(2 marks)

$6x^2 = 7xy + 20y^2$ where $x > 0$ and $y > 0$

(b) Find the ratio $x : y$

 **Video Solutions**

(3 marks)

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Number
Ratio
... with algebra, factorising

21	(a)	3 : 4	P1	for start of process, eg isolate terms in c , eg $4c = 3d$ or divide all terms by d , eg $\frac{5c}{d} + 1 = \frac{c}{d} + 4$
			A1	for 3 : 4
	(b)	5 : 2	P1	for start of process: to take all terms to one side eg $6x^2 - 7xy - 20y^2 (= 0)$ or divide all terms by y^2 , eg $\frac{6x^2}{y^2} = \frac{7xy}{y^2} + \frac{20y^2}{y^2}$ or substitute a value of x ($x > 0$) or a value of y ($y > 0$) into the equation, eg $x = 5$, $150 = 35y + 20y^2$
			P1	for second step in process, eg $(2x - 5y)(3x + 4y) (= 0)$ or $6p^2 - 7p - 20 (= 0)$ (where $p = \frac{x}{y}$) or $20y^2 + 35y - 150 (= 0)$
			A1	5 : 2

Accept any equivalent ratio or $c = 3, d = 4$

Accept $x = 5, y = 2$ or equivalent ratios, eg, $1 : \frac{2}{5}$



Number

Proportion

Conversions

Recipes

Sample and
Population

... with area

... with volume

Inverse (worded)

Algebraic



Number
Proportion
<i>Conversions</i>

- 2 In London, 1 litre of petrol costs 108.9p
In New York, 1 US gallon of petrol costs \$2.83

$$1 \text{ US gallon} = 3.785 \text{ litres}$$
$$£1 = \$1.46$$

In which city is petrol better value for money, London or New York?
You must show your working.

 **Video Solutions**

(3 marks)

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HOME

Number
Proportion
<i>Conversions</i>

2		New York (supported)	P1	for changing between £ and \$, eg $1.089 \times 1.46 (= 1.58(9.))$ or $2.83 \div 1.46 (= 1.93(8.))$ or between litres and gallons, eg $1.089 \times 3.785 (= 4.12(1.))$ or $2.83 \div 3.785 (= 0.74(7.))$
			P1	for a complete process to give values that can be used for comparison, eg “ $1.938\dots \div 3.785 (= 0.51(2.))$ ” or “ $1.589\dots \times 3.785 (= 6.01(7.))$ ” or $1.089 \times 3.785 (= 4.12(1.))$ and $2.83 \div 1.46 (= 1.93(8.))$
			C1	for New York and correct comparative values



November 2021 Paper 3H (Calc)

- 4 A water tank is empty.
Anil needs to fill the tank with 2400 litres of water.

Company **A** supplies water at a rate of 8 litres in 1 minute 40 seconds.

Company **B** supplies water at a rate of 2.2 gallons per minute.

1 gallon = 4.54 litres

Company **A** would take more time to fill the tank than Company **B** would take to fill the tank.

How much more time?

Give your answer in minutes correct to the nearest minute.

Number
Proportion
<i>Conversions, problem solving</i>



Number
Proportion
Conversions, problem solving

4

260

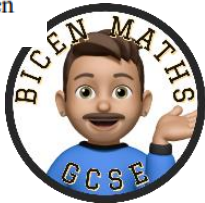
- P1 conversion to common units of capacity
eg $2.2 \times 4.54 (= 9.988)$ or $8 \div 4.54 (= 1.76\dots)$
OR
for Company A
 $2400 \div 4.54 (= 528.63\dots)$
OR
 $2400 \div 8 (= 300)$
OR
a rate per minute $8 \div [\text{time for Company A}] (= 4.8\dots)$ oe
- P1 for a complete process to find the time for company A or company B in minutes.
eg in litres
Company A $2400 \div "4.8\dots" (= 500)$ or $"300" \times [1 \text{ min } 40 \text{ sec}] (= 500)$
or Company B $2400 \div "9.988" (= 240.28\dots)$
OR
eg in gallons
Company A $"528.63\dots" \div ("1.76\dots" \div [1 \text{ min } 40 \text{ sec}]) (= 500)$
or Company B $"528.63\dots" \div 2.2 (= 240.28\dots)$
- P1 for complete processes to find the times for both company A and company B in minutes.

Company A
eg in litres $2400 \div "4.8\dots" (= 500)$ or $"300" \times [1 \text{ min } 40 \text{ sec}] (= 500)$
or in gallons $"528.63\dots" \div ("1.76\dots" \div [1 \text{ min } 40 \text{ sec}]) (= 500)$
AND
Company B
eg in litres $2400 \div "9.988" (= 240.28\dots)$
or in gallons $"528.63\dots" \div 2.2 (= 240.28\dots)$
- A1 for an answer in the range 259 to 260

Results of calculations may be truncated or rounded.

[time for Company A] could be 1 min 40 sec or 1.66... or 1.6 or 1.40 etc as long as it is clear it relates to 1 min 40 sec

If the answer is given within the range but then rounded incorrectly award full marks.



Summer 2019 Paper 1H (Non-Calc)

Number
Proportion
<i>Recipes</i>

2 Deon needs 50g of sugar to make 15 biscuits.

She also needs

three times as much flour as sugar

two times as much butter as sugar

Deon is going to make 60 biscuits.

(a) Work out the amount of flour she needs.

(3 marks)

Deon has to buy all the butter she needs to make 60 biscuits.

She buys the butter in 250g packs.

(b) How many packs of butter does Deon need to buy?

 **Video Solutions**

(2 marks)

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HOME

Number
Proportion
Recipes

2	(a)	600	P1	for starting process to calculate amount of flour eg $60 \div 15 (= 4)$ or $3 \times 50 (= 150)$	4 implied by 200g of sugar
			P1	for complete process eg $\frac{60}{15} \times "150"$	
			A1	cao	
	(b)	2	P1	for process to calculate amount of butter eg $\frac{60}{15} \times 2 \times 50 (= 400)$	[butter] must be clearly stated or calculated, may be seen in part (a)
			A1	OR for process to calculate the number of packs of butter needed eg [butter] $\div 250$ cao	



Summer 2019 Paper 2H (Calc)

3 Hannah is planning a day trip for 195 students.

She asks a sample of 30 students where they want to go.
Each student chooses one place.

The table shows information about her results.

Place	Number of students
Theme Park	10
Theatre	5
Sports Centre	8
Seaside	7

(i) Work out how many of the 195 students you think will want to go to the Theme Park.

(2 marks)

(ii) State any assumption you made **and** explain how this may affect your answer.

(1 mark)



 **Video Solutions**



Number
Proportion
<i>Sample and population</i>

3	(i)	65	M1	for working with proportion eg $10 \div 30 \times 195 (=65)$	Condone use of 200 for 195
			A1	cao	
	(ii)	statement	C1	for statement Acceptable examples sample is representative (otherwise answer wrong) random sample (otherwise answer will be different) the 30 students are from the 195 (otherwise not accurate) 10 out of every 30 want to go to the Theme Park (otherwise answer will be different/wrong) there is no bias Not acceptable examples There would be more than 10 people who want to go to the Theme Park I rounded my answer	



- 4 Each person in a fitness club is going to get a free gift.
Stan is going to order the gifts.

Stan takes a sample of 50 people in the fitness club.
He asks each person to tell him the gift they would like.

The table shows information about his results.

Gift	Number of people
sports bag	17
gym towel	7
headphones	11
voucher	15

There are 700 people in the fitness club.

- (i) Work out how many sports bags Stan should order.
- (ii) Write down any assumption you made **and** explain how this could affect your answer.

(2 marks)

(1 mark)

Number
Proportion
<i>Sample and population</i>



Number
Proportion
Sample and population

4	(i)	238	P1	for working with proportion eg $\frac{17}{50} \times 700$ oe
	(ii)	statement	A1	cao
			C1	for statement Acceptable Sample is representative (otherwise answer wrong) Random sample (otherwise answer will be different) The 50 people are from the 700 (otherwise not accurate) 17 out of every 50 want a sports bag (otherwise answer will be different / wrong) There is no bias That the other 650 will want the same gifts as the 50 Not acceptable There would be more than 17 people who want the sports bag I rounded my answer 17 out of 50 want a sports bag A repeat of the calculation done in (i) Most of the people would want a sports bag References as what might change in the future (eg a change in membership) That all 700 people wanted a type of gift rather than no gift (otherwise would have changed my answer)



Summer 2020 Paper 3H (Calc)

Number
Proportion
... with area of rectangles

4 Maisie knows that she needs 3 kg of grass seed to make a rectangular lawn 5 m by 9 m.

Grass seed is sold in 2 kg boxes.

Maisie wants to make a rectangular lawn 10 m by 14 m.
She has 5 boxes of grass seed.

(a) Has Maisie got enough grass seed to make a lawn 10 m by 14 m? **(4 marks)**
You must show all your working.

Maisie opens the 5 boxes of grass seed.

She finds that 4 of the boxes contain 2 kg of grass seed.
The other box contains 1 kg of grass seed.

(b) Does this affect whether Maisie has enough grass seed to make her lawn? **(1 mark)**
Give a reason for your answer.

 **Video Solutions**

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HOME

Number
Proportion
... with area of rectangles

4	(a)	Yes (supported)	P1 for start of process, eg $5 \times 9 (= 45)$ or $10 \times 14 (= 140)$ or $5 \times 2 (= 10 \text{ (kg)})$ or $3 \div 2 (= 1.5 \text{ (boxes)})$	Accept values rounded or truncated to 1dp in both (a) and (b). Ignore units
			P1 for process using ratio of areas, eg $"140" \div "45" (= 3.1...)$ or for using ratio of amount of seed eg $"10" \div 3 (= 3.3...)$ or for finding coverage for 1 kg of grass seed, eg $"45" \div 3 (= 15 \text{ (m}^2\text{)})$	
			P1 for process to find amount of seed needed, eg $"140" \div "45" \times 3 (= 9.3... \text{kg})$ or $"140" \div "45" \times "1.5" (= 4.6... \text{(boxes)})$ oe or $"15" \times 2 (= 30 \text{ (m}^2 \text{ per box)})$ and $"140" \div "30" (= 4.6... \text{(boxes)})$ or for process to find area that can be seeded, eg $"10" \div 3 \times "45" (= 150 \text{ (m}^2\text{)})$ or $"140" \div "10" (= 14 \text{ (m}^2\text{)})$ oe	Accept 9.4 Accept 4.7
			C1 for "Yes" supported by correct figures eg 4.6...(and 5), or 9.3...and 10 or 150 and 140 (or 140 to 148.5) or 15 and 14	
	(b)	Yes, (does not have enough) (supported)	C1 for reasoning supported with correct figures, eg does not have enough seed and compares 9 (kg) with 9.3...(kg) or 4.5 (boxes) with 4.6... (boxes) or 135 (m ²) with 140 (m ²) ft from (a)	Values used in (a) do not need repeating in (b) as long as intention is clear

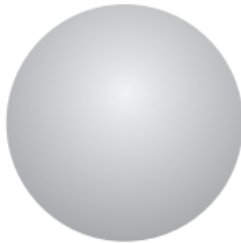


Number
Proportion
<i>Comparing volumes</i>

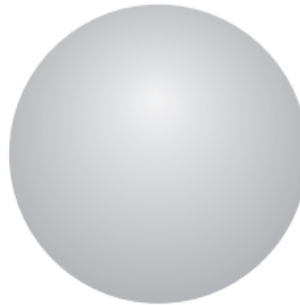
12 Here are three spheres.



P



Q



R

The volume of sphere **Q** is 50% more than the volume of sphere **P**.
The volume of sphere **R** is 50% more than the volume of sphere **Q**.

Find the volume of sphere **P** as a fraction of the volume of sphere **R**.

 **Video Solutions**

(3 marks)



12	$\frac{4}{9}$	P1	for process to find link between volume of Q and volume of P or between volume of R and volume of Q, eg ratio 1.5 : 1 or $Q = 1.5P$ or $P = \frac{2}{3}Q$ or two values in the ratio 1 : 1.5 such as 100 and 150	$1.5^2 (= \frac{9}{4})$ is enough for this mark, award P1P1 Accept $P = \frac{4}{9}R$
		P1	for process to find link between volume of R and volume of P eg $1.5^2 : 1$ or two values in the ratio 1 : 2.25 such as 100 and 225	
		A1	for $\frac{4}{9}$ oe fraction eg $\frac{100}{225}$	



- 9 Yesterday it took 5 cleaners $4\frac{1}{2}$ hours to clean all the rooms in a hotel.

There are only 3 cleaners to clean all the rooms in the hotel today.

Each cleaner is paid £8.20 for each hour or part of an hour they work.

How much will each cleaner be paid today?

Number

Proportion

Inverse proportion

 **Video Solutions**

(3 marks)

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Number
Proportion
<i>Inverse proportion</i>

9		65.60	P1	for start in using inverse proportionality, eg $5 \times 4.5 (= 22.5)$ or $4.5 = \frac{k}{5}$ or $5 \times 4.5 \times 60 (= 1350)$ or $\frac{5}{3}$ or $\frac{3}{5}$
			P1	for process to find number of hours for each cleaner today, eg $\frac{22.5}{3} (= 7.5)$
			A1	for 65.6(0) (SC B2 for 61.5(0))



Number
Proportion
<i>Inverse proportion</i>

- 4 It would take 120 minutes to fill a swimming pool using water from 5 taps.
- (a) How many minutes will it take to fill the pool if only 3 of the taps are used?

..... minutes
(2)

- (b) State one assumption you made in working out your answer to part (a).
-
-
(1)



Number
Proportion
<i>Inverse proportion</i>

4	(a)	200	M1	for $120 \times 5 \div 3$ oe	
			A1	cao	
	(b)	statement	C1	Statement that each tap fills at the same rate or that the rate does not change over time Examples Acceptable responses: Taps are running at the same speed They (clearly referring to taps) all fill the pool with the same volume of water The amount of water is the same in the same time (again referring to taps) Each tap is doing a fifth of the filling That all taps take equal time to fill the pool All taps produce the same amount of water That the water flow stays at the same rate over the whole time. Non acceptable responses It will take more time because there are less taps The less taps used the longer it takes to fill the pool That 1 tap can take up to 24 mins each 3 taps will take longer to fill the pool	Any statement referring to the same amount of water flowing from each tap is acceptable.



Summer 2019 Paper 3H (Calc)

9 A company has to make a large number of boxes.

The company has 6 machines.
All the machines work at the same rate.
When all the machines are working, they can make all the boxes in 9 days.

The table gives the number of machines working each day.

	day 1	day 2	day 3	all other days
Number of machines working	3	4	5	6

Work out the total number of days taken to make all the boxes.

Number
Proportion
<i>Inverse proportion</i>

 **Video Solutions**

(3 marks)



Number
Proportion
<i>Inverse proportion</i>

9	10	P1	for a process to start to solve the problem eg $6 \times 9 (= 54)$ machine days needed or 12 (machine days used in first 3 days) or 42 (machine days needed after first 3 days) or 6 (machine days not used in first 3 days) or $3 + 4 + 5$ equivalent to 2 days with 6 machines or has used 48 machine days in first 9 days	eg $3 + 4 + 5 (= 12)$ eg $6 \times 9 - 12 (= 42)$ eg $3 + 2 + 1 = 6$ eg $12 \div 6 = 2$
		P1	for “42” $\div 6 (= 7)$ (more days needed) or 3 days – 2 (equivalent) days (= 1) extra day needed to make up for the days not used	
		A1	cao	



November 2021 Paper 3H (Calc)

Number
Proportion
<i>Inverse proportion</i>

- 9 On Monday, 12 people took 5 hours to clean a number of cars.
On Tuesday, 15 people cleaned the same number of cars.

Assuming that all the people worked at the same rate,

- (a) work out how many hours the 15 people took to clean the cars.

(2 marks)

The assumption is wrong.

- (b) How might this affect the time taken for the 15 people to clean the cars?

(1 mark)



Number
Proportion
<i>Inverse proportion</i>

9	(a)	4	P1 A1	$12 \times 5 \div 15$ cao
	(b)	Statement	C1	Acceptable examples it could take more time it could take less time it could take more or less time it would take longer if they worked at a slower rate Not acceptable examples the time will be less as there are more people if the rate at which the 15 people work changes it would have taken longer it would take less time



Summer 2017 Paper 1H (Non-Calc)

13 The table shows a set of values for x and y .

x	1	2	3	4
y	9	$2\frac{1}{4}$	1	$\frac{9}{16}$

y is inversely proportional to the square of x .

(a) Find an equation for y in terms of x .

(2 marks)

(b) Find the positive value of x when $y = 16$

Number
Proportion
<i>Algebraic</i>

 **Video Solutions**

(2 marks)



Number
Proportion
<i>Algebraic</i>

13	(a)			
		$y = \frac{9}{x^2}$	M1	begins to work with $y = \frac{k}{x^2}$ oe e.g. subs of a pair of numbers into $y = \frac{k}{x^2}$ or states $k=9$
			A1	for $y = \frac{9}{x^2}$ Accept $y = 9x^{-2}$
	(b)	$\frac{3}{4}$	M1	ft (dep on previous M1) subs $y = 16$ into proportional formula of the form $y = \frac{k}{x^2}$ oe
			A1	oe



16 y is directly proportional to $\sqrt[3]{x}$

$$y = 1\frac{1}{6} \text{ when } x = 8$$

Find the value of y when $x = 64$

Number

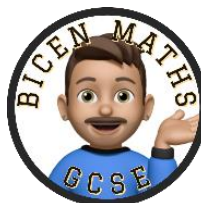
Proportion

Algebraic

 **Video Solutions**

(3 marks)

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Number
Proportion
<i>Algebraic</i>

16		$\frac{7}{3}$	M1 M1 A1	for $y = k \sqrt[3]{x}$ oe or $\frac{7}{6} = \sqrt[3]{8} k$ oe for $k = \frac{7}{6 \times \sqrt[3]{8}}$ oe for $\frac{7}{3}$ oe
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Summer 2018 Paper 1H (Non-Calc)

14 y is inversely proportional to d^2

When $d = 10$, $y = 4$

d is directly proportional to x^2

When $x = 2$, $d = 24$

Find a formula for y in terms of x .

Give your answer in its simplest form.

Number

Proportion

Algebraic

 **Video Solutions**

(5 marks)

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Number
Proportion
<i>Algebraic</i>

14	$y = \frac{100}{9x^4}$	P1	for setting up a correct proportional relationship, eg $d \propto x^2$ or $d = kx^2$	Condone the use of 'α' instead of '=' for the four P marks
		P1	for setting up a second proportional relationship, eg $y \propto \frac{1}{d^2}$ or $y = \frac{K}{d^2}$	
		P1	(dep P1) for a process to find one of the constants of proportionality eg $24 = k \times 2^2$ ($k = 6$) or $4 = K \div 100$ ($K = 400$)	
		P1	full process to find y in terms of x eg $y = \frac{"400"}{("6"x^2)^2}$ oe	Both constants must come from a correct process
		A1	$y = \frac{100}{9x^4}$ oe	Expression must have been simplified, but could be given other equivalent ways eg $y = 11.111.. x^{-4}$



Number
Proportion
<i>Algebraic</i>

14 y is inversely proportional to x^3

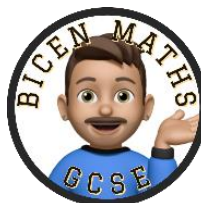
$$y = 44 \text{ when } x = a$$

Show that $y = 5.5$ when $x = 2a$

 **Video Solutions**

(3 marks)

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Number
Proportion
<i>Algebraic</i>

14	Evidence of solution	M1	for constructing an equation eg $y \propto \frac{1}{x^3}$ or eg $y = \frac{k}{x^3}$ oe	Must show all steps clearly
		M1	for substituting in the values a and 44 into $y = \frac{k}{x^3}$	
		C1	for a complete method to use the equation, the value of k and $x = 2a$ to show $y = 5.5$ eg $(2a)^3 y = 44a^3$ and $y = 44a^3 \div 8a^3 = 5.5$	



Summer 2019 Paper 1H (Non-Calc)

- 20 h is inversely proportional to p
 p is directly proportional to $\sqrt{t}$

Given that $h = 10$ and $t = 144$ when $p = 6$
find a formula for h in terms of t

Number
Proportion
<i>Algebraic</i>

 **Video Solutions**

(4 marks)

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HOME

Number
Proportion
<i>Algebraic</i>

20	$h = \frac{120}{\sqrt{t}}$	P1 for setting up a proportional relationship between h and p, eg $h \propto \frac{1}{p}$ or $h = \frac{k}{p}$ OR a proportional relationship between p and t, eg $p \propto \sqrt{t}$ or $p = K\sqrt{t}$ P1 for process to substitute at least 2 values, eg $10 = \frac{k}{6}$ ($k = 60$) or $6 = K\sqrt{144}$ ($K = 0.5$) P1 for full process leading to $h = \frac{"60"}{p}$ oe and $p = "0.5"\sqrt{t}$ oe A1 $h = \frac{120}{\sqrt{t}}$ oe eg $h = \frac{120\sqrt{t}}{t}$ or $h = \frac{60}{0.5\sqrt{t}}$	Condone the use of 'α' instead of '=' for the first two P marks Relationship may be implied by substitution Both constants must come from a correct process Formula for h in terms of t Does not need to be in simplest form
----	----------------------------	---	--



Number
Proportion
<i>Algebraic</i>

16 y is inversely proportional to the square of x .

$$y = 8 \text{ when } x = 2.5$$

Find the negative value of x when $y = \frac{8}{9}$

 **Video Solutions**

(3 marks)

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Number
Proportion
<i>Algebraic</i>

16	-7.5	M1	for stating a correct relationship, eg $y = \frac{k}{x^2}$ or $8 = \frac{k}{2.5^2}$	Accept $y \propto \frac{k}{x^2}$ where k may be 1
		A1	for $k = 50$, could be seen in an equation	
		A1	-7.5 oe	

 **Video Solutions**



Number
Proportion
<i>Algebraic</i>

18 x is proportional to $\sqrt{y}$ where $y > 0$

y is increased by 44%

Work out the percentage increase in x .

 **Video Solutions**

(3 marks)

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Summer 2020 Paper 1H (Non-Calc)

Number
Proportion
<i>Algebraic</i>

18	20	P1 for a statement of proportionality eg $x = k\sqrt{y}$ or 1.44 oe P1 for using $\sqrt{1.44}$ as multiplier eg $(x_2 =) k\sqrt{1.44y}$ or 1.2 oe A1 cao	Must be written in the form of an equation with a constant term, accept $x \propto k\sqrt{y}$
----	----	---	---

 **Video Solutions**



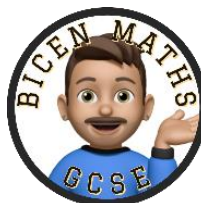
- 17 x is directly proportional to the square of y .
 y is directly proportional to the cube of z .

$$z = 2 \text{ when } x = 32$$

Find a formula for x in terms of z .

Number
Proportion
<i>Algebraic</i>

(4 marks)



Number
Proportion
<i>Algebraic</i>

17

$$x = \frac{1}{2}z^6$$

- M1 for setting up an equation eg $x = ky^2$ oe **or** $y = cz^3$ oe
- M1 for eliminating y eg $x = k(cz^3)^2$ oe
OR
substitutes values in both equations, eg $32 = ky^2$ and $y = c2^3$
- M1 for substituting in 32 and 2 to find the constant, eg $32 = m2^6$
OR
combines equations, eg $32 = k c^2 2^6$
- A1 oe

Accept use of proportionality sign,
eg $x \propto y^2$ or $y \propto z^3$ or $x \propto ky^2$ or $y \propto cz^3$
Accept use of proportionality sign,
eg $32 \propto ky^2$ and $y \propto c2^3$



Number

Factors, Multiples, Primes

Prime Factors

LCM, HCF



Number
Factors, Multiples, Primes
<i>Prime factors</i>

2 Express 56 as the product of its prime factors.

 **Video Solutions**

(2 marks)

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Number
Factors, Multiples, Primes
<i>Prime factors</i>

2		$2 \times 2 \times 2 \times 7$	M1	for complete method to find prime factors; could be shown on a complete factor tree with no more than 1 arithmetic error
			A1	accept $2^3 \times 7$



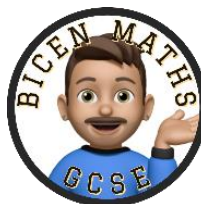
Number
Factors, Multiples, Primes
<i>Prime factors</i>

- 1 Write 36 as a product of its prime factors.

 **Video Solutions**

(2 marks)

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HOME

Number
Factors, Multiples, Primes
<i>Prime factors</i>

1		$2 \times 2 \times 3 \times 3$	M1 A1	for complete method to find prime factors; could be shown on a complete factor tree with no more than 1 arithmetic error or 2,2,3,3,(1) $2 \times 2 \times 3 \times 3$ oe
---	--	--------------------------------	----------	---

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HOME

Summer 2018 Paper 2H (Calc)

Number
Factors, Multiples, Primes
<i>LCM, HCF</i>

2 (a) Find the lowest common multiple (LCM) of 40 and 56

.....
(2)

$A = 2^3 \times 3 \times 5$ $B = 2^2 \times 3 \times 5^2$

(b) Write down the highest common factor (HCF) of A and B .

.....
(1)



 **Video Solutions**



Number
Factors, Multiples, Primes
<i>LCM, HCF</i>

2	(a)	280	M1	for listing at least 3 multiples of both 40 and 56 OR finds the prime factors of both 40 and 56	40, 80, 120, ... 56, 112, 168, ... OR 2,2,2,5 and 2,2,2,7
	(b)	60	A1	cao	
			B1	60 or $2^2 \times 3 \times 5$ oe	2^2 , 3, 5 not enough ie must be a product



Number
Factors, Multiples, Primes
<i>LCM, HCF</i>

2 (a) Find the Highest Common Factor (HCF) of 60 and 84

(2 marks)

(b) Find the Lowest Common Multiple (LCM) of 24 and 40

(2 marks)



Number
Factors, Multiples, Primes
<i>LCM, HCF</i>

2	(a)	12	M1	for a correct factor tree for either 60 or 84 with no more than one arithmetic error or for listing factors of 60 or 84, at least 4 correct for either (with no more than 1 incorrect in either list), could be in factor pairs or for the prime factors of 60 (2, 2, 3, 5) or 84 (2, 2, 3, 7)	Condone the use of 1 in any factor tree 60: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 84: 1, 2, 3, 4, 6, 7, 12, 14, 21, 28, 42, 84
			A1	for 12 or $2 \times 2 \times 3$ oe SC B1 for answer of 4 or 6, if M0 scored	2,2,3 is not enough, it must be a product
	(b)	120	M1	for a correct factor tree for either 24 or 40 with no more than one arithmetic error or for at least 3 multiples of both 24 and 40 (can include 24 and 40) or for the prime factors of either 24 (2, 2, 2, 3) or 40 (2, 2, 2, 5) or for a common multiple from their lists ($\neq 120$)	Condone the use of 1 in any factor tree 24: 24, 48, 72, 96, 120, ... 40: 40, 80, 120, ... For the list not containing 120, accept the first 3 correct multiples or one error in the first 4 multiples
			A1	for 120 or $2 \times 2 \times 2 \times 3 \times 5$ oe	



Number
Factors, Multiples, Primes
<i>HCF</i>

3 Find the highest common factor (HCF) of 72 and 90

 **Video Solutions**

(2 marks)

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HOME

Number
Factors, Multiples, Primes
<i>HCF</i>

3	18	M1	for listing factors of 72 and 90, at least 4 correct for each (with no more than 1 incorrect in each list), could be in factor pairs	Factors of 72: 1, 2, 3, 4, 6, 8, 9, 12, 18, 24, 36, 72 Factors of 90: 1, 2, 3, 5, 6, 9, 10, 15, 18, 30, 45, 90
		A1	for 18 or 2×3^2 oe SC B1 for answer of 6 or 9 if M0 scored	$2, 3^2$ is not enough, it must be a product



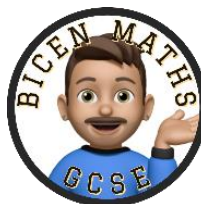
Number
Factors, Multiples, Primes
<i>LCM</i>

1 Find the Lowest Common Multiple (LCM) of 108 and 120

 **Video Solutions**

(3 marks)

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HOME

Number
Factors, Multiples, Primes
<i>LCM</i>

1	1080	M1	for method to write one number as a product of prime factors (condone one division error in method chosen), eg. one complete factor tree or 2, 2, 3, 3, 3 or 2, 2, 2, 3, 5 or for listing at least 5 multiples of either number (condone one error) or for any common multiple ($\neq 1080$), eg. 12960 ($= 108 \times 120$)	Accept first 5 multiples if all correct or one error in the first 6 multiples
		M1	for method to write both numbers as a product of prime factors (condone a total of one division error) eg. two complete factor trees or 2, 2, 3, 3, 3 and 2, 2, 2, 3, 5 or lists of multiples of the two numbers, at least 5 of each, one of which includes 1080	For the list not containing 1080, accept first 5 correct multiples or one error in the first 6 multiples
		A1	cao SC: B2 for any product that would lead to 1080, eg. $2^3 \times 3^3 \times 5$ or $12 \times 9 \times 10$	



Number
Factors, Multiples, Primes
<i>LCM</i>

20 Here is a list of five numbers.

98^{53} 98^{64} 98^{73} 98^{88} 98^{91}

Find the lowest common multiple of these five numbers.

 **Video Solutions**

(1 mark)



Summer 2020 Paper 3H (Calc)

Number
Factors, Multiples, Primes
<i>LCM</i>

20

98^{91}

B1

cao



Video Solutions

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HOME

Number
Factors, Multiples, Primes
<i>Product of Prime Factors, LCM</i>

1 (a) Write 84 as a product of its prime factors.

(2 marks)

(b) Find the lowest common multiple (LCM) of 60 and 84

 **Video Solutions**

(2 marks)



Number
Factors, Multiples, Primes
<i>Product of Prime Factors, LCM</i>

1	(a)	$2 \times 2 \times 3 \times 7$	M1	for a complete method to find prime factors, could be shown on a factor tree, with no more than one arithmetic error or for 2, 2, 3, 7	Condone the use of 1
			A1	for $2 \times 2 \times 3 \times 7$ oe	Accept $2^2 \times 3 \times 7$
	(b)	420	M1	for at least 3 multiples of both 60 and 84 (can include 60 and 84) or finds the prime factors of both 84 (may be seen in (a)) and 60, may be seen in factor trees	60, 120, 180, 240, 300, 360, 420 84, 168, 252, 336, 420 $60 = 2 \times 2 \times 3 \times 5$ or $2^2 \times 3 \times 5$ If factor tree in (a) is incorrect fit this factor tree in part3 (b) for M1 only
			A1	420 or $2 \times 2 \times 3 \times 5 \times 7$ oe	



Number
Factors, Multiples, Primes
<i>LCM in context</i>

10 Here are three lamps.

lamp A



lamp B



lamp C



Lamp A flashes every 20 seconds.

Lamp B flashes every 45 seconds.

Lamp C flashes every 120 seconds.

The three lamps start flashing at the same time.

How many times in one hour will the three lamps flash at the same time?

 **Video Solutions**

(3 marks)



Number
Factors, Multiples, Primes
<i>LCM in context</i>

10	10	P1	for start to a process to find the LCM of 20, 45 and 120 (= 360), eg $45 = 3 \times 3 \times 5$ or $20 = 2 \times 2 \times 5$ or $120 = 2 \times 2 \times 2 \times 3 \times 5$ or writes down at least 3 multiples of 45 and 120	Could be presented as complete prime factor trees for 45 or 120
		P1	(dep) for a process to find number of times/hour using their LCM, eg $3600 \div 360$ or $3600 \div 720$	Must use a common multiple. Working may be in minutes.
		A1	for 10 or 11	

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HOME

Number

Recurring Decimals

Ordering

Converting to
Fractions



- 8 Write these numbers in order of size.
Start with the smallest number.

$0.2\dot{4}\dot{6}$

$0.24\dot{6}$

$0.\dot{2}4\dot{6}$

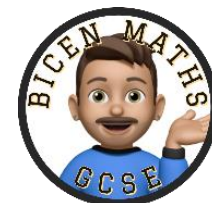
0.246

Number
Recurring Decimals
<i>Ordering decimals</i>

 **Video Solutions**

(2 marks)

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HOME

Number
Recurring Decimals
<i>Ordering decimals</i>

8		0.246, 0. $\dot{2}4\dot{6}$ 0. $\dot{2}4\dot{6}$, 0.24 $\dot{6}$	M1 A1	for correct use of recurring symbol eg $0.2\dot{4}\dot{6} = 0.24646\dots$ or 3 terms in the correct relative position cao
---	--	--	----------	---

 **Video Solutions**

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HOME

- 15 Express $0.4\dot{1}\dot{8}$ as a fraction.
You must show all your working.

Number

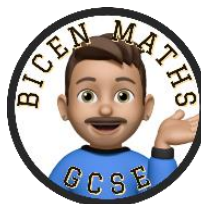
Recurring Decimals

Express as a fraction

 **Video Solutions**

(3 marks)

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HOME

Number
Recurring Decimals
<i>Express as a fraction</i>

15

$$\frac{414}{990}$$

M1

for $(x =) 0.41818\ldots$ or $(10x =) 4.1\dot{8}$ or $4.1818\ldots$
or $(100x =) 41.\dot{8}1$ or $41.818\ldots$ or $(1000x =) 418.\dot{1}\dot{8}$ or $418.18\ldots$

M1

for using two recurring decimals with a terminating decimal difference,
eg. $(1000x - 10x =) 418.\dot{1}\dot{8} - 4.\dot{1}\dot{8}$
or $418.18\ldots - 4.1818\ldots (= 414)$

A1

for $\frac{414}{990}$ oe, eg $\frac{23}{55}$

Accept
 $(100x - x =) 41.\dot{8}\dot{1} - 0.4\dot{1}\dot{8}$
or $41.818\ldots - 0.41818\ldots (= 41.4)$

$\frac{41.4}{99}$ must be simplified to gain the accuracy mark



13 Ted is trying to change $0.\dot{4}\dot{3}$ to a fraction.

Here is the start of his method.

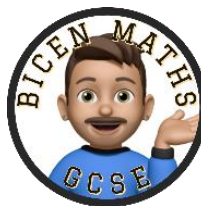
$$x = 0.\dot{4}\dot{3}$$

$$10x = 4.\dot{3}\dot{4}$$

$$10x - x = 4.\dot{3}\dot{4} - 0.\dot{4}\dot{3}$$

Evaluate Ted's method so far.

Number
Recurring Decimals
<i>Express as a fraction</i>



Number
Recurring Decimals
<i>Express as a fraction</i>

13

Explanation

C1

explanation

Acceptable examples

he should have used $100(x)$ rather than $10(x)$

he should have used $1000x$ and $10x$

Ted's working does not eliminate the recurring decimals

the recurring numbers after the decimal point have to be in the same sequence

he should have multiplied by 100 to subtract easier after the decimal point

he should have multiplied by 100 because two numbers are recurring

Not acceptable examples

it is not correct

the method is not complete

he should have used $1000x$

he should have multiplied by 100

he should have multiplied by 100 and then done $100x - 10x$ to give $43/90$



15 $x = 0.4\dot{3}\dot{6}$

Prove algebraically that x can be written as $\frac{24}{55}$

Number

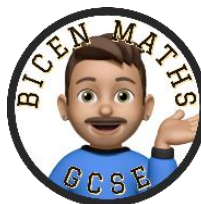
Recurring Decimals

Proof

 **Video Solutions**

(3 marks)

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HOME

Number
Recurring Decimals
<i>Proof</i>

15		Proof to reach $\frac{24}{55}$	M1	for $100x = 43.636... (43.\dot{6}\dot{3})$ or $10x = 4.3636... (4.\dot{3}\dot{6})$ and $1000x = 436.36....(436.\dot{3}\dot{6})$
			M1	(dep) for finding difference that would lead to a terminating decimal
			A1	for completing algebra to reach $\frac{24}{55}$



16 Prove algebraically that $0.2\dot{5}\dot{6}$ can be written as $\frac{127}{495}$

Number

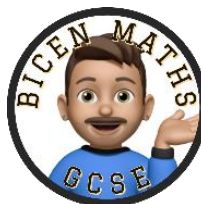
Recurring Decimals

Proof

 **Video Solutions**

(3 marks)

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HOME

Number
Recurring Decimals
Proof

16	Proof with $\frac{127}{495}$	M1	0.25656... or $0.2 + 0.05656..$ or $(10 \times 0.2\dot{5}\dot{6} =) 2.\dot{5}\dot{6}$ or $2.5656...$ or $(100 \times 0.2\dot{5}\dot{6} =) 25.\dot{6}\dot{5}$ or $25.6565...$ or $(1000 \times 0.2\dot{5}\dot{6} =) 256.\dot{5}\dot{6}$ or $256.5656...$
		M1	for finding two correct recurring decimals that when subtracted would result in a terminating decimal or integer, eg. $256.5656..... - 2.5656.....$ or $25.6565..... - 0.25656.....$ or $256.\dot{5}\dot{6}$ $- 2.\dot{5}\dot{6}$ or $25.\dot{6}\dot{5} - 0.2\dot{5}\dot{6}$ or for $\frac{254}{990}$ or $\frac{25.4}{99}$
		C1	full proof seen with $\frac{127}{495}$



15 Prove algebraically that $0.7\dot{3}$ can be written as $\frac{11}{15}$

Number

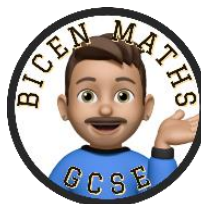
Recurring Decimals

Proof

 **Video Solutions**

(2 marks)

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Number
Recurring Decimals
<i>Proof</i>

15	Proof	M1	for $10x = 7.333\dots$ ($7.\dot{3}$) and for finding difference that would lead to a terminating decimal	100x and 1000x, etc could also be used
		A1	for completing algebra to reach $\frac{11}{15}$	

 **Video Solutions**

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HOME

16 Using algebra, prove that $0.1\dot{3}\dot{6} \times 0.\dot{2}$ is equal in value to $\frac{1}{33}$

Number

Recurring Decimals

Multiplying proof

 **Video Solutions**

(3 marks)

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HOME

Number
Recurring Decimals
<i>Multiplying proof</i>

16				M1	for the start of a method to convert 0.22.. to a fraction, eg $10y = 2.22..$ or $(y =) \frac{2}{9}$
				M1	for the start of a method to convert 0.13636... to a fraction, $10x = 1.3636..$ or $100x = 13.6363...$ or $1000x = 136.3636..$ or $(x =) \frac{13.5}{99}$ or $(x =) \frac{135}{990}$
				C1	for correct arithmetic and concluding the proof
					OR
				M1	for $0.\dot{1}3\dot{6} \times 0.\dot{2} = 0.\dot{0}\dot{3} (=z)$
				M1	for complete method to find two appropriate recurring decimals the difference of which is a rational number, eg. $100z = 3.0303..., (z =) 0.0303... \text{ or } \frac{3}{99}$
				C1	for correct arithmetic and concluding the proof



Number

Indices

Simple

Fractional

Mixed

Matching the Bases



1 Work out the value of $\frac{3^7 \times 3^{-2}}{3^3}$

Number

Indices

Simplify and evaluate

 **Video Solutions**

(2 marks)

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HOME

Number
Indices
<i>Simplify and evaluate</i>

1	9	M1	for a correct first step, using the laws of indices to simplify eg. 3^2 or $3^{7+ -2}$ or 3^{7-3} or 3^{-2-3} OR for using exact values, eg. $2187 \times \frac{1}{9} (= 243)$ or $2187 \div 27 (= 81)$ or $\frac{1}{27 \times 9} (= \frac{1}{243})$
		A1	cao



Number
Indices
<i>Fractional</i>

10 (a) Write down the value of $100^{\frac{1}{2}}$

.....
(1)

(b) Find the value of $125^{\frac{2}{3}}$

.....
(2)

 **Video Solutions**

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HOME

Number
Indices
Fractional

10	(a)		10	B1	accept ± 10
	(b)		25	M1	for $(\sqrt[3]{125})^2$ or $\sqrt[3]{125} = 5$ or $125^2 = 15625$ or $\sqrt[3]{125^2}$
				A1	cao

 **Video Solutions**



Number
Indices
<i>Fractional</i>

12 Patrick has to work out the exact value of $64^{\frac{1}{4}}$

Patrick says,

“ $\frac{1}{4}$ of 64 is 16 so $64^{\frac{1}{4}} = 16$ ”

Explain what is wrong with what Patrick says.

 **Video Solutions**

(1 mark)

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Number
Indices
Fractional

12	Explanation	C1	for explanation eg needs to find 4th root or gives the correct answer of 2.828... Acceptable examples: He needs to find $\sqrt[4]{64}$ It should be 2.8..(or $2\sqrt{2}$) It is not asking for $64 \div 4$, it is asking what number to the power of 4 = 64 $64^{\frac{1}{4}}$ means the fourth root not a quarter of 64 $64^{\frac{1}{4}}$ means square root and square root again, not divide by 4 Not acceptable examples: It should be 2 The expression is 64 to the power of $\frac{1}{4}$ $64^{\frac{1}{4}}$ is not a $\frac{1}{4}$ of 64
----	-------------	----	--



Number
Indices
Mixed

12 (a) Find the value of $81^{-\frac{1}{2}}$

(b) Find the value of $\left(\frac{64}{125}\right)^{\frac{2}{3}}$

.....
(2)

.....
(2)

 **Video Solutions**



HOME

Number
Indices
Mixed

12	(a)		$\frac{1}{9}$	M1	for showing a method using either reciprocal or square root e.g. $\frac{1}{n}$ or 9 seen
				A1	cao Accept $\pm\frac{1}{9}$ or 0.1 recurring
	(b)		$\frac{16}{25}$	M1	for showing cube root of 64 as 4 and the cube root of 125 as 5 or $\frac{16}{n}$ ($n \neq 25$) or $\frac{n}{25}$ ($n \neq 16$) or an intention to find the cube root and square.
				A1	cao Accept 0.64



November 2017 Paper 2H (Calc)

6 $p^3 \times p^x = p^9$

(a) Find the value of x .

(1 mark)

$$(7^2)^y = 7^{10}$$

(b) Find the value of y .

(1 mark)

$100^a \times 1000^b$ can be written in the form 10^w

(c) Show that $w = 2a + 3b$

 **Video Solutions**

(2 marks)

Number
Indices
Mixed



Number
Indices
Mixed

6 (a)		6	B1	cao
(b)		5	B1	cao
(c)		Shown	M1	for writing 100^a or 1000^b as a power of 10 ($=10^{2a}$ or 10^{3b}) or 10^{2a+3b} or $100 = 10^2$ and $1000 = 10^3$
			C1	for complete chain of reasoning leading to conclusion



Number
Indices
Mixed

9 (a) Write down the value of $36^{\frac{1}{2}}$

.....
(1)

(b) Write down the value of 23^0

.....
(1)

(c) Work out the value of $27^{-\frac{2}{3}}$

.....
(2)

 **Video Solutions**



Number
Indices
Mixed

9	(a)	6	B1	cao	Accept ±6
	(b)	1	B1	cao	
	(c)	$\frac{1}{9}$	M1	for evidence of working with a cube root eg $\sqrt[3]{27}$ or $\sqrt[3]{729}$	
				OR evidence of working with a reciprocal eg $\frac{1}{27^{2/3}}$ or $\left(\frac{1}{27}\right)^{\frac{2}{3}}$	
			A1	cao	



November 2018 Paper 1H (Non-Calc)

Number
Indices
Mixed

14 (a) Work out the value of $\left(\frac{16}{81}\right)^{\frac{3}{4}}$

(2 marks)

$$3^a = \frac{1}{9} \quad 3^b = 9\sqrt{3} \quad 3^c = \frac{1}{\sqrt{3}}$$

(b) Work out the value of $a + b + c$

 **Video Solutions**

(2 marks)

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HOME

Number
Indices
Mixed

14	(a)	$\frac{8}{27}$	M1	for showing the 4th root of 16 as 2 and the 4th root of 81 as 3 or $\frac{8}{n}$ ($n \neq 27$) or $\frac{n}{27}$ ($n \neq 8$) or an intention to find the 4th root and cube, eg. $\sqrt[4]{\left(\frac{16}{81}\right)^3}$ or $\left(\sqrt[4]{\frac{16}{81}}\right)^3$ oc
			A1	cao
	(b)	0	M1	for writing $\frac{1}{9} = 3^{-2}$, $9\sqrt{3} = 3^{2.5}$, $\frac{1}{\sqrt{3}} = 3^{-0.5}$ as powers of 3, with at least 2 correct or for working out $\frac{1}{9} \times 9\sqrt{3} \times \frac{1}{\sqrt{3}} = 1$
			A1	cao



Summer 2019 Paper 1H (Non-Calc)

Number
Indices
Mixed

8 $(2.3)^6 = 148$ correct to 3 significant figures.

(b) Find the value of $(0.23)^6$ correct to 3 significant figures.

(1 mark)

(c) Find the value of 5^{-2}

 **Video Solutions**

(1 mark)

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HOME

Number
Indices
Mixed

(b)	0.000 148	B1	for 0.000 148 oe	Can use standard form
(c)	$\frac{1}{25}$	B1	for $\frac{1}{25}$ or 0.04	

 **Video Solutions**



11 (a) Find the value of $\sqrt[4]{81 \times 10^8}$

(2 marks)

(b) Find the value of $64^{-\frac{1}{2}}$

(2 marks)

(c) Write $\frac{3^n}{9^{n-1}}$ as a power of 3

 **Video Solutions**

(2 marks)



Number
Indices
Mixed

11	(a)	300	M1	for working out $\sqrt[4]{81}$ as 3 or $\sqrt[4]{10^8}$ as 10^2 or 100	Mark may be awarded if operations are attempted on 8100000000 eg 3000000000
			A1	for 300 or 3×10^2 or 3×100	
	(b)	$\frac{1}{8}$	M1	for showing a square root of 64 as 8 or recognition of the reciprocal eg $\frac{1}{n}$ or shows expressions that show an understanding of the $\frac{1}{2}$ index and the minus index eg $\frac{1}{\sqrt{64}}$ or other equivalent forms	
			A1	oe	
	(c)	3^{2-n}	M1	for $3^{2(n-1)}$ or 3^{2n-2} or $(3^2)^{n-1}$	
			A1	for 3^{2-n} oe eg $3^{n-2(n-1)}$	
					Accept $\pm \frac{1}{8}$ oe



November 2021 Paper 1H (Non-Calc)

9 (a) Write down the value of 7^0

Number
Indices
Mixed

.....
(1)

(b) Find the value of $3 \times 3^6 \times 3^{-6}$

.....
(1)

(c) Find the value of 2^{-4}

.....
(1)

(d) Find the value of $27^{\frac{1}{3}}$

.....
(1)



Number
Indices
<i>Mixed</i>

9	(a)	1	B1	cao
	(b)	3	B1	cao
	(c)	$\frac{1}{16}$	B1	oe
	(d)	3	B1	cao



18 $16^{\frac{1}{5}} \times 2^x = 8^{\frac{3}{4}}$

Work out the exact value of x .

Number

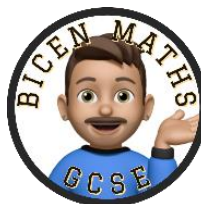
Indices

Matching the bases

 **Video Solutions**

(3 marks)

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HOME

Number
Indices
<i>Matching the bases</i>

18

1.45

P1

for converting to a common base with at least one correct conversion,
eg. $(16 =) 2^4$ or $(8 =) 2^3$

P1

(dep) for correct use of index laws to derive an equation, eg. $4 \times \frac{1}{5} + x = 3 \times \frac{3}{4}$ oe

A1

for 1.45 oe (accept $2^{1.45}$)
OR

P1

for a process to find the value of 2^x , eg. $8^{\frac{3}{4}} \div 16^{\frac{1}{5}} = 2.73\dots$

A2

for 1.45 oe (accept $2^{1.45}$)



19 Given that $9^{-\frac{1}{2}} = 27^{\frac{1}{4}} \div 3^{x+1}$
find the exact value of x .

Number

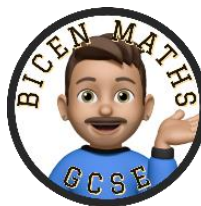
Indices

Matching the bases

 **Video Solutions**

(3 marks)

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HOME

Number
Indices
<i>Matching the bases</i>

19	$\frac{3}{4}$ oe	P1	for a first step to converting to a common base with one correct conversion, eg. $9^{-\frac{1}{2}} = 3^{-1}$ or $\frac{1}{3}$ or $27^{\frac{1}{4}} = 3^{\frac{3}{4}}$ oe	$9^{-\frac{1}{2}} = 3^{-1}$ (or $\frac{1}{3}$) oe or $27^{\frac{1}{4}} = 3^{\frac{3}{4}}$ oe seen alone gets the P1
		P1	(dep) for $3^{-1} = 3^{\frac{3}{4}} \div 3^{x+1}$ oe	
		A1	cao	



Number

Surds

Expanding and
Simplifying

Rationalising the
Denominator

Mixed Skills

Problem Solving



Number
Surds
<i>Expanding and simplifying</i>

13 $\sqrt{5}(\sqrt{8} + \sqrt{18})$ can be written in the form $a\sqrt{10}$ where a is an integer.
Find the value of a .

 **Video Solutions**

(3 marks)

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HOME

Number
Surds
<i>Expanding and simplifying</i>

13	5	M1	for $\sqrt{40}$ or $\sqrt{90}$ OR $2\sqrt{2}$ or $3\sqrt{2}$	
		M1	for $2\sqrt{10}$ or $3\sqrt{10}$ or $\sqrt{4} \times \sqrt{10}$ or $\sqrt{9} \times \sqrt{10}$ or $\sqrt{4 \times 10}$ or $\sqrt{9 \times 10}$ OR $2\sqrt{2} + 3\sqrt{2}$	
		A1	cao	Answer of $5\sqrt{10}$ from correct working gets M2 A0



21 Show that $\frac{6 - \sqrt{8}}{\sqrt{2} - 1}$ can be written in the form $a + b\sqrt{2}$ where a and b are integers.

Number

Surds

Rationalising the denominator

 **Video Solutions**

(3 marks)

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HOME

Number
Surds
<i>Rationalising the denominator</i>

21	$\frac{6-\sqrt{8}}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1}$ $\frac{6\sqrt{2}+6-\sqrt{8}\sqrt{2}-\sqrt{8}}{2-1}$ $=6\sqrt{2}+6-4-2\sqrt{2}$	$2+4\sqrt{2}$	M1 M1 A1	for correct first step eg multiplies numerator and denominator by $\sqrt{2}+1$ condone missing brackets (dep) for expansion of numerator with 4 terms correct with or without signs or 3 out of exactly 4 terms correct for $2+4\sqrt{2}$ oe or for stating $a=2$ and $b=4$
----	---	---------------	------------------------	---



20 Martin did this question.

Rationalise the denominator of $\frac{14}{2 + \sqrt{3}}$

Here is how he answered the question.

$$\begin{aligned}\frac{14}{2 + \sqrt{3}} &= \frac{14 \times (2 - \sqrt{3})}{(2 + \sqrt{3})(2 - \sqrt{3})} \\ &= \frac{28 - 14\sqrt{3}}{4 + 2\sqrt{3} - 2\sqrt{3} + 3} \\ &= \frac{28 - 14\sqrt{3}}{7} \\ &= 4 - 2\sqrt{3}\end{aligned}$$

Martin's answer is wrong.

(a) Find Martin's mistake. **(1 mark)**

Number

Surds

Rationalising the denominator

Sian did this question.

Rationalise the denominator of $\frac{5}{\sqrt{12}}$

Here is how she answered the question.

$$\begin{aligned}\frac{5}{\sqrt{12}} &= \frac{5\sqrt{12}}{\sqrt{12} \times \sqrt{12}} \\ &= \frac{5 \times 3\sqrt{2}}{12} \\ &= \frac{5\sqrt{2}}{4}\end{aligned}$$

Sian's answer is wrong.

(b) Find Sian's mistake. **(1 mark)**



Number
Surds
<i>Rationalising the denominator</i>

20	(a)	explanation	C1	for a correct explanation, eg $\sqrt{3} \times -\sqrt{3} = -3$, not 3
	(b)	explanation	C1	for correct explanation, eg $\sqrt{12} = 2\sqrt{3}$, not $3\sqrt{2}$



Number
Surds
<i>Rationalising the denominator</i>

20 Show that $\frac{(\sqrt{18} + \sqrt{2})^2}{\sqrt{8} - 2}$ can be written in the form $a(b + \sqrt{2})$ where a and b are integers.

 **Video Solutions**

(3 marks)

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Number
Surds
<i>Rationalising the denominator</i>

20	fully correct working leading to $16(1+\sqrt{2})$	C1	for expanding the numerator, eg $18 + 2\sqrt{2}\sqrt{18} + 2$ or $\sqrt{324} + \sqrt{36} + \sqrt{36} + \sqrt{4}$ (= 32) or for simplifying $\sqrt{18}$, eg. $\sqrt{18} = 3\sqrt{2}$ or $\sqrt{18} + \sqrt{2} = 4\sqrt{2}$	Expanded terms need not be simplified
		C1	(indep) for method to rationalise the denominator, eg. $\frac{\text{"numerator"}}{\sqrt{8}-2} \times \frac{\sqrt{8}+2}{\sqrt{8}+2}$	
		C1	for fully correct working leading to $16(1+\sqrt{2})$	Accept $a = 16, b = 1$



Number
Surds
<i>Rationalising the denominator</i>

16 (a) Rationalise the denominator of $\frac{22}{\sqrt{11}}$

Give your answer in its simplest form.

(2 marks)

(b) Show that $\frac{\sqrt{3}}{2\sqrt{3}-1}$ can be written in the form $\frac{a+\sqrt{3}}{b}$ where a and b are integers. (2)

 **Video Solutions**

(3 marks)



Number
Surds
<i>Rationalising the denominator</i>

16	(a)	$2\sqrt{11}$	M1	for method to multiply numerator and denominator by $\sqrt{11}$ or a multiple of $\sqrt{11}$, eg $\frac{22}{\sqrt{11}} \times \frac{\sqrt{11}}{\sqrt{11}}$
			A1	for $2\sqrt{11}$
	(b)	$\frac{6 + \sqrt{3}}{11}$	M1	for method to multiply numerator and denominator by $2\sqrt{3} + 1$ or a multiple of $2\sqrt{3} + 1$, eg $\frac{\sqrt{3}}{2\sqrt{3} - 1} \times \frac{2\sqrt{3} + 1}{2\sqrt{3} + 1}$
			M1	(dep) for $\sqrt{3} \times 2\sqrt{3} = 6$ or $2\sqrt{3} \times 2\sqrt{3} = 12$
			A1	for $\frac{6 + \sqrt{3}}{11}$ (accept $a = 6$ and $b = 11$)



19 Show that $\frac{8 + \sqrt{12}}{5 + \sqrt{3}}$ can be written in the form $\frac{a + \sqrt{3}}{b}$, where a and b are integers.

Number

Surds

Rationalising the denominator

(4 marks)



HOME

Number
Surds
<i>Rationalising the denominator</i>

19	Result shown	M1	(indep) for writing $\sqrt{12}$ as $2\sqrt{3}$	This mark can be awarded whenever this is seen, which might be later in the process.
		M1	for method to rationalise the denominator eg $\frac{8+\sqrt{12}}{5+\sqrt{3}} \times \frac{5-\sqrt{3}}{5-\sqrt{3}}$ or $\frac{8+2\sqrt{3}}{5+\sqrt{3}} \times \frac{5-\sqrt{3}}{5-\sqrt{3}}$ oe	
		M1	(dep on previous M1) for expanding terms, condone one error in numerator or denominator eg $\frac{40-8\sqrt{3}+5\sqrt{12}-\sqrt{12}\sqrt{3}}{25-5\sqrt{3}+5\sqrt{3}-\sqrt{3}\sqrt{3}}$ or $\frac{40-8\sqrt{3}+10\sqrt{3}-2\sqrt{3}\sqrt{3}}{25-5\sqrt{3}+5\sqrt{3}-\sqrt{3}\sqrt{3}}$ or $\frac{34+2\sqrt{3}}{22}$ oe	
		A1	for a complete chain of reasoning leading to $\frac{17+\sqrt{3}}{11}$	



Summer 2019 Paper 1H (Non-Calc)

Number
Surds
Mixed

18 (a) Express $\sqrt{3} + \sqrt{12}$ in the form $a\sqrt{3}$ where a is an integer.

(2 marks)

(b) Express $\left(\frac{1}{\sqrt{3}}\right)^7$ in the form $\frac{\sqrt{b}}{c}$ where b and c are integers.

 **Video Solutions**

(3 marks)



Number
Surds
Mixed

18	(a)	$3\sqrt{3}$	M1	for working unambiguously with $\sqrt{12}$, eg $\sqrt{4 \times 3}$ or $\sqrt{4} \times \sqrt{3}$ or $2\sqrt{3}$	May be seen as the first step
			A1	cao	
	(b)	$\frac{\sqrt{3}}{81}$	M1	for simplifying the power eg $(\sqrt{3})^7 = 27\sqrt{3}$	
			M1	for method to rationalise the denominator eg multiplying by $\frac{\sqrt{3}}{\sqrt{3}}$	
			A1	for $\frac{\sqrt{3}}{81}$ or equivalent fraction in form $\frac{\sqrt{b}}{c}$, eg $\frac{\sqrt{2187}}{2187}$	



Number
Surds
Mixed

20 Show that $\frac{\sqrt{180} - 2\sqrt{5}}{5\sqrt{5} - 5}$ can be written in the form $a + \frac{\sqrt{5}}{b}$ where a and b are integers.

 **Video Solutions**

(4 marks)



Number
Surds
Mixed

20	$1 + \frac{\sqrt{5}}{5}$	P1 for writing $\sqrt{180}$ as $6\sqrt{5}$ P1 for process to rationalising the denominator eg $\frac{\sqrt{180} - 2\sqrt{5}}{5\sqrt{5} - 5} \times \frac{5\sqrt{5} + 5}{5\sqrt{5} + 5}$ or $\frac{4\sqrt{5}}{5\sqrt{5} - 5} \times \frac{5\sqrt{5} + 5}{5\sqrt{5} + 5}$ oe P1 (dep on previous P1) for expanding terms eg $\frac{5\sqrt{5}\sqrt{180} + 5\sqrt{180} - 50 - 10\sqrt{5}}{125 - 25}$ or $\frac{100 + 20\sqrt{5}}{100}$ oe A1 for $1 + \frac{\sqrt{5}}{5}$	This process mark can be awarded whenever this is seen, which might be later in the process. Accept written as $a = 1, b = 5$
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23 S is a geometric sequence.

- (a) Given that $(\sqrt{x} - 1)$, 1 and $(\sqrt{x} + 1)$ are the first three terms of S, find the value of x .
You must show all your working.

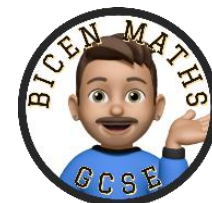
(3 marks)

- (b) Show that the 5th term of S is $7 + 5\sqrt{2}$

 **Video Solutions**

(2 marks)

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Number
Surds
... with geometric sequences

23 (a)		2	M1	for start to express the common ratio algebraically, eg $1/(\sqrt{x} - 1)$ or $(\sqrt{x} + 1)/1$ or $\sqrt{x} + 1 = k \times 1$ or $1 = k \times (\sqrt{x} - 1)$
			M1	for setting up an appropriate equation in x , eg $1/(\sqrt{x} - 1) = (\sqrt{x} + 1)/1$
			C1	for convincing argument to show $x = 2$
(b)		Shown	M1	for expressing the relationship between the common ratio, one of the first three terms of the sequence and the fifth term, eg 5 th term = 3 rd term $\times$ (common ratio) ²
			C1	for a complete explanation to include eg, $(\sqrt{2} + 1)(\sqrt{2} + 1)^2 = 7 + 5\sqrt{2}$



Number

Standard Form

Writing, comparing,
ordering

Multiplying and
Dividing

Mixed Calculations

Substitution



8 (a) Write 0.00562 in standard form.

(1 mark)

(b) Write 1.452×10^3 as an ordinary number.

(1 mark)

Number
Standard Form
<i>Writing, comparing</i>



 **Video Solutions**

Number
Standard Form
<i>Writing, comparing</i>

8	(a)	5.62×10^{-3}	B1	cao
	(b)	1452	B1	cao

 **Video Solutions**



November 2019 Paper 3H (Calc)

7 (a) Write 32 460 000 in standard form.

Number
Standard Form
<i>Writing, comparing</i>

(1 mark)

(b) Write 4.96×10^{-3} as an ordinary number.

(1 mark)

Asma was asked to compare the following two numbers.

$$A = 6.212 \times 10^8 \quad \text{and} \quad B = 4.73 \times 10^9$$

She says,

“6.212 is bigger than 4.73 so A is bigger than B .”

(c) Is Asma correct?

You must give a reason for your answer.



Video Solutions

(1 mark)



Number
Standard Form
Writing, comparing

7	(a)	3.246×10^7	B1	cao	
	(b)	0.00496	B1	cao	
	(c)	No with explanation	C1	No and explanation that B is bigger as the power of 10 is bigger. Acceptable examples She is incorrect as 10^8 is smaller than 10^9 No, because B has more digits than A No, A is millions but B is billions No, if you subtract A from B the answer is positive (but if you subtract B from A the answer is negative) A= 621200000, B=4730000000, B is bigger No because she did not take into account standard form No as when you find the ordinary number B is greater than A Not acceptable examples Yes... A = 5 zeros after the number where as B = 7 zeros after the number No as 4.73×10^9 is one more than 6.212×10^8 6.212 is to the power of 8 and 4.73 is to the power of 9 so there is an extra digit Asma is wrong because she has more numbers behind the decimal point which means that it will be bigger than A No B has more zeros	Decision eg “No” may be seen by the question. “She is incorrect” is equivalent to “no”



Number
Standard Form
<i>Ordering Numbers</i>

9 Write these numbers in order of size.
Start with the smallest number.

6.72×10^5

67.2×10^{-4}

672×10^4

0.000 672

 **Video Solutions**

(2 marks)



Number
Standard Form
Ordering Numbers

9	0.000 672, 67.2×10^{-4} 6.72×10^5 672×10^4	B2 (B1	cao for correct conversions to same format, condoning one error or for 3 numbers in the correct order (ignoring one) or for all 4 numbers listed in reverse order)	Accept correct numbers in any form
---	--	---------------	---	------------------------------------

 **Video Solutions**

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HOME

Number
Standard Form
<i>Multiplying/Dividing</i>

8 (a) Write 7.97×10^{-6} as an ordinary number.

.....
(1)

(b) Work out the value of $(2.52 \times 10^5) \div (4 \times 10^{-3})$
Give your answer in standard form.

.....
(2)

 **Video Solutions**



Summer 2017 Paper 1H (Non-Calc)

Number
Standard Form
<i>Multiplying/Dividing</i>

8	(a)		0.00000797	B1	cao
	(b)		6.3×10^7	M1	for partial calculation involving powers of 10 e.g. $0.63 \times 10^{5-3}$ or 6.3×10^n where $n \neq 7$ or for $n \times 10^8$ or for 63000000
				A1	cao

 **Video Solutions**

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  **HOME**

- 7 Work out $(13.8 \times 10^7) \times (5.4 \times 10^{-12})$
Give your answer as an ordinary number.

Number

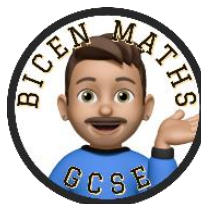
Standard Form

Multiplying/Dividing

 **Video Solutions**

(2 marks)

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HOME

Number
Standard Form
<i>Multiplying/Dividing</i>

7		0.000 745 2	M1	digits 7452 seen
			A1	cao

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HOME

- 7 Work out $(3.42 \times 10^{-7}) \div (7.5 \times 10^{-6})$
Give your answer in standard form.

Number

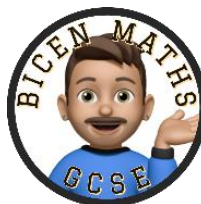
Standard Form

Multiplying/Dividing

 **Video Solutions**

(2 marks)

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HOME

Number
Standard Form
<i>Multiplying/Dividing</i>

7

4.56×10^{-2}

M1 for 0.000000342 ÷ 0.0000075
OR for 0.0456 oe eg 0.456×10^{-1} **or** 45.6×10^{-3} **or** $\frac{57}{1250}$
OR for an answer of 4.56×10^n

A1
cao

 **Video Solutions**



Summer 2017 Paper 2H (Calc)

Number
Standard Form
Calculations

10 The table shows some information about eight planets.

Planet	Distance from Earth (km)	Mass (kg)
Earth	0	5.97×10^{24}
Jupiter	6.29×10^8	1.898×10^{27}
Mars	7.83×10^7	6.42×10^{23}
Mercury	9.17×10^7	3.302×10^{23}
Neptune	4.35×10^9	1.024×10^{26}
Saturn	1.28×10^9	5.68×10^{26}
Uranus	2.72×10^9	8.683×10^{25}
Venus	4.14×10^7	4.869×10^{24}

(a) Write down the name of the planet with the greatest mass.

(1 mark)

(b) Find the difference between the mass of Venus and the mass of Mercury.

(1 mark)

Nishat says that Neptune is over a hundred times further away from Earth than Venus is.

(c) Is Nishat right?

You must show how you get your answer.

 **Video Solutions**

(2 marks)



Number
Standard Form
Calculations

10	(a)	Jupiter	B1	for Jupiter (accept 1.898×10^{27})
	(b)	4.5388×10^{24}	B1	for 4.5388×10^{24} oe (e.g. 45.388×10^{23})
	(c)	Yes (supported)	M1	for $(4.35 \times 10^9) \div (4.14 \times 10^7)$ (= 105(.07..)) or $(4.14 \times 10^7) \times 100$ (= 4.14×10^9) or $(4.35 \times 10^9) \div 100$ (= 4.35×10^7)
			A1	for Yes with correct supporting evidence



Number
Standard Form
Calculations

7 (a) Write the number 0.000 086 23 in standard form.

(1 mark)

(b) Work out $\frac{3.2 \times 10^3 + 5.1 \times 10^{-2}}{4.3 \times 10^{-4}}$

Give your answer in standard form, correct to 3 significant figures.

(2 marks)



 **Video Solutions**



Number
Standard Form
Calculations

7	(a)	8.623×10^{-5}	B1	cao	
	(b)	7.44×10^6	M1	for $\frac{3200 + 0.051}{0.00043}$ or $\frac{3200.051}{0.00043}$ or performs an operation eg shows 163.2, 7441860.5, 118.6(...) or an answer or $7.44(\dots) \times 10^n$ where $n \neq 6$ or 7441979(...) or an answer of 7.4×10^6	7441979.0689...
			A1	for $7.44(1979\dots) \times 10^6$	If a correct answer is shown in working and then rounded incorrectly, award full marks. Answer need only be given correctly to 3 sig fig; if following digits are incorrect ignore them.



Summer 2019 Paper 3H (Calc)

Number
Standard Form
Calculations

11 In May 2019, the distance between Earth and Mars was 3.9×10^7 km.

In May 2019, a signal was sent from Earth to Mars.
Assuming that the signal sent from Earth to Mars travelled at a speed of 3×10^5 km per second,

(a) how long did the signal take to get to Mars?

(2 marks)

The speed of the signal sent from Earth to Mars in May 2019 was actually less than 3×10^5 km per second.

(b) How will this affect your answer to part (a)?



 **Video Solutions**

(1 mark)

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HOME

Number
Standard Form
Calculations

11	(a)	130	P1	for process to divide eg $(3.9 \times 10^7) \div (3 \times 10^5)$	Condone missing brackets
			A1	cao	Accept 1.3×10^2
	(b)	Explanation	C1	Explanation referring to the time Acceptable examples The time will be more It will take longer The answer will be bigger Not acceptable examples The answer will be wrong The answer will be different	



Summer 2020 Paper 3H (Calc)

Number
Standard Form
Calculations

- 10 A person’s heart beats approximately 10^5 times each day.
A person lives for approximately 81 years.
- (a) Work out an estimate for the number of times a person’s heart beats in their lifetime.
Give your answer in standard form correct to 2 significant figures.

(2 marks)

2×10^{12} red blood cells have a total mass of 90 grams.

- (b) Work out the average mass of 1 red blood cell.
Give your answer in standard form.



 **Video Solutions**

(2 marks)



Number
Standard Form
Calculations

10	(a)	3.0×10^9	P1	for correct process, eg $10^5 \times 365 \times 81$ or for a correct answer not written in standard form, eg 2956500000 or $2.9(565) \times 10^n$ where $n \neq 9$ oe	Values may be rounded. Allow 350, 360, 366, 370, 400 and 80, 100
			A1	for an answer in the range 2.8×10^9 to 4.0×10^9	
	(b)	4.5×10^{-11}	P1	for correct process, eg $\frac{90}{2 \times 10^{12}}$ or for correct answer not written in standard form, eg 45×10^{-12} or 0.45×10^{-10} or 4.5×10^n where $n \neq -11$	Allow $90 \div 2 \times 10^{12}$
			A1	cao	



November 2021 Paper 3H (Calc)

Number
Standard Form
Calculations

3 (a) Write 4.5×10^5 as an ordinary number.

.....
(1)

(b) Write 0.007 in standard form.

.....
(1)

(c) Work out $4.2 \times 10^3 + 5.3 \times 10^2$
Give your answer in standard form.

.....
(2)



 **Video Solutions**

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Number
Standard Form
Calculations

3	(a)	450 000	B1	cao
	(b)	7×10^{-3}	B1	cao
	(c)	4.73×10^3	M1 A1	for 4730 oe or for 4.73×10^n where $n \neq 3$ cao



Summer 2018 Paper 3H (Calc)

9 $T = \sqrt{\frac{w}{d^3}}$

$w = 5.6 \times 10^{-5}$
 $d = 1.4 \times 10^{-4}$

- (a) Work out the value of T .
Give your answer in standard form correct to 3 significant figures.

(2 marks)

w is increased by 10%
 d is increased by 5%

Lottie says,
“The value of T will increase because both w and d are increased.”

- (b) Lottie is wrong.
Explain why.

Number
Standard Form
<i>Substitution</i>

 **Video Solutions**

(2 marks)



Number
Standard Form
Substitution

9	(a)	4.52×10^3	M1	for $2.04\dots \times 10^7$ oe eg $2.04\dots \times 10^{-5} \div 10^{-12}$ or $20.4\dots \times 10^6$ or 204(08163.27) or for correct value of T , 4517.(53....), not written in standard form, eg 4520	May be given correct to 3 sig figs or more
			A1	for answer in the range 4.51×10^3 to 4.52×10^3 (SC B1 for $6.32\dots \times 10^{-1}$)	
	(b)	Explanation	M1	for method to find the scale factor or decreased value in T , eg $\sqrt{\frac{1.1}{1.05^3}}$ (= 0.97.....) oe or $\sqrt{\frac{5.6 \times 10^{-5} \times 1.1}{(1.4 \times 10^{-4} \times 1.05)^3}}$ (= $4.40\dots \times 10^3$) oe	Award mark for a correct method to calculate the scale factor or the percentage increases in w and d^3 or the decreased value of T
			C1	(dep M1) for explanation eg value of scale factor less than 1, so a decrease in T OR compares $4.40\dots \times 10^3$ with their value of T from (a) provided answer to (a) is greater	This mark may only be awarded if supported by numerical evidence



Algebra

Indices



Algebra
Indices

1 (a) Simplify $m^3 \times m^4$

.....
(1)

(b) Simplify $(5np^3)^3$

.....
(2)

(c) Simplify $\frac{32q^9r^4}{4q^3r}$

.....
(2)



 **Video Solutions**

Algebra
Indices

1	(a)	m^7	B1	cao
	(b)	$125n^3p^9$	B2	cao
			(B1	for 2 of 3 terms correct in a single product)
	(c)	$8q^6r^3$	B2	cao
			(B1	for 2 of 3 terms correct in a single product)

Allow multiplication signs

$125n^3p^x$ or $125n^xp^9$ where $x \neq 0$ or an^3p^9 where a is a number

Allow multiplication signs

$8q^6r^x$ or $8q^xr^3$ where $x \neq 0$ or aq^6r^3 where a is a number



$$\frac{y^4 \times y^n}{y^2} = y^{-3}$$

9 (b) Find the value of n .

 **Video Solutions**

(2 marks)

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(b)		-5		M1		for beginning to combine indices eg $4+n$ or y^{-3+2}
				A1		
						cao

10 (a) Simplify $\frac{x-1}{5(x-1)^2}$

 **Video Solutions**

(1 mark)

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10	(a)	$\frac{1}{5(x-1)}$	B1	for $\frac{1}{5(x-1)}$ or $\frac{1}{5x-5}$
----	-----	--------------------	----	--

10 (b) Simplify $\frac{4(y+3)^3}{(y+3)^2}$

 **Video Solutions**

(1 mark)

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HOME

$$(b) \quad \left| \quad 4(y + 3) \quad \right| \text{B1} \quad \left| \quad 4(y + 3) \text{ or } 4y + 12 \quad \right|$$

7 (a) Simplify $(p^2)^5$

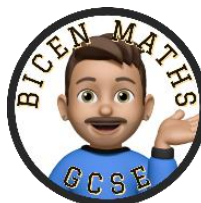
(1 mark)

(b) Simplify $12x^7y^3 \div 6x^3y$

(2 marks)

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Algebra
Indices

7	(a)	p^{10}	B1	cao
	(b)	$2x^4y^2$	M1	for any two of $12 \div 6 (= 2)$, $x^{7-3} (= x^4)$, $y^{3-1} (= y^2)$ in a single product or written as a fraction with complete and correct cancelling of at least two terms
			A1	cao

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10 (a) Simplify $\left(\frac{1}{m^2}\right)^0$ (1 mark)

(b) Simplify $\frac{8(x-4)}{(x-4)^2}$ (1 mark)

(c) Simplify $(3n^4w^2)^3$ (2 marks)

 **Video Solutions**



Algebra
Indices

10	(a)	1	B1	cao
	(b)	$\frac{8}{x-4}$	B1	cao
	(c)	$27n^{12}w^6$	B2	cao
			(B1	for two of 27, n^{12} , w^6 in a product)

 **Video Solutions**



Summer 2020 Paper 3H (Calc)

Algebra

Indices

1 (a) Simplify $n^3 \times n^5$

(1 mark)

(b) Simplify $\frac{c^3d^4}{c^2d}$

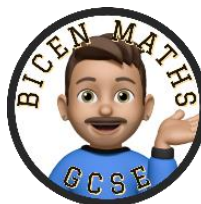
(2 marks)

(c) Solve $\frac{5x}{2} > 7$

(2 marks)

 **Video Solutions**

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Algebra
Indices

1	(a)	n^8	B1	cao	
	(b)	cd^3	M1	for partial simplification, eg c or d^3	May be seen as simplification in original fraction
			A1	for cd^3	Accept c^1d^3
	(c)	$x > \frac{14}{5}$	M1	for $5x > 14$ or $5x = 14$ or critical value, $\frac{14}{5}$ oe	Must see carried out correctly, ie at least $5x > 7 \times 2$ not just intention seen.
			A1	$x > \frac{14}{5}$ or $x > 2\frac{4}{5}$ or $x > 2.8$	Allow other signs for this mark.



12 $(ax^6)^{\frac{1}{n}} = 7x^3$

Work out the value of a and the value of n .

12

49, 2

P1

for setting up $6 \div n = 3$ oe **or** $7^n = a$ oe **or** one correct answer

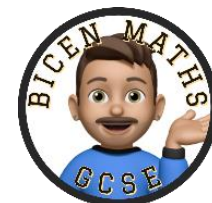
A1

cao

Accept the figures written as a complete statement
eg $(49x^6)^{\frac{1}{2}}$

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HOME

Algebra

Expanding

Single Brackets

Double Brackets

Triple Brackets

Expanding brackets is often tested with other topics, and not usually in stand alone questions



2 Expand and simplify $5(p + 3) - 2(1 - 2p)$

 **Video Solutions**

(2 marks)

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HOME

2	$9p + 13$	M1	for method to expand one bracket, eg $5 \times p + 5 \times 3 (= 5p + 15)$ or $2 \times 1 - 2 \times 2p (= 2 - 4p)$ or $-2 \times 1 - 2 \times -2p (= -2 + 4p)$	If an attempt is made to multiply by -2 in the second brackets then it must be done consistently.
		A1	cao	



1 (a) Expand and simplify $(x + 5)(x - 9)$

 **Video Solutions**

(2 marks)

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Algebra
Expanding
<i>Double Brackets</i>

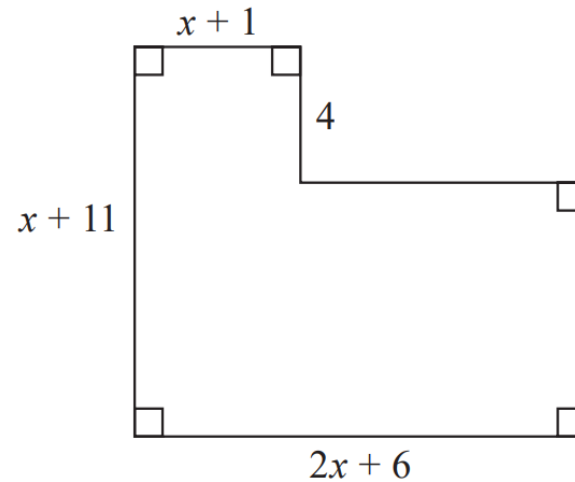
1	(a)	$x^2 - 4x - 45$	M1	for 3 of 4 terms correct or 4 terms correct ignoring signs	3 terms correct can be implied, eg $x^2 - 4x + c$
			A1	cao	



November 2021 Paper 1H (Non-Calc)

Algebra
Expanding
<i>Double Brackets, with context</i>

14 Here is a shape with all its measurements in centimetres.



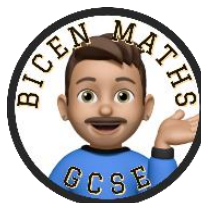
The area of the shape is $A \text{ cm}^2$

Show that $A = 2x^2 + 24x + 46$

 **Video Solutions**

(3 marks)

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  **HOME**

14	Shown	M1	for a start to the method, eg finds one correct area $4(x + 1)$ or $(x + 7)(2x + 6)$ or $(x + 1)(x + 11)$ or $(x + 7)(x + 5)$ or $4(x + 5)$ or $(x + 11)(2x + 6)$	
		M1	for a complete expression for the total area, eg $4(x + 1) + (x + 7)(2x + 6)$ or $4x + 4 + 2x^2 + 14x + 6x + 42$ OR $(x + 1)(x + 11) + (x + 7)(x + 5)$ or $x^2 + x + 11x + 11 + x^2 + 7x + 5x + 35$ OR $(x + 11)(2x + 6) - 4(x + 5)$ or $2x^2 + 22x + 6x + 66 - 4x - 20$	
		A1	for a complete chain of reasoning with fully correct algebra leading to $2x^2 + 24x + 46$	$2x^2 + 24x + 46$ is given so need to see brackets expanded correctly



Summer 2017 Paper 1H (Non-Calc)

Algebra

Expanding

Triple Brackets

- 10 Show that $(x + 1)(x + 2)(x + 3)$ can be written in the form $ax^3 + bx^2 + cx + d$ where a , b , c and d are positive integers.

 **Video Solutions**

(3 marks)

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HOME

Algebra
Expanding
Triple Brackets

10

$\begin{array}{r} x^3+6x^2+11x+6 \end{array}$	M1	for method to find the product of any two linear expressions (3 correct terms) e.g. $x^2+x+2x+2$ or $x^2+2x+3x+6$ or $x^2+x+3x+3$
	M1	for method of multiplying out remaining products, half of which are correct (ft their first product) e.g. $x^3+x^2+2x^2+3x^2+2x+3x+6x+6$
	A1	cao

 **Video Solutions**



9 (a) Expand and simplify $(x - 2)(2x + 3)(x + 1)$

Algebra

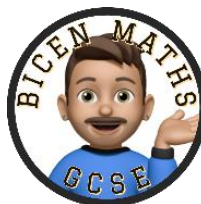
Expanding

Triple Brackets

 **Video Solutions**

(3 marks)

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HOME

Algebra
Expanding
Triple Brackets

9	(a)	$2x^3 + x^2 - 7x - 6$	M1	for a method to find the product of two linear expressions eg 3 correct terms out of 4 terms or 4 terms ignoring signs	Note that (eg) $-x - 6$ in expansion of $(x - 2)(2x + 3)$ is to be regarded as 3 correct terms.
			M1	for a complete method to obtain all terms, half of which are correct (ft their first product) eg $2x^3 - x^2 - 6x + 2x^2 - x - 6$	First product must be quadratic but need not be simplified or may be simplified incorrectly
			A1	cao	

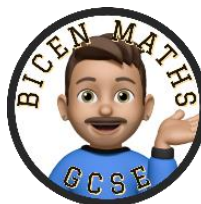


- 18 (a) Show that $(2x + 1)(x + 3)(3x + 7)$ can be written in the form $ax^3 + bx^2 + cx + d$ where a , b , c and d are integers.

 **Video Solutions**

(3 marks)

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Algebra
Expanding
Triple Brackets

18	(a)	$6x^3 + 35x^2 + 58x + 21$	M1	for a method to find the product of two linear expressions, 3 correct terms out of 4 terms e.g. $2x^2 + x + 6x + 3$ or $3x^2 + 7x + 9x + 21$ or $6x^2 + 14x + 3x + 7$	Note that, for example, $7x + 3$ is regarded as three terms in the expansion of $(2x + 1)(x + 3)$
			M1	for a complete method to obtain all terms, at least half of which are correct (ft their first product) e.g. $6x^3 + 32x^2 + 42x + 3x^2 + 16x + 21$	First product must be a 3 or 4 term quadratic but need not be simplified or may be simplified incorrectly
			A1	cao	Accept $a = 6, b = 35, c = 58, d = 21$

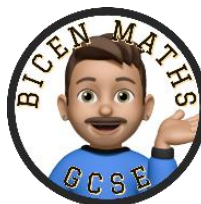


15 Expand and simplify $(3x + 2)(2x + 1)(x - 5)$

 **Video Solutions**

(3 marks)

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Algebra
Expanding
Triple Brackets

15	$6x^3 - 23x^2 - 33x - 10$	M1	for method to find the product of any two linear expressions (3 out of no more than 4 terms correct with correct signs or 4 correct terms ignoring signs)	Note that, for example, $6x^2 + 7x$ or $7x + 2$ are regarded as three terms in the expansion of $(3x + 2)(2x + 1)$ First product must be quadratic but need not be simplified or may be simplified incorrectly
		M1	for method of multiplying out remaining products, half of which are correct (ft their first product)	
		A1	cao	



12 (b) Expand and simplify $(x - 3)(2x + 3)(4x + 5)$

 **Video Solutions**

(3 marks)

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Algebra
Expanding
Triple Brackets

(b)	$8x^3 - 2x^2 - 51x - 45$	M1	for method to find the product of two linear expressions, eg 3 correct terms out of 4 terms or 4 terms ignoring signs
		M1	for a complete method to obtain all terms, half of which are correct (ft their first product) eg $8x^3 - 12x^2 - 15x + 10x^2 - 36x - 45$
		A1	cao.

Note that, for example, $-3x - 9$ in expansion of $(x - 3)(2x + 3)$ is to be regarded as 3 correct terms.

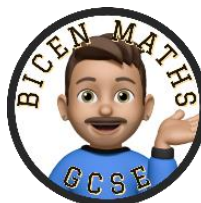
First product must be quadratic with at least 3 terms but need not be simplified or may be simplified incorrectly



12 Expand and simplify $(x - 2)(3x + 2)(2x + 3)$

 **Video Solutions**

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HOME

12	$6x^3 + x^2 - 20x - 12$	M1	for method to find the product of any two linear expressions (3 out of no more than 4 terms correct with correct signs or 4 correct terms ignoring signs), eg. $6x^2 + 9x + 4x + 6$ or $3x^2 + 2x - 6x - 4$ or $2x^2 + 3x - 4x - 6$	Note that, for example, $6x^2 + 13x$ or $13x + 6$ are regarded as three terms in the expansion of $(x - 2)(3x + 2)$ First product must be quadratic but need not be simplified or may be simplified incorrectly.
		M1	for method of multiplying out remaining products, half of which are correct (ft their first product), eg. $6x^3 + 13x^2 - 12x^2 + 6x - 26x - 12$	
		A1	cao	



Algebra

Factorising

Single Brackets

Common Bracket

Difference of Two
Squares

Factorising is often tested with other topics, and not usually in stand alone questions



10 (b) Factorise fully $50 - 2y^2$

Algebra

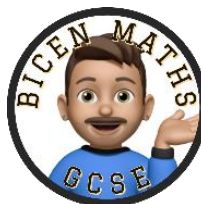
Factorising

*Single bracket (uses
difference of two
squares)*

 **Video Solutions**

(2 marks)

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HOME

Algebra
Factorising
<i>Single bracket (uses difference of two squares)</i>

(b)	$2(5 + y)(5 - y)$	M1	for partial factorisation, eg $2(25 - y^2)$ oe or $(10 + 2y)(5 - y)$ oe or $(5 + y)(10 - 2y)$ oe or $-2(y^2 - 25)$ oe
		A1	for $2(5 + y)(5 - y)$ or $-2(5 + y)(y - 5)$



1 Factorise fully $9x^2 + 6x$

Algebra

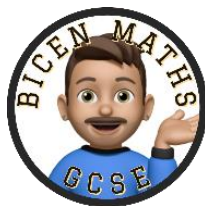
Factorising

Single bracket

 **Video Solutions**

(2 marks)

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HOME

Algebra
Factorising
<i>Single bracket</i>

(b)	$3x(3x + 2)$	B2	for $3x(3x + 2)$
		(B1	for $3(3x^2 + 2x)$ or $x(9x + 6)$ or $3x(ax + b)$ where a and b are integers or $(3x + 2)$ as a factor)

 **Video Solutions**



13 (b) Factorise $(x + y)^2 + 3(x + y)$

Algebra

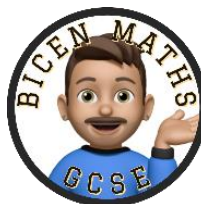
Factorising

Common bracket

 **Video Solutions**

(1 mark)

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$$(b) \quad (x + y)(x + y + 3) \quad B1 \quad cao$$

Summer 2018 Paper 1H (Non-Calc)

Algebra
Factorising
<i>Difference of two squares</i>

15 (a) Factorise $a^2 - b^2$

(1 mark)

(b) Hence, or otherwise, simplify fully $(x^2 + 4)^2 - (x^2 - 2)^2$

 **Video Solutions**

(3 marks)

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HOME

Algebra
Factorising
<i>Difference of two squares</i>

15	(a)	$(a - b)(a + b)$	B1	cao	Accept reversed brackets
	(b)	$12(x^2 + 1)$	M1	for using ' a ' = $x^2 + 4$ and ' b ' = $x^2 - 2$ OR multiplying out both brackets, at least one fully correct	Correct 4 terms if not simplified or 3 terms if simplified
			M1	(dep) for a correct expression for (' a ' + ' b ')('' a ' - ' b '') with no additional brackets, simplified or unsimplified eg $(x^2 + 4 + x^2 - 2)(x^2 + 4 - x^2 + 2)$ or $(2x^2 + 2) \times 6$ OR ft for a correct expression without brackets, simplified or unsimplified eg $x^4 + 8x^2 + 16 - x^4 + 4x^2 - 4$	
			A1	for $12(x^2 + 1)$ or $12x^2 + 12$ oe	



Algebra

Changing the Subject

Variable appears
once

Variable appears
twice



November 2018 Paper 1H (Non-Calc)

2 $v^2 = u^2 + 2as$

$u = 12$ $a = -3$ $s = 18$

(a) Work out a value of v .

(2 marks)

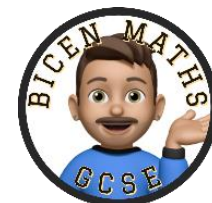
(b) Make s the subject of $v^2 = u^2 + 2as$

Algebra
Changing the Subject
<i>Variable appears once</i>

 **Video Solutions**

(2 marks)

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2	(a)	6 or -6	M1	for $12^2 + 2 \times -3 \times 18 (= 36)$	Terms may be partially evaluated. Only one value is required for full marks Must see this step carried out, not just the intention shown
			A1	for 6 or -6, accept ± 6	
	(b)	$s = \frac{v^2 - u^2}{2a}$	M1	for subtracting u^2 from both sides or dividing all terms by $2a$ as the first step	
			A1	$s = \frac{v^2 - u^2}{2a}$ oe	



10 Make k the subject of the formula $y = \sqrt{2m - k}$

 **Video Solutions**

(2 marks)

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10

$$k = 2m - y^2$$

M1

correct first step of showing an intention to square both sides with no algebraic ambiguity in any resulting statements,
eg $y^2 = 2m - k$

A1

for $k = 2m - y^2$



12 $T = \frac{q}{2} + 5$

Here is Spencer's method to make q the subject of the formula.

$$2 \times T = q + 5$$

$$q = 2T - 5$$

What mistake did Spencer make in the first line of his method?

Algebra

Changing the Subject

*Variable appears
once*

 **Video Solutions**

(1 mark)

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12	Mistake identified	C1	for a correct mistake identified Acceptable examples all three terms should be multiplied by 2 and not just two of them the 5 should be multiplied by 2 it should be $2 \times T = q + 2 \times 5$ should subtract 5 first (before multiplying by 2) Not acceptable examples Should remove the 5 first $2 \times T$ should be $2T$ should have got rid of the denominator	Accept answers showing a correct first step
----	--------------------	----	--	---



14 (b) Make v the subject of the formula $w = \frac{15(t - 2v)}{v}$

 **Video Solutions**

(3 marks)

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Algebra
Changing the Subject
<i>Variable appears twice</i>

(b)	$v = \frac{15t}{w + 30}$	M1 M1 A1	A correct step towards solution e.g. expanding brackets to get $15t - 30v$ or multiply both sides by v For a method to rearrange the formula to isolate terms in v eg $vw + 30v = 15t$ oe
-----	--------------------------	----------------	---



 **Video Solutions**



15 Make m the subject of the formula $f = \frac{3m + 4}{m - 1}$

Algebra

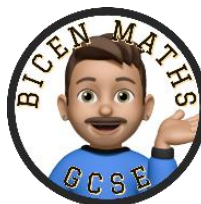
Changing the Subject

*Variable appears
twice*

 **Video Solutions**

(3 marks)

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15	$m = \frac{f+4}{f-3}$	M1	for multiplying both sides by $m - 1$, eg. $f(m - 1) = 3m + 4$	Condone missing brackets for this mark only
		M1	(dep) for a method to rearrange the formula to isolate terms in m in a correct equation, eg. $fm - 3m = f + 4$ or $-fm + 3m = -f - 4$	
		A1	for $m = \frac{f+4}{f-3}$ oe, eg $m = \frac{-f-4}{-f+3}$	



17 Make f the subject of the formula $d = \frac{3(1 - f)}{f - 4}$

 **Video Solutions**

(4 marks)

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HOME

17	$f = \frac{4d + 3}{d + 3}$	M1	for clearing the fraction eg $d(f - 4) = 3(1 - f)$ or $df - 4d = 3 - 3f$	Condone error in expansion of RHS for this mark
		M1	(dep M1) for isolating f terms in a correct equation eg $df + 3f = 3 + 4d$	
		M1	(dep on two terms in f) for factorising eg $f(d + 3) = 3 + 4d$	
		A1	oe	



14 The ratio $(y + x) : (y - x)$ is equivalent to $k : 1$

Show that $y = \frac{x(k + 1)}{k - 1}$

 **Video Solutions**

(3 marks)

Find video solutions and more...  **YouTube**
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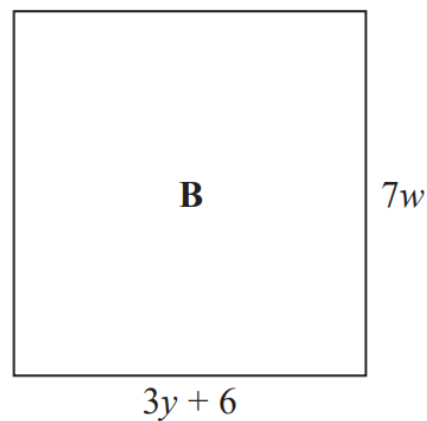
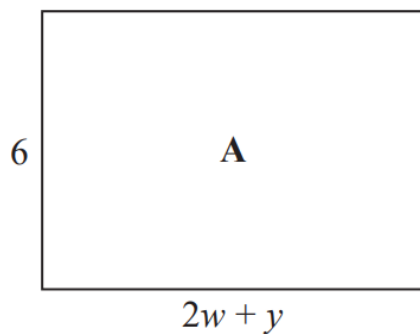


HOME

14	$ky - y = x + kx$ $y(k - 1) = x(1 + k)$	$y = \frac{x(k+1)}{k-1}$	M1	$y + x = k(y - x)$ or $\frac{y+x}{y-x} = k$ oe
			M1	For isolating x and y on opposite sides eg $ky - y = x + kx$
			A1	Completing correct algebraic reasoning to reach conclusion



11 The diagram shows two rectangles, **A** and **B**.



All measurements are in centimetres.

The area of rectangle **A** is equal to the area of rectangle **B**.

Find an expression for y in terms of w .

Algebra

Changing the Subject

*Variable appears
twice, Area*

 **Video Solutions**

(4 marks)

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HOME

11	$\frac{30w}{6-21w}$	P1 for forming an equation, eg $6(2w + y) = 7w(3y + 6)$ or $12w + 6y = 21wy + 42w$ oe P1 for expanding brackets correctly and gathering w terms or isolating y terms in a correct equation, eg $6y = 21wy + 30w$ or $6y - 21wy = 42w - 12w$ or $6y - 21wy = 30w$ P1 (dep on two terms in y) for factorising out the y, eg $y(6 - 21w) = 42w - 12w$ or $y(6 - 21w) = 30w$ or $3y(2 - 7w) = 30w$ A1 for $(y =) \frac{30w}{6-21w}$ oe	Condone missing brackets for this mark
----	---------------------	--	--



Algebra

Sequences

Linear

Quadratic

Geometric

Fibonacci



Summer 2020 Paper 1H (Non-Calc)

Algebra

Sequences

Linear Sequences

- 1 The first five terms of an arithmetic sequence are

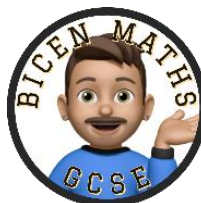
1 4 7 10 13

Write down an expression, in terms of n , for the n th term of this sequence.

 **Video Solutions**

(2 marks)

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HOME

Summer 2020 Paper 1H (Non-Calc)

Algebra

Sequences

Linear Sequences

1	$3n - 2$	B2	for $3n - 2$ oe	Accept a different variable, eg. $3x - 2$
		(B1	for $3n + k$ where $k \neq -2$ or is absent unambiguously shown)	$n = 3n - 2$ gets B1 only $n + 3$ gets NO marks

 **Video Solutions**

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HOME

6 The n th term of a sequence is $2n^2 - 1$

The n th term of a different sequence is $40 - n^2$

Show that there is only one number that is in both of these sequences.

 **Video Solutions**

(3 marks)

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HOME

Algebra
Sequences
<i>Generating quadratic sequences</i>

6	Shown (supported)	M1	for method to find at least two terms, eg $2 \times 4^2 - 1 (= 31)$ and $40 - 3^2 (= 31)$	1 7 17 31 49 71 97 127 161 199 39 36 31 24 15 4 -9
		M1	for generating at least three correct terms of each sequence	
		A1	for generating at least the terms 1, 7, 17, 31, 49 of the first sequence and at least the terms 39, 36, 31, 24, 15, 4 of the second sequence	



Algebra
Sequences
<i>Quadratic Sequences</i>

22 Here are the first five terms of a sequence.

4 11 22 37 56

Find an expression, in terms of n , for the n th term of this sequence.

 **Video Solutions**

(3 marks)



22		$2n^2 + n + 1$	M1 M1 A1	for a correct start to a method to find n th term, eg. equal 2nd differences imply a term in n^2 or sight of $an^2 + bn + c$ for a method leading to $2n^2$ and either n or 1 for $2n^2 + n + 1$ oe
----	--	----------------	----------------	---



Algebra
Sequences
<i>Quadratic Sequences</i>

16 Here are the first six terms of a quadratic sequence.

−1 5 15 29 47 69

Find an expression, in terms of n , for the n th term of this sequence.

 **Video Solutions**

(3 marks)



16	$2n^2 - 3$	M1	begins to work with 2 nd differences	6 10 14 18 22 4 4 4 4 A quadratic expression of the form $2n^2 + bn + c$ can be awarded the first 2 marks
		M1	identifies $2n^2$ as part of the expression eg gives the sequence 2, 8, 18, 32, ... or gives a quadratic expression which includes the term $2n^2$	
		A1	oe	



20 Here are the first five terms of a sequence.

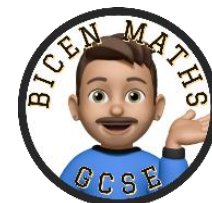
−1 0 3 8 15

Find an expression, in terms of n , for the n th term of this sequence.

 **Video Solutions**

(2 marks)

Find video solutions and more...  YouTube
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HOME

20	$n^2 - 2n$	M1	for correct deduction from differences, eg 2nd difference of 2 implies $1n^2$ or gives a quadratic expression which includes the term $1n^2$ or states 1,4,9,16,25 and deduces 2,4,6,8,10
		A1	oe



16 Here are the first five terms of a quadratic sequence.

10 21 38 61 90

Find an expression, in terms of n , for the n th term of this sequence.

 **Video Solutions**

(3 marks)

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16	$3n^2 + 2n + 5$	M1	for a correct start to a method to find the n th term, eg equal 2nd differences imply a term in n^2	Need to see constant second difference found and n^2 $3n^2 + 2n$ implies M2
		M1	for working with $3n^2$, eg $3n^2$ and sequence 7, 9, 11, ...	
		A1	for $3n^2 + 2n + 5$	



Summer 2018 Paper 3H (Calc)

16 The n th term of a sequence is given by $an^2 + bn$ where a and b are integers.

The 2nd term of the sequence is -2

The 4th term of the sequence is 12

(a) Find the 6th term of the sequence.

Algebra
Sequences
Quadratic Sequences and Simultaneous Equations

(4 marks)

Here are the first five terms of a different quadratic sequence.

0 2 6 12 20

(b) Find an expression, in terms of n , for the n th term of this sequence.

 **Video Solutions**

(2 marks)



Algebra
Sequences
Quadratic Sequences and Simultaneous Equations

16	(a)	42	P1	for process to find an equation in a and b , eg $a \times 2^2 + b \times 2 = -2$ ($4a + 2b = -2$) or $a \times 4^2 + b \times 4 = 12$ ($16a + 4b = 12$)	Allow one arithmetic error in elimination, eg $16a + 8b = -8$ and $16a + 4b = 12$ leading to $4b = 20$ but no subtraction sign seen
			P1	for process to find a pair of simultaneous equations and eliminate one unknown, eg $16a + 8b = -8$ and $16a + 4b = 12$ and subtraction or $16a + 4b = 12$ and $8a + 4b = -4$ and subtraction	
			A1	for $a = 2$ and $b = -5$	
			A1	cao	
	(b)	$n^2 - n$	M1	for correct method, eg n^2 seen as a term	
			A1	for $n^2 - n$ oe	



23 S is a geometric sequence.

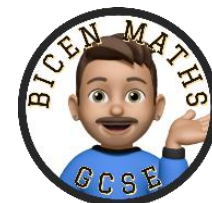
- (a) Given that $(\sqrt{x} - 1)$, 1 and $(\sqrt{x} + 1)$ are the first three terms of S, find the value of x .
You must show all your working.

(3 marks)

- (b) Show that the 5th term of S is $7 + 5\sqrt{2}$

 **Video Solutions**

(2 marks)



Algebra
Sequences
<i>Geometric Sequences and Surds</i>

23 (a)		2	M1	for start to express the common ratio algebraically, eg $1/(\sqrt{x} - 1)$ or $(\sqrt{x} + 1)/1$ or $\sqrt{x} + 1 = k \times 1$ or $1 = k \times (\sqrt{x} - 1)$
			M1	for setting up an appropriate equation in x , eg $1/(\sqrt{x} - 1) = (\sqrt{x} + 1)/1$
			C1	for convincing argument to show $x = 2$
(b)		Shown	M1	for expressing the relationship between the common ratio, one of the first three terms of the sequence and the fifth term, eg 5 th term = 3 rd term $\times$ (common ratio) ²
			C1	for a complete explanation to include eg, $(\sqrt{2} + 1)(\sqrt{2} + 1)^2 = 7 + 5\sqrt{2}$



Algebra
Sequences
<i>Fibonacci</i>

5 The first four terms of a Fibonacci sequence are

$$a \qquad 2a \qquad 3a \qquad 5a$$

The sum of the first five terms of this sequence is 228

Work out the value of a .

 **Video Solutions**

(3 marks)

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Algebra
Sequences
Fibonacci

5	12	P1	for a process to find the fifth term, eg $3a + 5a (= 8a)$
		P1	for setting up the equation eg $a + 2a + 3a + 5a + [8a] = 228$
		A1	cao

[8a] allow use of what is clearly indicated as the missing term
 $\frac{228}{19}$ or $\frac{228}{1+2+3+5+8}$ scores P1 P1
 $\frac{228}{1+2+3+5+[8]}$ scores P0P1



Algebra

Linear Equations

Unknowns on Both
Sides

Equations in
Context

Linear equations are often tested with other topics, and not usually in stand alone questions



11 Solve $\frac{3x - 2}{4} - \frac{2x + 5}{3} = \frac{1 - x}{6}$

Algebra

Linear Equations

... unknowns on both sides

 **Video Solutions**

(4 marks)

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Algebra
Linear Equations
... unknowns on both sides

11		$9\frac{1}{3}$	M1	for writing at least 2 fractions with a common denominator eg. $\frac{3(3x-2)}{12}, \frac{4(2x+5)}{12}, \frac{2(1-x)}{12}$ with at least one correct numerator or for $\frac{3x}{4} - \frac{2}{4} - \frac{2x}{3} - \frac{5}{3} = \frac{1}{6} - \frac{x}{6}$ (accept $+\frac{5}{3}$ instead of $-\frac{5}{3}$)
			M1	(dep) for a method to eliminate all fractions in an equation, ignore errors in any expanded terms eg. $3(3x - 2) - 4(2x + 5) = 2(1 - x)$ or $6 \times [3(3x - 2) - 4(2x + 5)] = 12 \times [1 - x]$ or $3 \times 3x - 3 \times 2 - 4 \times 2x - 4 \times 5 = 2 \times 1 - 2 \times x$ OR for the correct expansion of brackets leading to $\frac{9x-6-8x-20}{12} = \frac{2-2x}{12}$
			M1	(dep on M2) for correctly isolating terms in x and number terms of their linear equation e.g. $9x - 8x + 2x = 2 + 6 + 20$
			A1	for $9\frac{1}{3}$ oe



7 Solve $\frac{5-x}{2} = 2x-7$

Algebra

Linear Equations

... unknowns on both sides

 **Video Solutions**

(3 marks)

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Algebra
Linear Equations
... unknowns on both sides

7	3.8	M1	for a correct first step, eg $5 - x = 2(2x - 7)$ or $5 - x = 4x - 14$ or $\frac{5}{2} - \frac{x}{2} = 2x - 7$	Method must show LHS $\times 2$ and both terms on RHS $\times 2$ or $5 - x$ and both terms on RHS $\times 2$
		M1	(dep) for isolating terms in x eg $4x + x = 14 + 5$ or $-\frac{x}{2} - 2x = -7 - \frac{5}{2}$	eg $-4x$ both sides with -5 both sides or $+x$ both sides with $+14$ both sides
		A1	oe	Accept $\frac{19}{5}$, $3\frac{4}{5}$ oe but not $\frac{-19}{-5}$ oe

 **Video Solutions**

(3 marks)



1 Solve $5x - 6 = 3(x - 1)$

Algebra

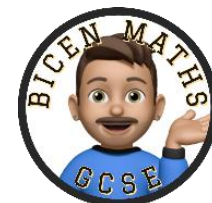
Linear Equations

... unknowns on both sides

 **Video Solutions**

(3 marks)

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1		$1\frac{1}{2}$	M1	for correct expansion of the bracket or dividing all terms by 3 as a first step eg $3x - 3$ or $(5x - 6)/3 = 3(x - 1)/3$
			M1	for isolating terms in x on one side of an equation eg $5x - 6 - 3x = -3$ or both constants on one side of an equation, eg $5x = 3x - 3 + 6$, ft $5x - 6 = 3x - 1$
			A1	for $1\frac{1}{2}$ oe



10 (a) Solve $\frac{9+x}{7} = 11-x$

Algebra

Linear Equations

... unknowns on both sides

 **Video Solutions**

(3 marks)

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HOME

Algebra
Linear Equations
... unknowns on both sides

10	(a)	8.5	M1	for multiplying both sides by 7 as a first step eg $9 + x = 7(11 - x)$ or dividing each term on the left hand side by 7 eg $\frac{9}{7} + \frac{x}{7} = 11 - x$	× 7 written near the equation is not enough for this mark
			M1	(dep M1) for method to isolate the x terms on one side	
			A1	oe	

 **Video Solutions**

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HOME

8 The number of days, d , that it will take to build a house is given by

$$d = \frac{720}{n}$$

where n is the number of workers used each day.

Ali's company will take 40 days to build the house.

Hayley's company will take 30 days to build the house.

Hayley's company will have to use more workers each day than Ali's company.

How many more?

 **Video Solutions**

(3 marks)

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HOME

8	6	M1	for $720 \div 40 (= 18)$ or $720 \div 30 (= 24)$
		M1	for a complete process eg $(720 \div 30) - (720 \div 40)$ or “18” $\times \frac{4}{3} -$ “18” or “24” $-$ “24” $\times \frac{3}{4}$
		A1	cao

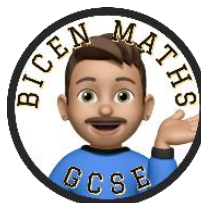
- 2 Kiaria is 7 years older than Jay.
Martha is twice as old as Kiaria.
The sum of their three ages is 77

Find the ratio of Jay's age to Kiaria's age to Martha's age.

 **Video Solutions**

(4 marks)

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HOME

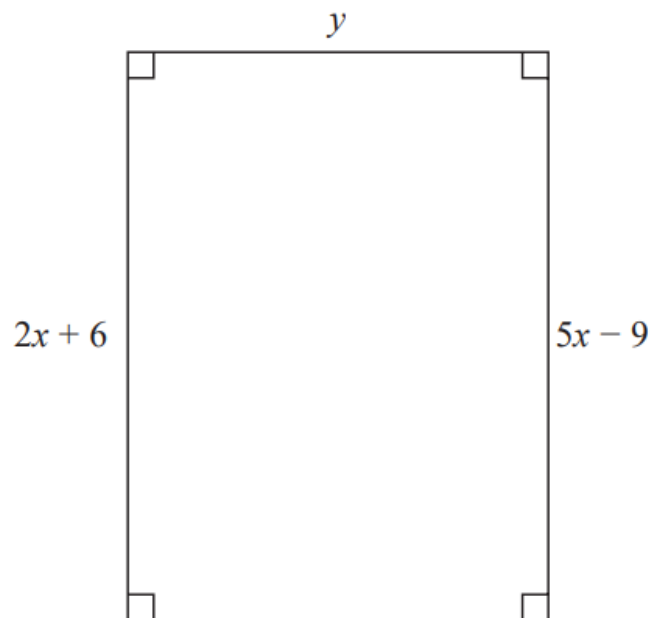
Algebra
Linear Equations
... with ratio

2		14:21:42	P1	for 2 out of 3 expressions in one letter eg from $x, x+7, 2x+14$ or see a set of numbers to show interpretation of the relationships, eg 10, 17, 34
			P1	(dep) for sum of their 3 expressions =77 eg $x + x+7+2x+14 =77$ oe or 2 systematic correct trials including addition
			P1	for a correct process to isolate their term in x or $x=14$
			A1	for ratio 14:21:42 oe

 **Video Solutions**



6 Here is a rectangle.



All measurements are in centimetres.

The area of the rectangle is 48 cm^2 .

Show that $y = 3$

Algebra

Linear Equations

... with area of
rectangle

 **Video Solutions**

(4 marks)

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HOME

Algebra
Linear Equations
... with area of rectangle

6		Shows reasoning to reach $y=3$	M1	forms equation eg $2x + 6 = 5x - 9$	$48 \div 3 (=16)$	$3(2x + 6) = 48$ or $3(5x - 9) = 48$, condone missing bracket
			M1	isolates x and number terms $3x = 15$	forms equation $2x+6=$ “16” or $5x - 9=$ “16”	Isolates x and number terms $6x =$ “30” or $15x =$ “75”
			M1	substitutes “5” into side length eg $2 \times 5 + 6 (=16)$	isolates x and number terms $2x=$ “10” or $5x =$ “25”	forms the second equation
			A1	$48 \div 16=3$ or $16 \times 3=48$	shows $x=5$ for both solutions	$x=5$ from 2 different equations.



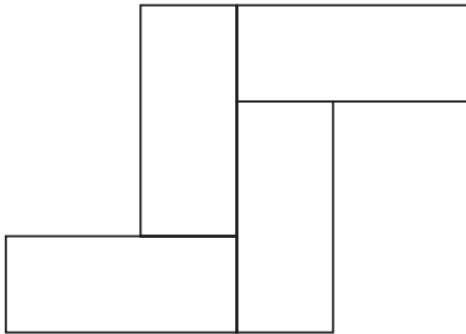
November 2017 Paper 3H (Calc)

6 Here is a rectangle.



The length of the rectangle is 7 cm longer than the width of the rectangle.

4 of these rectangles are used to make this 8-sided shape.



The perimeter of the 8-sided shape is 70 cm.

Work out the area of the 8-sided shape.

Algebra

Linear Equations

... with area
/perimeter of
rectangle

 **Video Solutions**

(5 marks)

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  **HOME**

Algebra
Linear Equations
... with area /perimeter of rectangle

6		147	P1	starts process, eg uses x and $x + 7$
			P1	starts to work with at least 6 correct sides, may be on the diagram or in an expression
			P1	(dep on previous P1) gives a correct expression for the perimeter, eg $x + x + 7 + x + 7 + x + 7 + x + x + 7 + x + 7 + x + 7$ or adds at least 6 correct sides and equates to 70
			A1	for width = 3.5 oe and length = 10.5 oe
			B1	ft (dep P2) for correct area for their x



Algebra

Quadratic Equations

Without context

With context



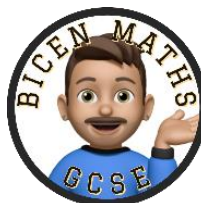
16 Solve $(x - 2)^2 = 3$

Give your solutions correct to 3 significant figures.

 **Video Solutions**

(2 marks)

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HOME

16	$\frac{- - 4 \pm \sqrt{(-4)^2 - 4 \times 1 \times 1}}{2 \times 1}$	0.268, 3.73	M1	for $x - 2 = \pm\sqrt{3}$ oe or one solution or use of $x^2 - 4x + 1 = 0$ to substitute into formula (allow one error in substitution)
			A1	0.267 – 0.27, 3.7 – 3.74



8 Solve $x^2 = 5x + 24$

 **Video Solutions**

(3 marks)

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HOME

8	8 and -3	M1	for rearranging to get $x^2 - 5x - 24 (= 0)$ or $-x^2 + 5x + 24 (= 0)$	Can be implied by $(x - 8)(x + 3)$ or $(-x + 8)(x + 3)$
		M1	for $(x \pm 8)(x \pm 3)$ or $(x + a)(x + b)$ where $ab = -24$ or $a + b = -5$ or substitution into formula, condoning one sign error eg $(x =) \frac{- -5 \pm \sqrt{(-5)^2 - 4 \times 1 \times -24}}{2 \times 1}$	
		A1	for 8 and -3	



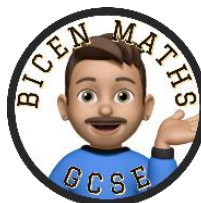
(c) Solve $5x^2 - 4x - 3 = 0$

Give your solutions correct to 3 significant figures.

 **Video Solutions**

(3 marks)

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HOME

(c)	1.27 and -0.472	M1	for substitution into the formula	Condone one sign error in the substitution Accept -4^2 or $(-4)^2$
		M1	for simplifying to the form $\frac{-b \pm \sqrt{N}}{k}$ eg $\frac{4 \pm \sqrt{76}}{10}$ or 1.27 to 1.28 or -0.48 to -0.47	
		A1	for 1.27 to 1.28 and -0.48 to -0.47	



17 Given that

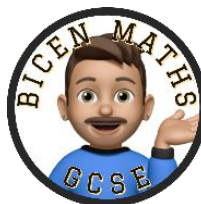
$$x^2 : (3x + 5) = 1 : 2$$

find the possible values of x .

 **Video Solutions**

(4 marks)

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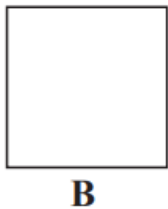
HOME

17	-1, 2.5	P1	for process to form an equation, eg $\frac{x^2}{3x+5} = \frac{1}{2}$ or $2x^2 = 3x + 5$
		P1	for writing in a suitable form ready for solution, eg $2x^2 - 3x - 5 (= 0)$ or $-2x^2 + 3x + 5 (= 0)$
		P1	(dep 1st P1) for process to solve quadratic equation of form $ax^2 + bx + c (= 0)$ eg $(2x - 5)(x + 1) (= 0)$ or $\frac{- -3 \pm \sqrt{(-3)^2 - 4 \times 2 \times -5}}{2 \times 2}$
		A1	for -1, 2.5 oe



Algebra
Quadratic Equations
... with area of squares

14 Here are two squares, **A** and **B**.



The length of each side of square **B** is 4 cm greater than the length of each side of square **A**.
The area of square **B** is 70 cm² greater than the area of square **A**.

Find the area of square **B**.
Give your answer correct to 3 significant figures.
You must show all your working.

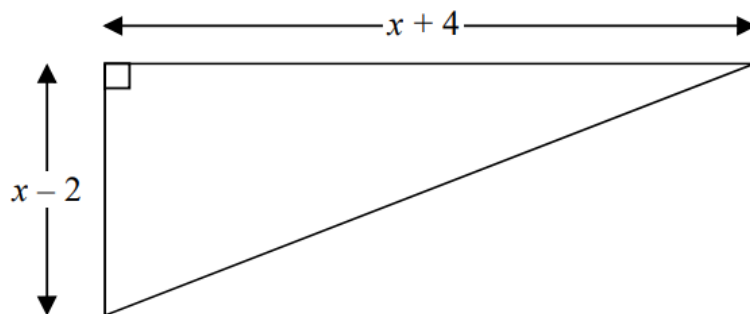


Algebra
Quadratic Equations
... with area of squares

14	116	P1	for setting up an equation, eg $(x + 4)^2 = x^2 + 70$	for setting up an equation, eg $x^2 - (x - 4)^2 = 70$	Equation must be in a single variable. If a candidate uses a trial and improvement method, it is either full marks or no marks.
		P1	for process to reduce equation down to a linear equation ready to solve eg $8x = 54$ oe	for process to reduce equation down to a linear equation ready to solve eg $8x = 86$ oe	Candidates must get as far as $ax = b$
		A1	for 6.75 oe	for 10.75 oe	
		B1	ft (dep P2) for finding the area of B or for answer in range 115 to 116		



14 The diagram shows a right-angled triangle.



All the measurements are in centimetres.

The area of the triangle is 27.5 cm^2

Work out the length of the shortest side of the triangle.

You must show all your working.

 **Video Solutions**

(4 marks)

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HOME

Algebra
Quadratic Equations
... with area of triangle

14	5	P1	for process to find the area of the triangle, eg. $0.5 \times (x + 4)(x - 2)$ oe OR for process to find the area of rectangle and 27.5×2 , eg. $(x + 4)(x - 2)$ and 55	Trial and improvement methods must be fully correct identifying the value of x as 7 (3 marks) or the shortest side as 5 (4 marks)
		P1	(dep P1) for process to expand the brackets and derive a quadratic equation, eg. $x^2 + 4x - 2x - 8 = 55$ or $0.5(x^2 + 4x - 2x - 8) = 27.5$ oe	
		P1	(dep P2) for complete process to solve the quadratic equation $x^2 + 2x - 63 = 0$ eg $(x - 7)(x + 9) (= 0)$ or $\frac{-2 \pm \sqrt{2^2 - 4 \times 1 \times -63}}{2 \times 1}$ or $(x + 1)^2 - 1 - 63 (= 0)$	
		A1	cao SC: B1 for $x^2 + 4x - 2x - 8 = 27.5$	An answer of 5 with no supportive working gets no marks

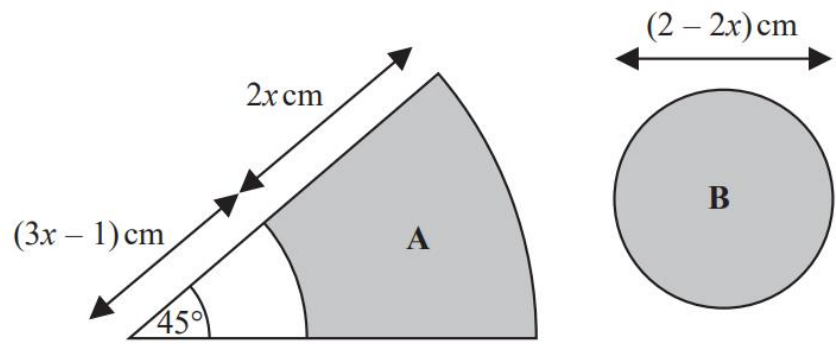


Summer 2020 Paper 1H (Non-Calc)

Algebra
Quadratic Equations
... with sectors/circles

22 The diagram shows two shaded shapes, **A** and **B**.

Shape **A** is formed by removing a sector of a circle with radius $(3x - 1)$ cm from a sector of the circle with radius $(5x - 1)$ cm.
Shape **B** is a circle of diameter $(2 - 2x)$ cm.



The area of shape **A** is equal to the area of shape **B**.

Find the value of x .
You must show all your working.

 **Video Solutions**

(5 marks)

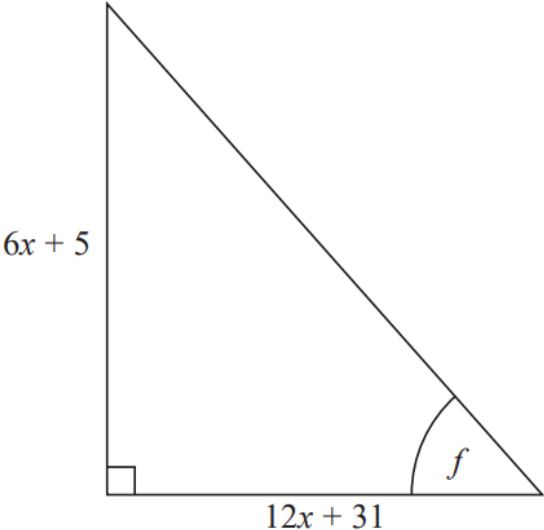
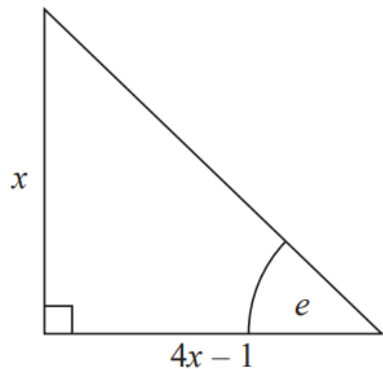


22	0.5	P1	derive an algebraic expression for the area of A eg $\frac{1}{8}\pi[(5x-1)^2-(3x-1)^2]$	Accept only the single value of 0.5 oe but award 0 marks for a correct answer with no supportive working
		P1	expand and simplify for either area A or area B eg $\frac{1}{8}\pi(16x^2-4x)$ or $\pi(x^2-2x+1)$	
		P1	(dep P2) equate and rearrange into a quadratic eqn of the form $ax^2+bx+c=0$ eg $2x^2+3x-2=0$	
		P1	(dep P3) factorise eg $(2x-1)(x+2)=0$ or use of formula eg $\frac{-3 \pm \sqrt{3^2 - 4 \times 2 \times -2}}{2 \times 2}$	
		A1	oe	



Summer 2018 Paper 3H (Calc)

19 Here are two right-angled triangles.



Given that

$$\tan e = \tan f$$

find the value of x .

You must show all your working.

Algebra
Quadratic Equations
... with trigonometry

 **Video Solutions**

(5 marks)



19	$\frac{5}{3}$	P1	for process to derive an equation in x , eg $\frac{x}{4x-1} = \frac{6x+5}{12x+31}$	
		P1	for complete process to remove fractions, eg $x(12x+31) = (6x+5)(4x-1)$	Must be correct use of brackets
		P1	for process to reduce to a quadratic equation, eg $12x^2 - 17x - 5 = 0$	Award for correct LHS only.
		P1	for process to solve the quadratic equation by factorisation or use of quadratic formula, eg $(4x+1)(3x-5) = 0$	Award for correct LHS only. Accept substitution into the formula; $\frac{- -17 \pm \sqrt{(-17)^2 - 4 \times 12 \times -5}}{2 \times 12}$
		A1	for $\frac{5}{3}$ oe	Accept answers in the range 1.66 to 1.67 as equivalent



Algebra

Simultaneous Equations

Linear

Non-Linear



Summer 2017 Paper 3H (Calc)

2 Solve the simultaneous equations

$$\begin{aligned}3x + y &= -4 \\ 3x - 4y &= 6\end{aligned}$$

Algebra

Simultaneous
Equations

Linear

 **Video Solutions**

(3 marks)

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Algebra
Simultaneous Equations
<i>Linear</i>

2

$$x = -\frac{2}{3}$$

$$y = -2$$

M1

for a method to eliminate one variable (condone one arithmetic error)

M1

(dep) for substituting found value in one of the equations or appropriate method after starting again (condone one arithmetic error)

A1

$$x = -\frac{2}{3} \text{ oe and } y = -2$$

 **Video Solutions**

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HOME

6 Solve the simultaneous equations

$$\begin{aligned}5x + y &= 21 \\ x - 3y &= 9\end{aligned}$$

Algebra

Simultaneous
Equations

Linear

 **Video Solutions**

(3 marks)

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HOME

Algebra
Simultaneous Equations
<i>Linear</i>

6	$x = 4.5, y = -1.5$	M1	correct process to eliminate one variable (condone one arithmetic error)	Fractions do not need to be in simplest form
		M1	(dep) for substituting found value in one of the equations OR correct process after starting again (condone one arithmetic error)	
		A1	for $x = 4.5, y = -1.5$ oe	



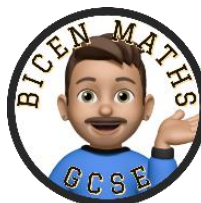
- 11 3 teas and 2 coffees have a total cost of £7.80
5 teas and 4 coffees have a total cost of £14.20

Work out the cost of one tea and the cost of one coffee.

 **Video Solutions**

(4 marks)

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Algebra
Simultaneous Equations
<i>Linear, worded</i>

11		Tea £1.40	P1	for setting up two appropriate equations eg $3t + 2c = 7.80$, $5t + 4c = 14.20$
		Coffee £1.80	M1	for method to eliminate one variable, condone one arithmetic error
			M1	for method to substitute found variable or start again
			A1	Tea £1.4(0) and Coffee £1.8(0) with amounts linked to correct drinks

 **Video Solutions**



November 2021 Paper 3H (Calc)

- 13 A pattern is made from four identical rectangles.
The sides of the rectangles are parallel to the axes.

Point A has coordinates $(3, 4)$

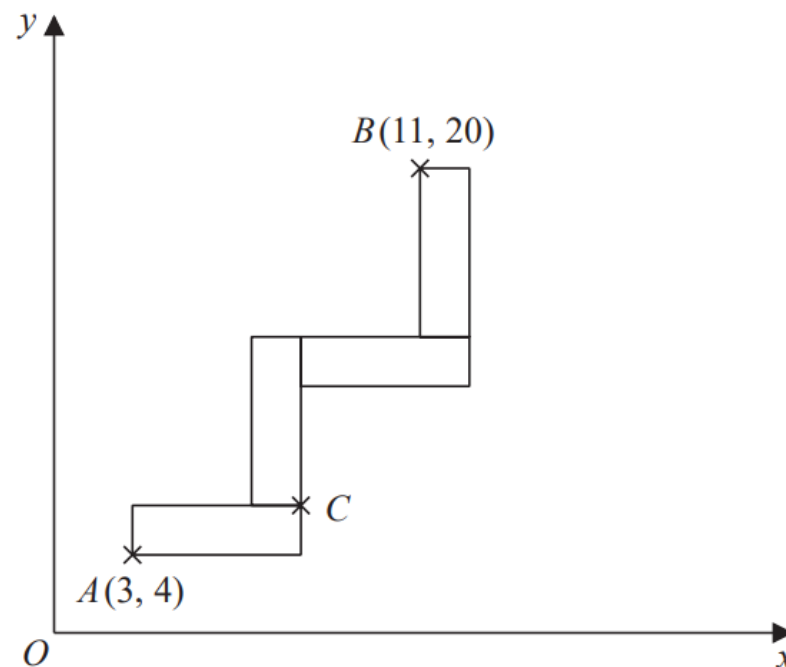
Point B has coordinates $(11, 20)$

Point C is marked on the diagram.

Work out the coordinates of C .

You must show all your working.

Algebra
Simultaneous Equations
Linear, coordinate context



 **Video Solutions**

(5 marks)

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Algebra
Simultaneous Equations
Linear, coordinate context

13	(9, 8)	P1	for setting up an equation for one dimension (width) of the pattern eg $2b - a = 8$ oe or $2x + y = 8$ oe	a and b are the width and length x is the difference between the length and width, y is the width of the rectangle
		P1	for setting up an equation for the other dimension (height) of the pattern eg $2b + a = 16$ oe or $2x + 3y = 16$ oe	
		P1	(dep P2) for a full process to solve for both variables eg $4b = 24$, $b = 6$ and $12 - a = 8$, $a = 4$ or $8 = 2y$, $y = 4$ and $8 = 2x + y$, $x = 2$	Both values correct implies this mark
		P1	(dep P3) for a full process to find one of the coordinates of C eg $3 + 6 (= 9)$ or $4 + 4 (= 8)$ or $3 + 2 + 4 (= 9)$ or $4 + 4 (= 8)$	
		A1	cao	Award 0 marks for a correct answer with no supportive working.



Summer 2017 Paper 1H (Non-Calc)

20 Solve algebraically the simultaneous equations

$$x^2 + y^2 = 25$$

$$y - 3x = 13$$

Algebra

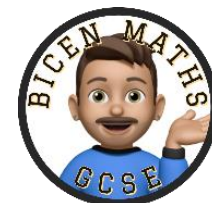
Simultaneous
Equations

Non-linear

 **Video Solutions**

(5 marks)

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HOME

Algebra
Simultaneous Equations
<i>Non-linear</i>

20		$x = -\frac{24}{5}$ $y = -\frac{7}{5}$ $x = -3,$ $y = 4$	M1 M1 M1 M1 A1	for substitution of a rearrangement of $y - 3x = 13$ e.g. $(3x + 13)^2 + x^2 = 25$ (dep M1) for expansion of bracket after substitution (at least 3 terms correct out of the 4 terms) e.g. $9x^2 + 39x + 39x + 169$ for forming quadratic ready for solving e.g. $10x^2 + 78x + 144 (= 0)$ for factorising e.g. $(5x + 24)(x + 3) (= 0)$ oe $x = -\frac{24}{5}, y = -\frac{7}{5}$ and $x = -3, y = 4$ SC: B1 (if M0) for all 4 values mis-associated or one correct pair of values or values given as coordinates.
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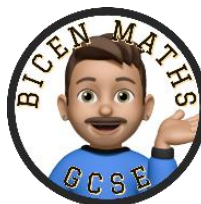


- 19 Prove algebraically that the straight line with equation $x - 2y = 10$ is a tangent to the circle with equation $x^2 + y^2 = 20$

 **Video Solutions**

(5 marks)

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Algebra
Simultaneous Equations
<i>Non-linear</i>

19		Proof (supported)	M1 M1 M1 M1 C1	starts process to find point of intersection by substituting, eg $(10 + 2y)^2 + y^2 (= 20)$ for expanding, eg $4y^2 + 20y + 20y + 100$ (3 out of 4 terms correct) (dep M2) for 3-term quadratic equation ready for solving, eg $5y^2 + 40y + 80 = 0$ (dep on previous M1) for method to solve an equation of the form $ay^2 + by + c = 0$, eg by factorising or correct substitution into quadratic formula fully correct method leading to $y = -4$ or $x = 2$ or $(y + 4)^2 = 0$ or $(x - 2)^2 = 0$ and statement, eg only one point of intersection so the line is a tangent to the circle
----	--	----------------------	----------------------------	--



19 Solve algebraically the simultaneous equations

$$\begin{aligned}2x^2 - y^2 &= 17 \\ x + 2y &= 1\end{aligned}$$

Algebra

Simultaneous
Equations

Non-linear

 **Video Solutions**

(5 marks)

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HOME

Algebra
Simultaneous Equations
Non-linear

19	$x = -\frac{23}{7}, y = \frac{15}{7}$	M1	for substitution of a rearrangement eg for $2(1 - 2y)^2 - y^2 = 17$ or $2x^2 - \left(\frac{1-x}{2}\right)^2 = 17$ or expansion of $(1 - 2y)^2 = 1 - 4y + 4y^2$ or $\left(\frac{1-x}{2}\right)^2 = \frac{1-2x+x^2}{4}$
	$x = 3, y = -1$	M1	for expansion of bracket and substitution eg $2(1 - 4y + 4y^2) - y^2 (= 17)$ or $8x^2 - (1 - 2x + x^2) (= 68)$
		A1	for forming quadratic ready for solving eg $7y^2 - 8y - 15 (= 0)$ or $7x^2 + 2x - 69 (= 0)$
		M1	fit a 3 term quadratic, factorising eg $(7y - 15)(y + 1) (-0)$ or $(7x + 23)(x - 3) (-0)$ or correct use of formula eg $\frac{8 \pm \sqrt{64 + 420}}{14}$ or $\frac{-2 \pm \sqrt{4 + 1932}}{14}$ or completing the square
		A1	$x = -\frac{23}{7} \text{ oe, } y = \frac{15}{7} \text{ oe and } x = 3, y = -1$

Can be implied by both x values correct or both y values correct.

Answers must be correctly paired.
 (Maybe in the body of the working)
 Accept for x between -3.29 and -3.28 and for y between 2.14 and 2.15

Answers only award 0 marks



Algebra
Simultaneous Equations
<i>Non-linear</i>

20 Solve algebraically the simultaneous equations

$$x^2 - 4y^2 = 9$$

$$3x + 4y = 7$$

 **Video Solutions**

(5 marks)

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Algebra
Simultaneous Equations
Non-linear

20	$x = 3\frac{2}{5}, y = -\frac{4}{5}$	M1	for substitution of a rearrangement eg $x = \frac{7-4y}{3}$ or $y = \frac{7-3x}{4}$ into $x^2 - 4y^2 = 9$ or expansion of $\left(\frac{7-4y}{3}\right)^2 = \frac{49-56y+16y^2}{9}$ or $\left(\frac{7-3x}{4}\right)^2 = \frac{49-42x+9x^2}{16}$
	$x = 5, y = -2$	M1	for correct expansion and substitution eg $\frac{49-56y+16y^2}{9} - 4y^2 = 9$ or $x^2 - 4\left(\frac{49-42x+9x^2}{16}\right) = 9$
		A1	for forming quadratic ready for solving eg $-20y^2 - 56y - 32 (= 0)$ or $5y^2 + 14y + 8 (= 0)$ oe or $5x^2 - 42x + 85 (= 0)$ oe
		M1	ft a 3 term quadratic , factorising eg $(5y + 4)(y + 2) (= 0)$ or $(5x - 17)(x - 5) (= 0)$ or correct use of formula eg $(y =) \frac{-14 \pm \sqrt{14^2 - 4 \times 5 \times 8}}{2 \times 5}$ or $(x =) \frac{- -42 \pm \sqrt{42^2 - 4 \times 5 \times 85}}{2 \times 5}$ or completing the square, eg $(y + \frac{7}{5})^2 - \frac{9}{25} (= 0)$ or $(x - \frac{21}{5})^2 - \frac{16}{25} (= 0)$
		A1	correctly pairs x and y values: $x = 3\frac{2}{5}, y = -\frac{4}{5}$ oe , $x = 5, y = -2$

Expansion may not be in simplest form but must be correct

Note we do not need to see “= 0”; just the LHS is sufficient.

Can be implied by both x values correct or both y values correct.

Answers must be correctly paired.
Accept coordinate pairs



16 The curve **C** has equation $y = x^2 + 3x - 3$

The line **L** has equation $y - 5x + 4 = 0$

Show, algebraically, that **C** and **L** have exactly one point in common.

Algebra

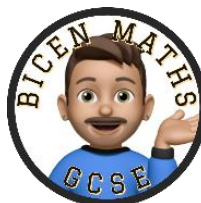
Simultaneous
Equations

Non-linear

 **Video Solutions**

(4 marks)

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Algebra
Simultaneous Equations
<i>Non-linear</i>

16	Shown (supported)	M1	for eliminating y or x , eg $x^2 + 3x - 3 = 5x - 4$	There must be a statement in words for the award of this mark
		M1	for rearranging, collecting terms and setting to 0 eg $x^2 - 2x + 1 (= 0)$	
		M1	for factorising or solving eg $(x - 1)^2 (= 0)$	
		C1	for statement confirming only 1 point in common eg only 1 root or only 1 value of x so only 1 set of coordinates	



Algebra

Inequalities

Linear

Quadratic



Summer 2019 Paper 2H (Calc)

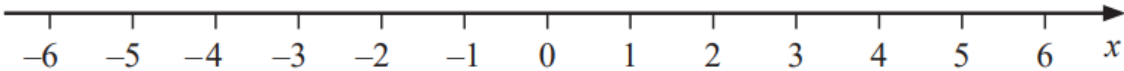
1 (a) Solve $14n > 11n + 6$

Algebra
Inequalities
<i>Linear, number line</i>

(2 marks)

(2)

(b) On the number line below, show the set of values of x for which $-2 < x + 3 \leq 4$



 **Video Solutions**

(3 marks)

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HOME

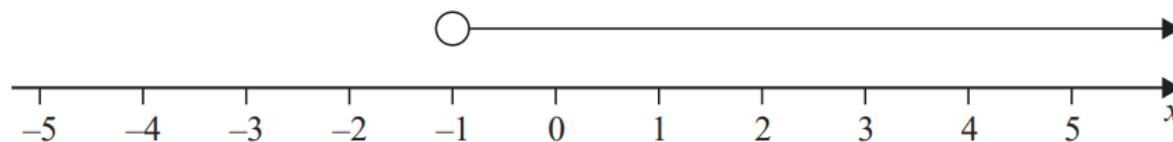
Algebra
Inequalities
Linear, number line

1	(a)	$n > 2$	M1	for a method to isolate terms in n in any inequality or equation eg $14n - 11n > 6$ or $n = 2$
			A1	cao
	(b)		M1	for $-2 - 3 < x \leq 4 - 3$ ($-5 < x \leq 1$)
			M1	for drawing a line from -5 to 1 or (indep) for an open circle at either -2 or -5 or (indep) for a closed circle at 4 or 1
			A1	cao

Ignore incorrect inequality sign and accept “=” sign
A circle around -5 and 1 implies M1
A line from -5 to 1 implies M2 if no working shown

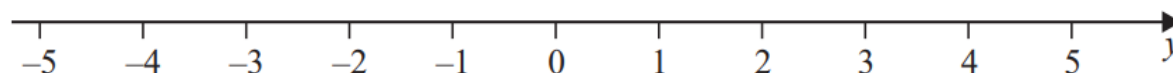


- 1 (a) Write down the inequality shown on this number line.



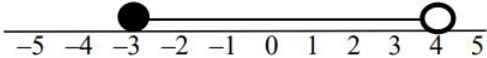
(1)

- (b) On the number line below, show the inequality $-3 \leq y < 4$



(2)

Algebra
Inequalities
<i>Linear, number line</i>

1	(a)	$x > -1$	B1	cao
	(b)	Diagram drawn	C2	for a fully correct diagram, eg 
			(C1	for drawing a line from -3 to 4 or (indep) for an open circle at 4 or (indep) for a closed circle at -3)

Condone arrow heads or line ending to denote the ‘end’ of the line



19 Solve $2x^2 + 3x - 2 > 0$

Algebra

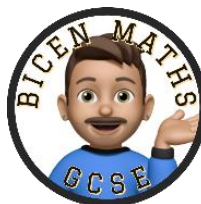
Inequalities

*Quadratic
Inequalities*

 **Video Solutions**

(3 marks)

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Algebra
Inequalities
<i>Quadratic Inequalities</i>

19		$x < -2, x > \frac{1}{2}$	M1	for a first step to solve the quadratic e.g. factorisation: $(2x + 4)(x - \frac{1}{2})$ or $(2x - 1)(x + 2)$ or using the formula $\frac{-3 \pm \sqrt{3^2 - 4 \times 2 \times (-2)}}{2 \times 2}$
			A1	for -2 and $\frac{1}{2}$
			A1	

 **Video Solutions**



Summer 2018 Paper 1H (Non-Calc)

20 n is an integer such that $3n + 2 \leq 14$ and $\frac{6n}{n^2 + 5} > 1$

Find all the possible values of n .

Algebra

Inequalities

Quadratic
Inequalities

 **Video Solutions**

(5 marks)

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20	2, 3, 4	M1	for method to solve $3n + 2 \leq 14$ eg $n \leq (14 - 2) \div 3$ oe	This could be shown within an equation rather than an inequality at this stage For the 2rd and 3rd M marks condone no '< 0' and condone use of incorrect inequality signs or '=' Accept $\frac{- -6 \pm \sqrt{(-6)^2 - 4 \times 1 \times 5}}{2 \times 1}$ (condone one sign error) Must come from correct working Could be shown on a number line
		M1	for complete method to rearrange $\frac{6n}{n^2 + 5} > 1$ to the form $an^2 + bn + c (< 0)$	
		M1	for method to begin to solve $n^2 - 6n + 5 (< 0)$ eg $(n \pm 5)(n \pm 1) (< 0)$	
		M1	(dep on previous M2) for $n > 1$ and $n \leq 4$ or $1 < n < 5$	
		A1	(dep M4) cao	
			Alternative method	This could be shown within an equation rather than an inequality at this stage The values from the trials may be given as improper fractions eg $\frac{24}{21}, \frac{18}{14}, \frac{12}{9}, \frac{6}{6}$
		M1	for method to solve $3n + 2 \leq 14$ eg $n \leq (14 - 2) \div 3$ oe OR for $3 \times 4 + 2 = 14$	
		M3	for trials with 1, 2, 3 and 4 in the quadratic inequality, correctly evaluated	
		(M2	for trials with three of 1, 2, 3 and 4, correctly evaluated)	
		(M1	for trials with two of 1, 2, 3 and 4, correctly evaluated)	
		A1	(dep M4) cao	



19 Solve $22 < \frac{m^2 + 7}{4} < 32$

Show all your working.

Algebra

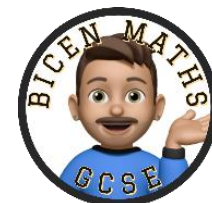
Inequalities

*Quadratic
Inequalities*

 **Video Solutions**

(3 marks)

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19	$9 < m < 11$ $-11 < m < -9$	M1	for a correct method to begin rearranging to solve for m^2 eg $88 < m^2 + 7$ or $m^2 + 7 < 128$ or $81 < m^2 < 121$	It is insufficient to just multiply all three elements by 4; some rearrangement must occur such as showing as two separate inequalities or isolating m^2
		M1	for a complete method to $m^2 = 81$ or $m^2 = 121$ or better	Accept an inequality used in place of “=”. m^2 must be isolated at this stage.
		M1	for a set of critical values: at least two out of 9, 11, -9, -11	Do not award if other values are also given eg 10
		M1	for selecting a correct inequality for one set of critical values eg $9 < m$ and $m < -9$ or $m < 11$ and $-11 < m$ or $9 < m$ and $m < 11$ or a set of inequalities with some error eg $9 ? m ? 11$ and $-11 ? m ? -9$ where ? is an incorrect inequality symbol like $9 < m \leq 11$ or $9 \geq m \geq 11$ or answer given as $\pm 9 < m < \pm 11$	Could be shown as $9 < m < 11$ or $-11 < m < -9$ or $-11 < m < 11$
		A1	$9 < m < 11$ and $-11 < m < -9$ given as boundaries of m	Accept with an “and” or an “or” or neither



18 (b) Solve $(1 - x)^2 < \frac{9}{25}$

Algebra

Inequalities

*Quadratic
Inequalities*

 **Video Solutions**

(3 marks)

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Algebra
Inequalities
Quadratic Inequalities

(b)	$\frac{2}{5} < x < 1\frac{3}{5}$	M1	for first step of finding the square root of both sides eg $1 - x < \pm \frac{3}{5}$ OR for writing in the form $ax^2 + bx + c (< 0)$ eg $x^2 - 2x + \frac{16}{25} (< 0)$ or $25x^2 - 50x + 16 (< 0)$
		M1	for showing critical values $\frac{2}{5}$ (= 0.4) and $1\frac{3}{5}$ (= 1.6) oe
		A1	for $\frac{2}{5} < x < 1\frac{3}{5}$ oe

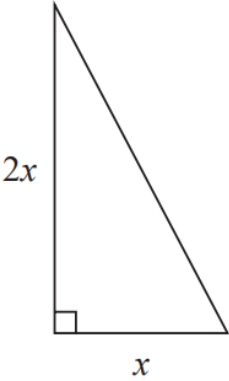
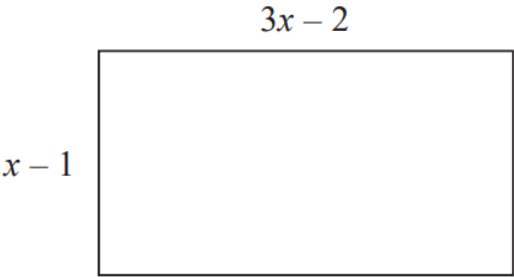
Condone use of an “=” sign; accept one square root (eg $\frac{3}{5}$) only shown.

Critical values can be stated, or shown in an expression (which may have incorrect inequality symbols)

Could be written as two separate expressions eg $x > \frac{2}{5}$ and $x < 1\frac{3}{5}$ oe



23 Here is a rectangle and a right-angled triangle.



All measurements are in centimetres.
 The area of the rectangle is greater than the area of the triangle.
 Find the set of possible values of x .

Algebra
Inequalities
Quadratic Inequalities, area of shapes

 **Video Solutions**

(5 marks)

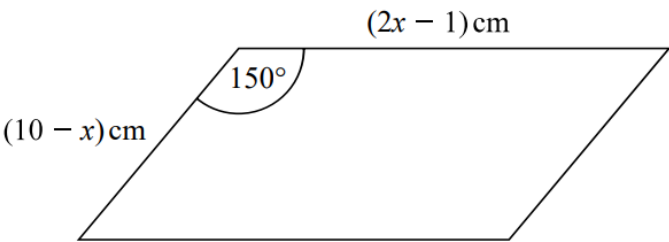


Algebra
Inequalities
Quadratic Inequalities, area of shapes

23		$x > 2$	P1	for process to derive algebraic expressions for area of both rectangle and triangle eg $(x - 1)(3x - 2)$ and $(2x \times x) \div 2$ (condone missing brackets)
			M1	for method to rearrange inequality to $2x^2 - 5x + 2 > 0$ oe providing in the form $ax^2 + bx + c > 0$
			M1	for a correct method to solve $2x^2 - 5x + 2 > 0$
			M1	for establishing critical values 2 and $\frac{1}{2}$
			A1	$x > 2$



23 The diagram shows a parallelogram.



The area of the parallelogram is greater than 15 cm²

(a) Show that $2x^2 - 21x + 40 < 0$

(3 marks)

(b) Find the range of possible values of x .

Algebra
Inequalities
Quadratic Inequalities, area of parallelogram

 **Video Solutions**

(3 marks)



Algebra
Inequalities
Quadratic Inequalities, area of parallelogram

23	(a)	Shown	C1	for a method to find the area of half of the parallelogram or of the whole parallelogram, eg $\frac{1}{2}(2x-1)(10-x) \sin 150$ or $\frac{1}{2}(2x-1)(10-x) \times \frac{1}{2} \text{ oe}$ or $(2x-1)(10-x) \sin 150$ or $(2x-1)(10-x) \times \frac{1}{2} \text{ oe}$	
			C1	for a correct expansion of the whole area eg $\frac{1}{2}(20x-10-2x^2+x)$ or $\frac{1}{2}(-2x^2+21x-10)$ or $-x^2+10.5x-5$	
			C1	complete chain of reasoning with fully correct algebra dealing with the inequality eg $x^2-10.5x+5 < -15$ or $x^2-10.5x+20 < 0$ or $2x^2-21x+10 < -30$ which lead to $2x^2-21x+40 < 0$	
	(b)	$2.5 < x < 8$	M1	for factorising, $(2x-5)(x-8)$	Could use the formula
			A1	for critical values, 2.5, 8	
			A1	for any statement that x is greater than 2.5 and x is less than 8	Need not be given as an inequality statement



Algebra

Algebraic Fractions



14 (a) Simplify $\frac{x^2 - 16}{2x^2 - 5x - 12}$

Algebra

Algebraic Fractions

Simplifying

 **Video Solutions**

(3 marks)

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HOME

Algebra
Algebraic Fractions
<i>Simplifying</i>

14	(a)			$\frac{x+4}{2x+3}$	M1	Factorising the denominator $(2x \pm 3)(x \pm 4)$ or $2\left(x \pm 1\frac{1}{2}\right)(x \pm 4)$
					M1	Factorising the numerator $(x - 4)(x + 4)$
					A1	oe

 **Video Solutions**



Summer 2018 Paper 1H (Non-Calc)

17 Simplify fully $\frac{3x^2 - 8x - 3}{2x^2 - 6x}$

Algebra

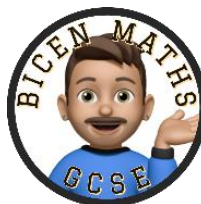
Algebraic Fractions

Simplifying

 **Video Solutions**

(3 marks)

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HOME

17	$\frac{3x + 1}{2x}$	M1	for $(3x + 1)(x - 3)$ or $2x(x - 3)$	Accept $(2x + 0)$ for the first two marks but not for the final answer
		A1	for $(3x + 1)(x - 3)$ and $2x(x - 3)$	
		A1	$\frac{3x + 1}{2x}$ oe	



12 (a) Write $\frac{4x^2 - 9}{6x + 9} \times \frac{2x}{x^2 - 3x}$ in the form $\frac{ax + b}{cx + d}$ where a , b , c and d are integers.

(3 marks)

(b) Express $\frac{3}{x + 1} + \frac{1}{x - 2} - \frac{4}{x}$ as a single fraction in its simplest form.

 **Video Solutions**

(3 marks)



12	(a)	$\frac{4x-6}{3x-9}$	M1	factorises numerator of $4x^2 - 9$ eg $(2x-3)(2x+3)$ oe	$\frac{2x(2x-3)(2x+3)}{3x(2x+3)(x-3)}$
			M1	factorises denominator eg $x(x-3)$ or $3(2x+3)$ or for $3x(2x^2-3x-9)$	
			A1	cancels to give $\frac{4x-6}{3x-9}$	
	(b)	$\frac{-x+8}{x(x+1)(x-2)}$	M1	method to use a common denominator eg $x(x+1)(x-2)$ by multiplying terms	Accept $a = 4, b = -6, c = 3, d = -9$
			M1	deduce numerator eg $3x(x-2) + x(x+1) - 4(x+1)(x-2)$	
			A1	oe	

Method must involve finding equivalents for all three separate terms; may be done in several stages.

Equivalents must be algebraically equivalent and must have involved full simplification.

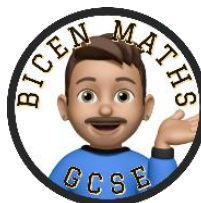


22 Show that $\frac{7x - 14}{x^2 + 4x - 12} \div \frac{x - 6}{x^3 - 36x}$ simplifies to ax where a is an integer.

 **Video Solutions**

(4 marks)

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22	7x	M1	multiplication by reciprocal, eg $\frac{7(x-2)}{(x-2)(x+6)} \times \frac{x(x+6)(x-6)}{x-6}$	Independent mark, may be awarded at any point
		M1	for factorising the numerator or denominator of the 1 st fraction, eg $\frac{7(x-2)}{(x-2)(x+6)}$ or $\frac{7(x-2)}{x^2+4x-12}$ or $\frac{7x-14}{(x-2)(x+6)}$	
		M1	for factorising the denominator of the second fraction, eg $\frac{x-6}{x(x+6)(x-6)} (= \frac{1}{x(x+6)})$	
		A1	completing the algebra to reach 7x	



22 Show that $\frac{6x^3}{(9x^2 - 144)} \div \frac{2x^4}{3(x - 4)}$ can be written in the form $\frac{1}{x(x + r)}$ where r is an integer.

 **Video Solutions**

(3 marks)

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HOME

22

$$\frac{1}{x(x+4)}$$

- M1 inverting the fraction and multiplying
eg $\frac{6x^3}{(9x^2-144)} \times \frac{3(x-4)}{2x^4}$
- M1 for factorising $9x^2 - 144$, eg $(3x - 12)(3x + 12)$
- A1 cao



Algebra
Algebraic Fractions
<i>Adding/Subtracting</i>

19 $2 - \frac{x + 2}{x - 3} - \frac{x - 6}{x + 3}$ can be written as a single fraction in the form $\frac{ax + b}{x^2 - 9}$ where a and b are integers.

Work out the value of a and the value of b .

 **Video Solutions**

(4 marks)



Algebra
Algebraic Fractions
<i>Adding/Subtracting</i>

19

	$a = 4, b = -42$	M1	for at least two terms from $2(x - 3)(x + 3)$, $(x + 2)(x + 3)$, $(x - 6)(x - 3)$
		M1	(dep) for the correct expansion of at least two expressions, irrespective of signs, eg. $2x^2 - 18$, $x^2 + 2x + 3x + 6$, $x^2 - 6x - 3x + 18$ oe
		M1	for $2x^2 - 18 - x^2 - 5x - 6 - x^2 + 9x - 18$
		A1	for $a = 4, b = -42$ (accept $4x - 42$)

 **Video Solutions**

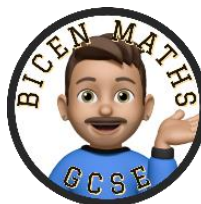


13 (a) Write $\frac{5}{x+1} + \frac{2}{3x}$ as a single fraction in its simplest form.

 **Video Solutions**

(2 marks)

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HOME

13	(a)	$\frac{17x + 2}{3x(x + 1)}$	M1	for a correct common denominator with at least one correct numerator eg. $\frac{5 \times 3x}{3x(x+1)} + \frac{2(x+1)}{3x(x+1)}$	$\frac{15x+2(x+1)}{3x(x+1)}$ gets M1 only
			A1	for a single simplified fraction, eg. $\frac{17x+2}{3x(x+1)}$ or equivalent eg. $\frac{17x+2}{3x^2+3x}$	



12 (a) Express $\frac{x}{x+2} + \frac{2x}{x-4}$ as a single fraction in its simplest form.

 **Video Solutions**

(3 marks)

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HOME

Algebra
Algebraic Fractions
<i>Adding/Subtracting</i>

12 (a)	$\frac{3x^2}{(x-4)(x+2)}$	M1	for method to identify a common denominator, eg $(x-4)(x+2)$	Accept $\frac{2x(x+2)}{(x-4)(x+2)} + \frac{x(x-4)}{(x-4)(x+2)}$
		M1	for method to combine the fractions, eg $\frac{2x(x+2) + x(x-4)}{(x-4)(x+2)}$	
		A1	for $\frac{3x^2}{(x-4)(x+2)}$ or $\frac{3x^2}{x^2-2x-8}$	



15 Show that $\frac{4x+3}{2x} + \frac{3}{5}$ can be written in the form $\frac{ax+b}{cx}$ where a , b and c are integers.

 **Video Solutions**

(3 marks)

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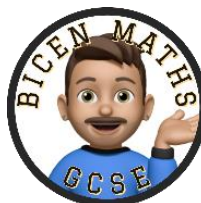
HOME

15	$\frac{26x+15}{10x}$	M1	for method to write at least one of the fractions with a suitable denominator, eg $\frac{4x+3}{2x} \times \frac{5}{5} (= \frac{20x+15}{10x})$ or $\frac{3}{5} \times \frac{2x}{2x} (= \frac{6x}{10x})$
		M1	for method to combine the fractions, eg $\frac{5(4x+3)}{5 \times 2x} + \frac{3 \times 2x}{5 \times 2x}$ or $\frac{5(4x+3) + 3 \times 2x}{5 \times 2x}$ or $\frac{20x+15}{10x} + \frac{6x}{10x}$
		A1	for correct algebra leading to $\frac{26x+15}{10x}$ oe in form $\frac{ax+b}{cx}$

 **Video Solutions**

(3 marks)

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HOME

13 Show that $6 + \left[(x + 5) \div \frac{x^2 + 3x - 10}{x - 1} \right]$ simplifies to $\frac{ax - b}{cx - d}$ where a , b , c and d are integers.

 **Video Solutions**

(4 marks)

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HOME

13	$\frac{7x - 13}{x - 2}$	B1	for factorising eg $(x+5)(x-2)$	
		M1	for a method to divide $(x+5)$ by the algebraic fraction eg $(x+5) \times \frac{(x-1)}{x^2+3x-10}$	Condone incorrect factorising
		M1	for finding 2 fractions with a common denominator or a single fraction eg $\frac{6(x-2)}{x-2} + \frac{(x-1)}{x-2}$ or $\frac{6(x-2)+(x-1)}{x-2}$ or $\frac{6(x^2+3x-10)}{x^2+3x-10} + \frac{(x+5)(x-1)}{x^2+3x-10}$ or $\frac{6(x^2+3x-10)+(x+5)(x-1)}{x^2+3x-10}$	Condone incorrect factorising
		A1	$\frac{7x-13}{x-2}$	



Algebra

Linear Graphs

Drawing Graphs

Gradient

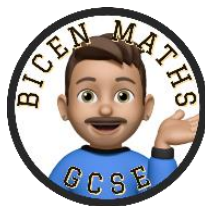
Equations of Lines

Parallel Lines

Perpendicular
Lines

Regions

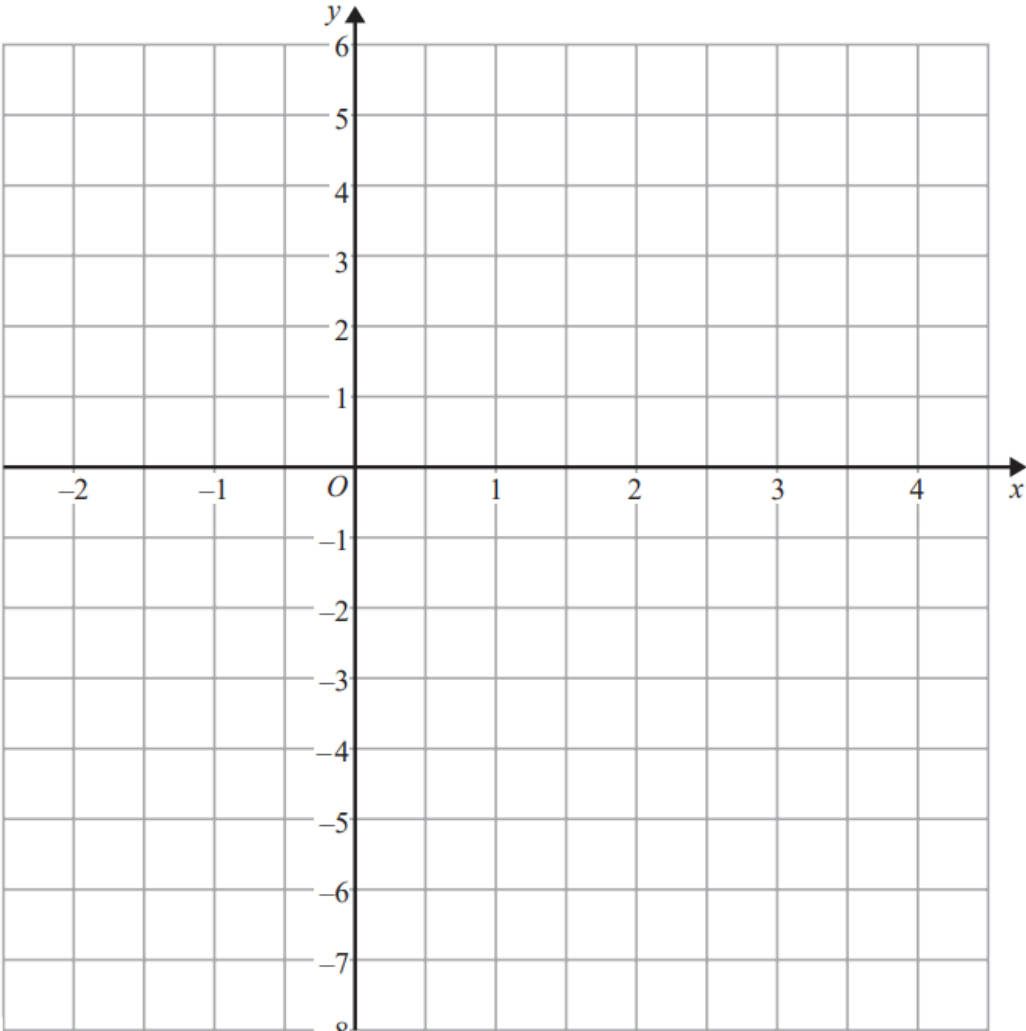
Misc.



Summer 2019 Paper 2H (Calc)

Algebra
Linear Graphs
Drawing linear

2 On the grid below, draw the graph of $y = 2x - 3$ for values of x from -2 to 4



 **Video Solutions**

(3 marks)



2	Graph	B3 (B2) (B1)	for a correct line between $x = -2$ and $x = 4$ for a correct straight line segment through at least 3 of $(-2, -7), (-1, -5), (0, -3), (1, -1), (2, 1), (3, 3), (4, 5)$ or for all of these points plotted but not joined OR for a line drawn with a positive gradient through $(0, -3)$ and clear intention to use a gradient of 2, eg line through $(0, -3)$ going across 2 squares and up 4 squares) for at least 2 correct points stated or plotted OR for a line drawn with a positive gradient through $(0, -3)$ OR a line with gradient 2)	Ignore any incorrect points. Points need not be plotted for a correct line (segment) drawn Table of values <table><tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>y</td><td>-7</td><td>-5</td><td>-3</td><td>-1</td><td>1</td><td>3</td><td>5</td></tr></table> Ignore any incorrect points Coordinates may be in a table or in working	x	-2	-1	0	1	2	3	4	y	-7	-5	-3	-1	1	3	5
x	-2	-1	0	1	2	3	4													
y	-7	-5	-3	-1	1	3	5													



November 2018 Paper 2H (Calc)

- 6 A is the point with coordinates $(5, 9)$
 B is the point with coordinates $(d, 15)$

The gradient of the line AB is 3

Work out the value of d .

Algebra

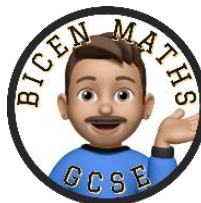
Linear Graphs

*Gradient of straight
lines*

 **Video Solutions**

(3 marks)

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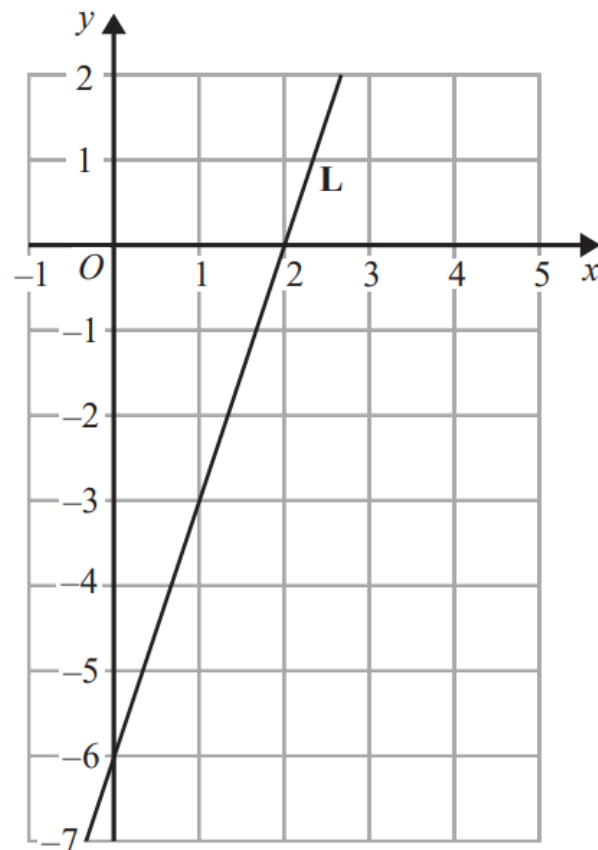
HOME

6	7	P1	process to use gradient eg $y = 3x + c$ or $c = -6$ or $\frac{15-9}{d-5}$	Condone use of a letter other than d , for d
		P1	or $(15 - 9) \div 3$ or $(6, 12)$	
		P1	(dep) full process to rearrange equation formed to isolate d	Must show processes to get as far as $d =$
			eg rearrangement of $15 = 3d - 6$ or $3 = \frac{15-9}{d-5}$ or for $5 + \frac{15-9}{3}$	Award P2 for an answer of $(7, 15)$
		A1	cao	



Summer 2018 Paper 2H (Calc)

3 The line **L** is shown on the grid.



Find an equation for **L**.

 **Video Solutions**

(3 marks)

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Algebra

Linear Graphs

Equations of Lines



HOME

Algebra
Linear Graphs
<i>Equations of Lines</i>

3	$y = 3x - 6$	M1	for a correct method to find the gradient of the line, or $m = 3$ OR identifies -6 as the intercept in words or in a partial equation OR $y - b = m(x - a)$ where $m \neq 3$ and (a, b) is a correct coordinate	Just ringing -6 is insufficient Award of this mark implies the first M1 c must be seen either as a letter or a number
		M1	for $y = 3x + c$ or (L=) $3x - 6$ or $y = "3"x - 6$ OR $y - y_1 = 3(x - x_1)$ or $y - b = "3"(x - a)$ where (a, b) is a correct coordinate	
		A1	accept $y = 3x + -6$ oe	



- 18** The straight line L_1 passes through the points with coordinates (4, 6) and (12, 2)
The straight line L_2 passes through the origin and has gradient -3

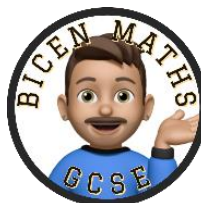
The lines L_1 and L_2 intersect at point P .

Find the coordinates of P .

 **Video Solutions**

(4 marks)

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HOME

18	$\left(\frac{-16}{5}, \frac{48}{5}\right)$	P1	for a method to find gradient of L_1 eg $\frac{6-2}{4-12} (= -\frac{1}{2})$ or states L_2 as $y = -3x$	Ignore sketches.
		P1	(dep on P1) for a method to find equation of L_1 eg subs into $y = "-\frac{1}{2}"x + c$ OR states L_1 as $y = "-\frac{1}{2}"x + 8$	
		P1	(dep on P2) complete method to equate both lines eg $"-\frac{1}{2}"x + 8 = -3x$	
		A1	oe	Accept equivalents eg $(-3.2, 9.6)$



Summer 2017 Paper 1H (Non-Calc)

- 6 The equation of the line L_1 is $y = 3x - 2$
The equation of the line L_2 is $3y - 9x + 5 = 0$

Show that these two lines are parallel.

Algebra

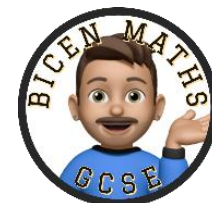
Linear Graphs

Parallel Lines

 **Video Solutions**

(2 marks)

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HOME

Algebra
Linear Graphs
<i>Parallel Lines</i>

6

comparison

M1

starts to manipulate expression e.g. $3y = 9x - 6$ or $3y = 9x - 5$

A1

gives equation(s) which can be used to show that the gradients of the two lines are the same e.g. $y = 3x - 5/3$

 **Video Solutions**

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HOME

19 A triangle has vertices P , Q and R .

The coordinates of P are $(-3, -6)$

The coordinates of Q are $(1, 4)$

The coordinates of R are $(5, -2)$

M is the midpoint of PQ .

N is the midpoint of QR .

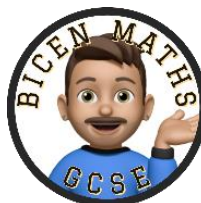
Prove that MN is parallel to PR .

You must show each stage of your working.

 **Video Solutions**

(3 marks)

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HOME

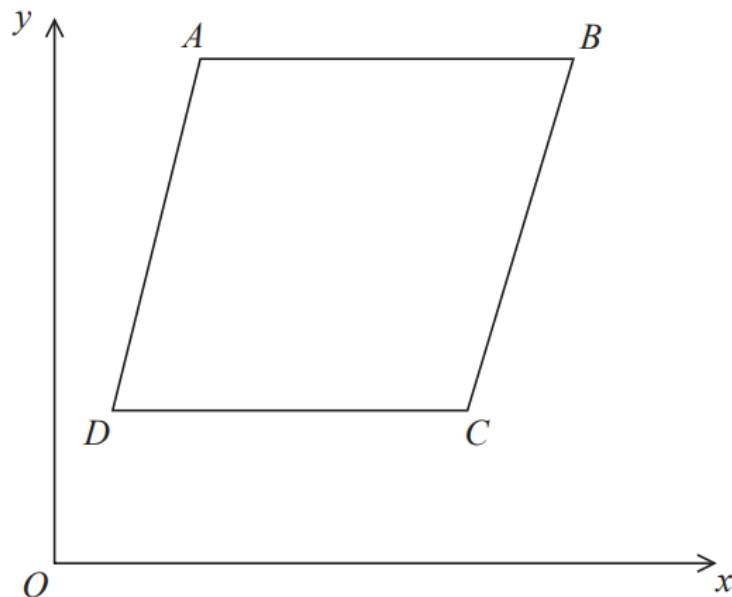
Algebra
Linear Graphs
<i>Parallel Lines</i>

19		Proof (supported)	M1	for a method to find coordinates of $M(-1, -1)$ or $N(3, 1)$
			M1	for method to find gradient of MN or PR or for method to find column vector for MN or PR or for differences of x coordinates and differences of y coordinates for MN or PR
			A1	for gradients of MN and PR , ie $\frac{1}{2}$ or or for column vectors of MN and PR , $\overrightarrow{MN} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$ and $\overrightarrow{PR} = \begin{pmatrix} 8 \\ 4 \end{pmatrix}$ or for differences of x coordinates and of y coordinates for MN and PR
			C1	for conclusion from reasoning and correct working

 **Video Solutions**

(3 marks)





$ABCD$ is a rhombus.

The coordinates of A are $(5, 11)$

The equation of the diagonal DB is $y = \frac{1}{2}x + 6$

Find an equation of the diagonal AC .

Algebra

Linear Graphs

Perpendicular Lines

 **Video Solutions**

(4 marks)

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HOME

18		$y = -2x + 21$	P1	shows evidence of understanding that AC is perpendicular to DB , or states the gradient of DB as 0.5 oe
			P1	shows a process to find the gradient of a perp. line e.g. use of $-\frac{1}{m}$ or states $y = -2x + c$ or states the gradient of AC as -2
			P1	(dep on P2) for sub. of $x = 5, y = 11$ into $y = mx + c$ where m is their found gradient for AC .
			A1	oe



Summer 2018 Paper 1H (Non-Calc)

- 19 The point P has coordinates $(3, 4)$
The point Q has coordinates (a, b)

A line perpendicular to PQ is given by the equation $3x + 2y = 7$

Find an expression for b in terms of a .

Algebra

Linear Graphs

Perpendicular Lines

 **Video Solutions**

(5 marks)

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19	$b = \frac{2}{3}a + 2$	P1	for process to rearrange the equation to give y in terms of x eg $y = \frac{7-3x}{2}$ or $y = -\frac{3}{2}x + \left(\frac{7}{2}\right)$ or $m = -\frac{3}{2}$	
		P1	for using their gradient in $mn = -1$	
		P1	for showing a process to find the gradient of PQ eg $\frac{b-4}{a-3}$ OR for substituting $x = 3$ and $y = 4$ in $y = \frac{2}{3}x + c$	
		P1	(dep P3) for forming an equation in a and b eg $\frac{b-4}{a-3} = \frac{2}{3}$ or $b = \frac{2}{3}a + 2$ OR correct equation in terms of x and y eg $y = \frac{2}{3}x + 2$	$y - 4 = \frac{2}{3}(x - 3)$ gets P4
		A1	for $b = \frac{2}{3}a + 2$ oe	Accept 0.66 or 0.67 oe for $\frac{2}{3}$



Summer 2019 Paper 2H (Calc)

Algebra

Linear Graphs

Perpendicular Lines

16 The straight line **L** has the equation $3y = 4x + 7$

The point *A* has coordinates $(3, -5)$

Find an equation of the straight line that is perpendicular to **L** and passes through *A*.

 **Video Solutions**

(3 marks)

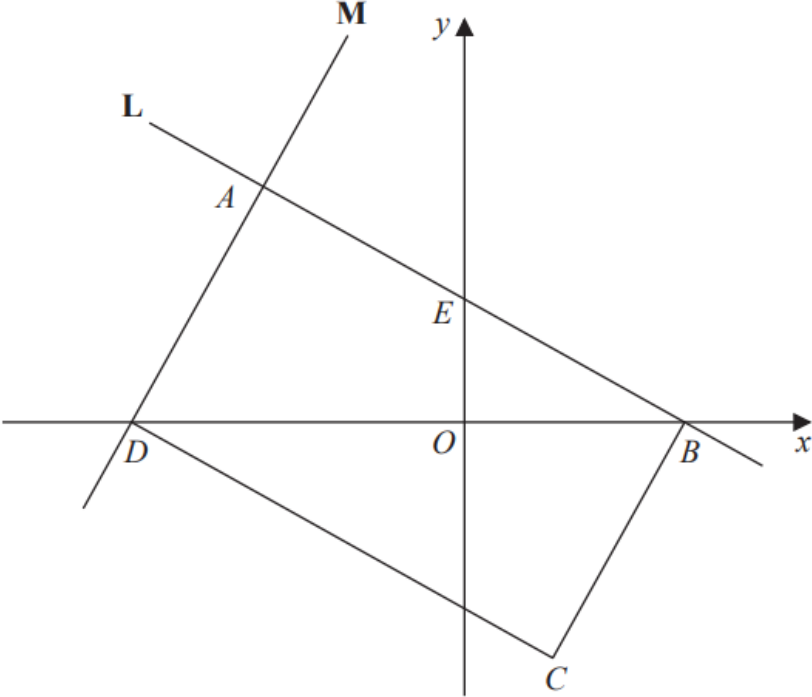
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HOME

16	$y = -\frac{3}{4}x - \frac{11}{4}$	M1	for identifying gradient of $\frac{4}{3}$	Ignore constant term
		M1	for beginning a method to find the gradient of the perpendicular line eg $\frac{4}{3} \times m = -1$ or identifies gradient of perpendicular line as $-\frac{3}{4}$	Can ft providing gradient is clearly stated
		A1	for $y = -\frac{3}{4}x - \frac{11}{4}$ or any equivalent equation	$4y + 3x = -11$ $y + 5 = -\frac{3}{4}(x - 3)$





Algebra
Linear Graphs
Perpendicular Lines

$ABCD$ is a rectangle.

A , E and B are points on the straight line L with equation $x + 2y = 12$

A and D are points on the straight line M .

$AE = EB$

Find an equation for M .

▶ **Video Solutions**

(4 marks)



19		$y = 2x + 36$	P1	starts process, eg by rearranging to find gradient, eg $y = 6 - \frac{x}{2}$ or $\frac{-1}{2}$ or positions of B and E
			P1	complete process to find position of A or uses $\frac{-1}{m}$ to find the gradient of M
			P1	complete process to find equation of M
			A1	$y = 2x + 36$ oe



November 2019 Paper 2H (Calc)

Algebra
Linear Graphs
<i>Perpendicular Lines</i>

25 The straight line **L** has equation $3x + 2y = 17$

The point *A* has coordinates (0, 2)

The straight line **M** is perpendicular to **L** and passes through *A*.

Line **L** crosses the *y*-axis at the point *B*.

Lines **L** and **M** intersect at the point *C*.

Work out the area of triangle *ABC*.

You must show all your working.

 **Video Solutions**

(5 marks)

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HOME

25	9.75	P1	process to find the gradient of L $\left(= -\frac{3}{2} \right)$
		P1	process to find the gradient of the perpendicular line M eg use of $-\frac{1}{m}$ or states gradient as $\frac{2}{3}$ or $y = \frac{2}{3}x + c$
		B1	(indep) gives y coordinate of $B = 8.5$ oe
		P1	(dep P2) process to find x coordinate of $C (= 3)$ or y coordinate of $C (= 4)$ eg the first stage of solving equations or using elimination by substitution, to find a coordinate of C .
		A1	9.75 oe

Could be indicated other ways, eg 8.5 on the y axis of a diagram
ft their linear equation for M with L; allow some error in manipulation of these linear equations as long as the overall process is correct.

Award 0 marks for a correct answer with no supportive working.



Summer 2020 Paper 1H (Non-Calc)

Algebra

Linear Graphs

Perpendicular Lines

15 The straight line L_1 has equation $y = 3x - 4$

The straight line L_2 is perpendicular to L_1 and passes through the point $(9, 5)$

Find an equation of line L_2

 **Video Solutions**

(3 marks)

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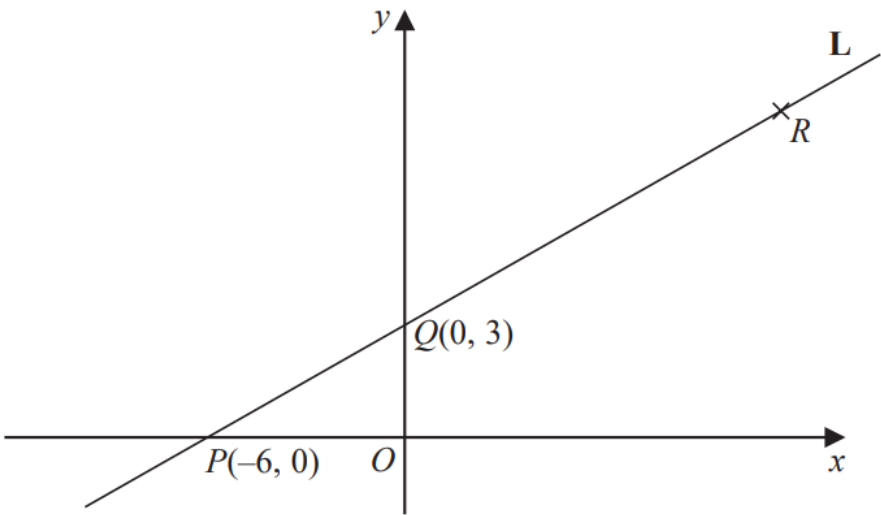


HOME

15	$y = -\frac{1}{3}x + 8$	M1	for a method for finding the gradient of L_2 eg use of $-\frac{1}{m}$ or $-\frac{1}{3}$	
		M1	(dep) for substitution of (9, 5) into $y = -\frac{1}{3}x + c$	
		A1	for $y = -\frac{1}{3}x + 8$ oe	$y - 5 = -\frac{1}{3}(x - 9)$ gets M2A1



11 Here is a sketch of the line L .



Algebra
Linear Graphs
Perpendicular Lines

The points $P(-6, 0)$ and $Q(0, 3)$ are points on the line L .

The point R is such that PQR is a straight line and $PQ:QR = 2:3$

(a) Find the coordinates of R .

(2 marks)

(b) Find an equation of the line that is perpendicular to L and passes through Q .

▶ **Video Solutions**

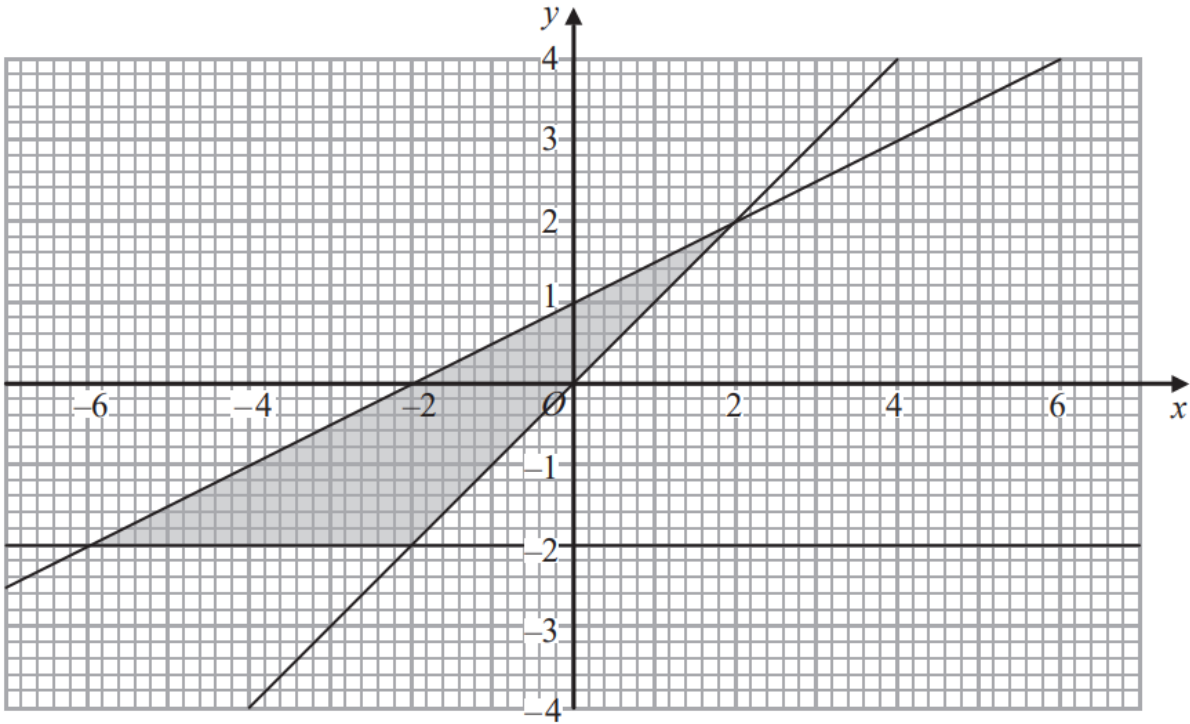
(3 marks)



11	(a)	(9, 7.5)	M1	for x coordinate = $PO(6) \times \frac{3}{2}$ (=9) or y coordinate = $OQ(3) \times \frac{5}{2}$ (= 7.5) or $PO(6) \times \frac{5}{2}$ (=15) or $OQ(3) \times \frac{3}{2}$ (= 4.5)	
			A1	cao	
	(b)	$y = -2x + 3$	P1	for process to find the gradient of the line, eg $3 \div 6$ (=0.5) or $y = mx + 3$	Could use P and R or Q and R as fit from (a)
			P1	for process to find gradient of perpendicular eg $-1 \div [\text{gradient of } PQ]$ (= -2)	
			A1	for $y = -2x + 3$ oe	



Algebra
Linear Graphs
Regions



Write down the three inequalities that define the shaded region.

 **Video Solutions**

(4 marks)



Algebra
Linear Graphs
Regions

13

|

$y \geq -2, y \geq x$
and $y \leq 0.5x + 1$

M1
M1
M1
A1

$y = -2$ indicated; accept any inequality for “=”
 $y = x$ oe indicated; accept any inequality for “=”
 $y = 0.5x + 1$ oe indicated; accept any inequality for “=”
 $y \geq -2, y \geq x$ and $y \leq 0.5x + 1$

 **Video Solutions**



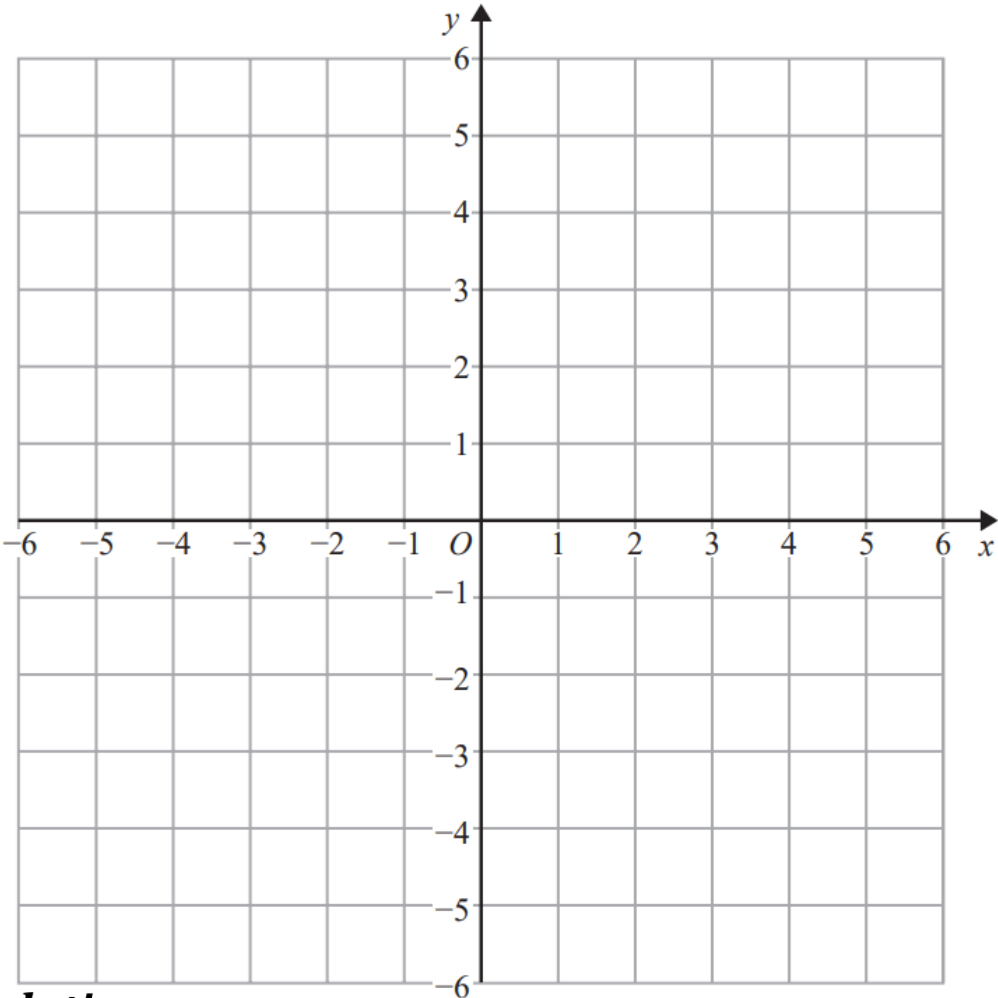
HOME

November 2017 Paper 2H (Calc)

14 On the grid, shade the region that satisfies all these inequalities.

$y > 1$ $x + y < 5$ $y > 2x$

Label the region **R**.



Algebra
Linear Graphs
Regions

 **Video Solutions**

(3 marks)

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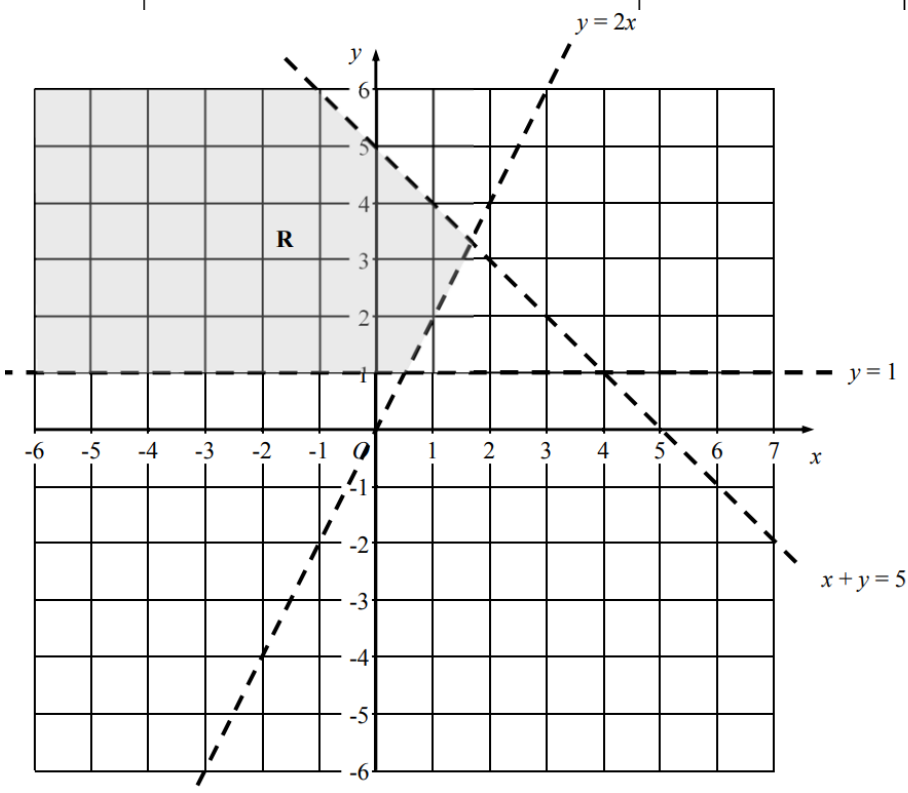


  **HOME**

Algebra
Linear Graphs
Regions

14

Region R
shaded



- M1 for two of the lines $y = 1$, $x + y = 5$, $y = 2x$ correctly drawn
- M1 for three lines correctly drawn
- A1 for fully correct region indicated with all lines correct

 **Video Solutions**



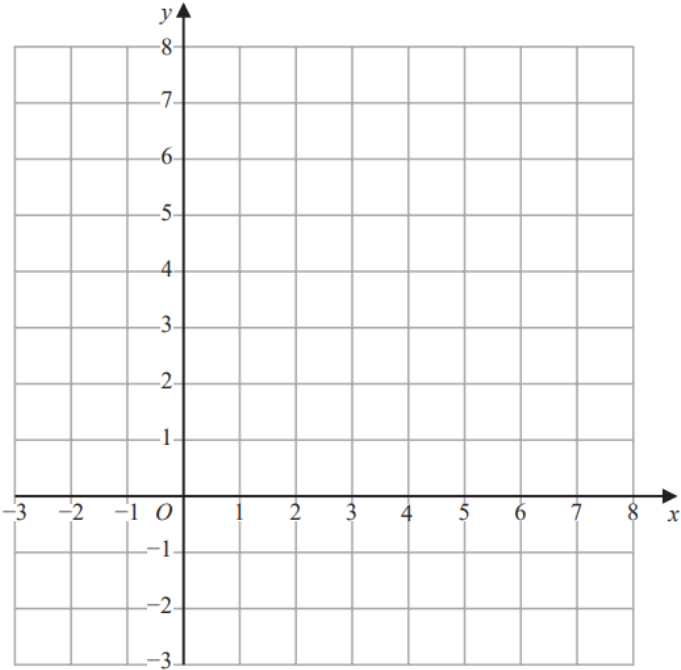
Algebra
Linear Graphs
Regions

13 (a) On the grid show, by shading, the region that satisfies all these inequalities.

$x \geq 0$ $x \leq 2$ $y \leq x + 3$ $2x + 3y \geq 6$

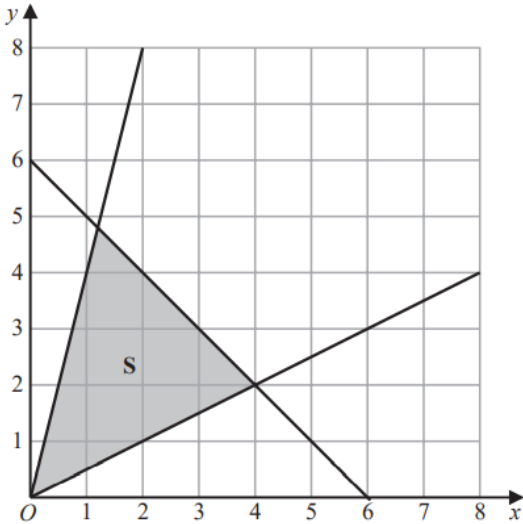
(4 marks)

Label the region R.



(b) The diagram below shows the region S that satisfies the inequalities

$y \leq 4x$ $y \geq \frac{1}{2}x$ $x + y \leq 6$



Geoffrey says that the point with coordinates (2, 4) does not satisfy all the inequalities because it does not lie in the shaded region.

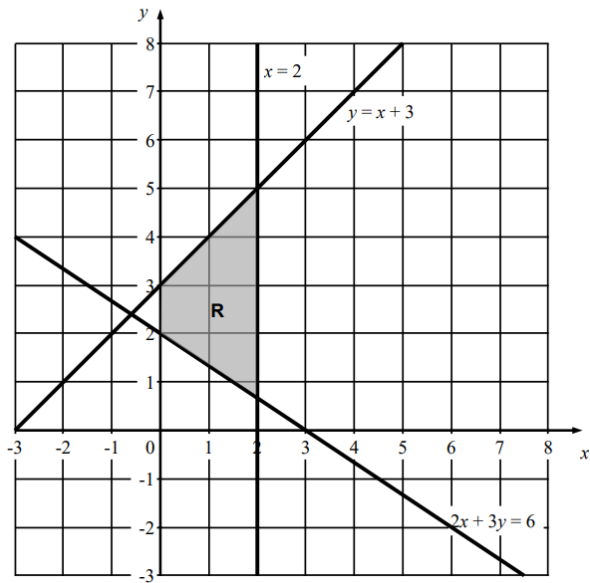
Is Geoffrey correct?
You must give a reason for your answer.

(1 mark)



Algebra
Linear Graphs
Regions

13	(a)	region identified	M1	for 2 of lines $x = 2$, $y = x + 3$, $2x + 3y = 6$ correctly drawn	Accept use of full or broken lines for all marks Award for clear intention, shading not needed. Award for clear intention, shading not needed.
			M1	for all 3 lines $x = 2$, $y = x + 3$, $2x + 3y = 6$ correctly drawn	
			M1	for region which satisfies at least 2 of the inequalities $x \leq 2$, $y \leq x + 3$, $2x + 3y \geq 6$	
			A1	for correct region identified	
	(b)	no supported with reason	B1	for no and reason, eg $(2, 4)$ does satisfy $x + y \leq 6$ or $(2, 4)$ lies on the boundary of the region satisfying the equality sign.	



Algebra
Linear Graphs
Regions

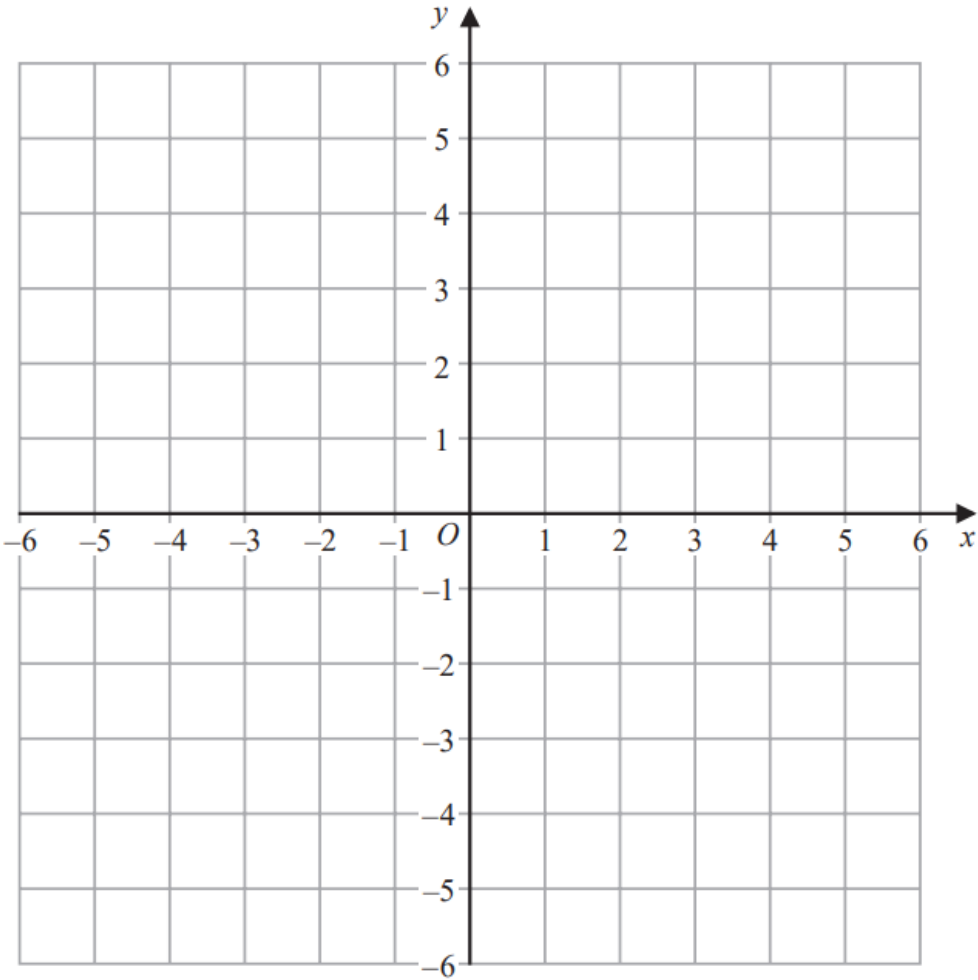
17 On the grid show, by shading, the region that satisfies all of these inequalities.

$2y + 4 < x$

$x < 3$

$y < 6 - 3x$

Label the region **R**.



 **Video Solutions**

(3 marks)



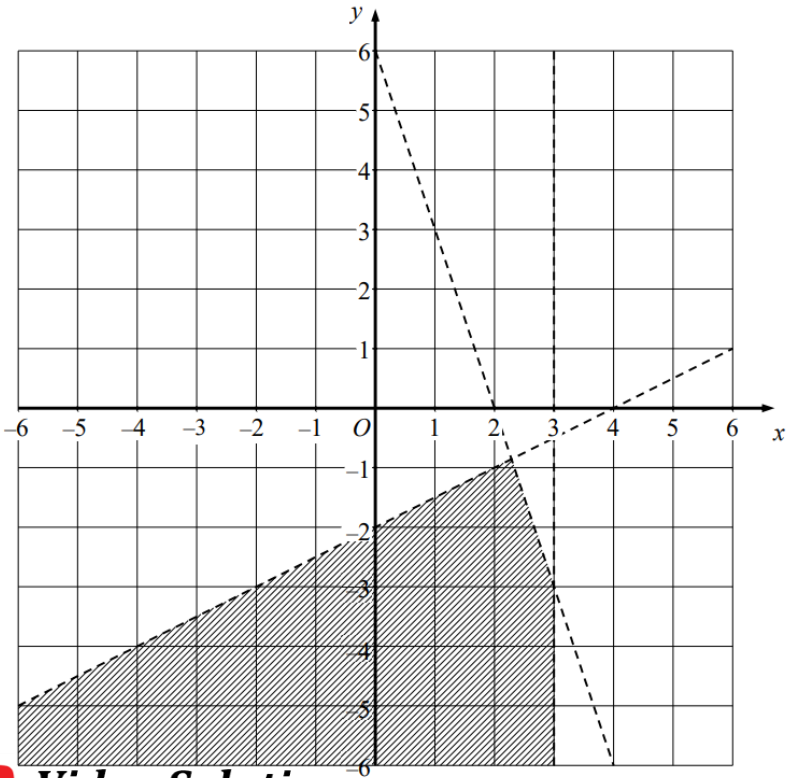
Algebra
Linear Graphs
Regions

17	Region shaded	M1	for two of the lines $2y + 4 = x$, $x = 3$, $y = 6 - 3x$ correctly drawn
		M1	for all three correct lines correctly drawn
		A1	for a fully correct region indicated with all lines correct

Accept full or broken lines for all marks

Award for clear intention, shading not needed

Diagram at end of mark scheme



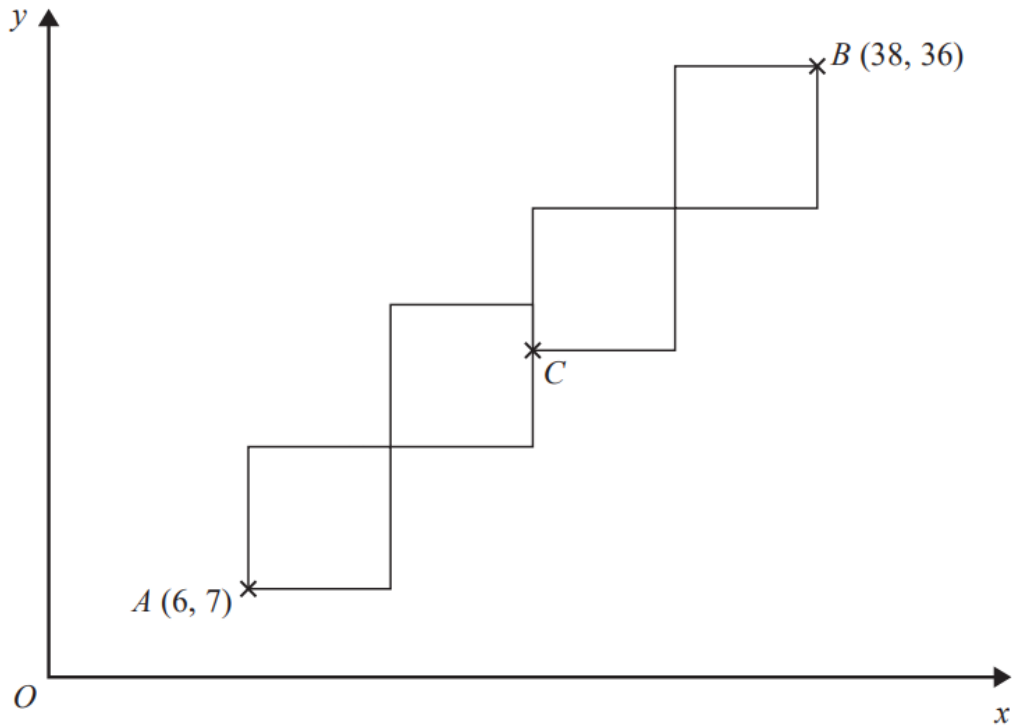
 **Video Solutions**



Summer 2018 Paper 1H (Non-Calc)

6 A pattern is made from four identical squares.

The sides of the squares are parallel to the axes.



Point A has coordinates $(6, 7)$
Point B has coordinates $(38, 36)$
Point C is marked on the diagram.

Work out the coordinates of C .

Algebra
Linear Graphs
<i>Understanding coordinates</i>

 **Video Solutions**

(5 marks)



Algebra
Linear Graphs
<i>Understanding coordinates</i>

6	(22, 20)	P1	for process to find width or height of diagram eg $38 - 6 (= 32)$ or $36 - 7 (= 29)$	Figures may be shown on the diagram
		P1	for process to find length of side of square eg $"32" \div 4 (= 8)$ or process to find half width of diagram eg $"32" \div 2 (= 16)$	
		P1	for process to find x coordinate eg $6 + 2 \times "8" (= 22)$ or $6 + "16" (= 22)$ or $(6 + 38) \div 2 (= 22)$	If $(6 + 38) \div 2$ leads to an answer other than 22, award P2 only
		P1	for process to find y coordinate eg $36 - 2 \times "8" (= 20)$ or $36 - "16" (= 20)$ or $7 + "8" + "29" - 3 \times "8" (= 20)$	
		A1	cao SC: award 4 marks for (20, 22)	Award for P3 for (22, y) or (x, 20) or $x = 22$ or $y = 20$



Algebra

Non-Linear Graphs

Quadratics

Cubics

Exponentials

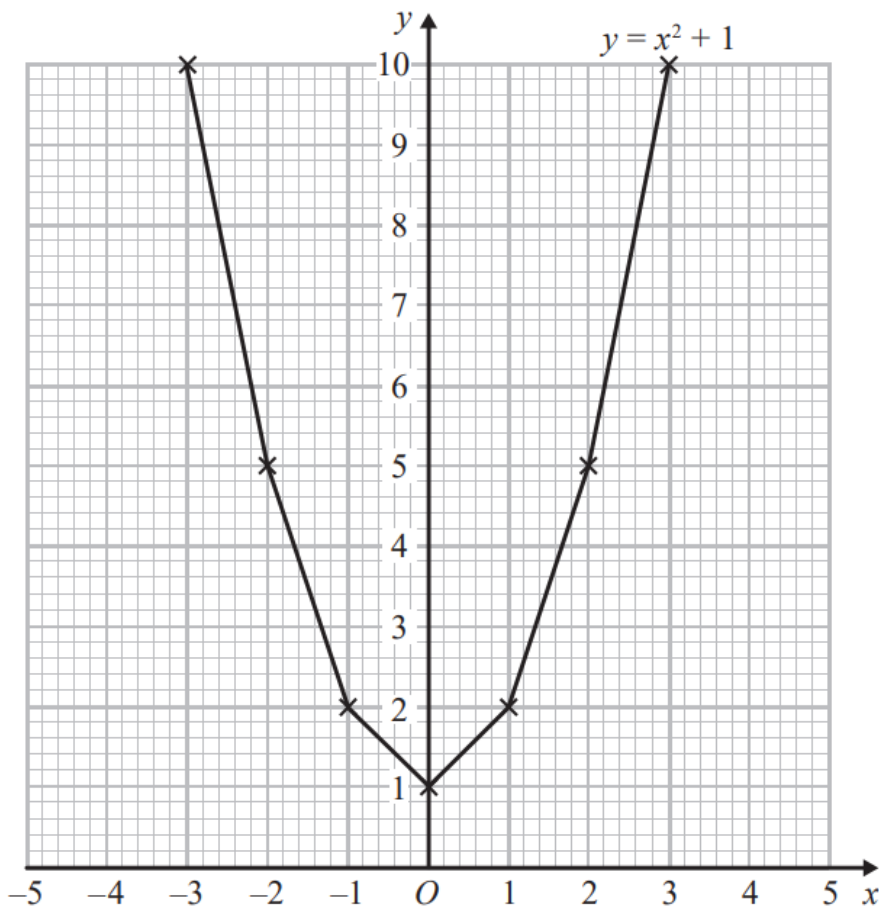
Types of Graphs



November 2017 Paper 1H (Non-Calc)

7 Brogan needs to draw the graph of $y = x^2 + 1$

Here is her graph.



Write down one thing that is wrong with Brogan's graph.

Algebra
Non-Linear Graphs
Drawing Quadratics

 **Video Solutions**

(1 mark)

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7

Comment

B1

for correct mathematical comment eg line segments not a curve **or** should draw freehand **or** should not use a ruler, **or** should be a curve

NB Do not accept statements about scale or plotting accuracy.

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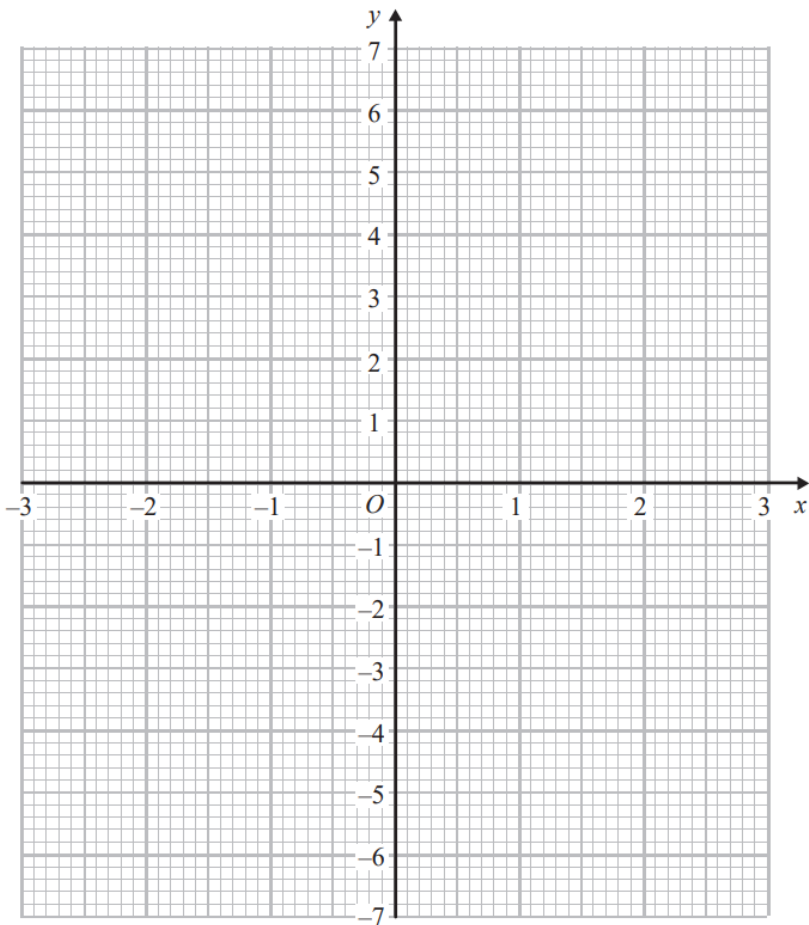
Summer 2018 Paper 2H (Calc)

5 (a) Complete the table of values for $y = x^2 - x - 6$

x	-3	-2	-1	0	1	2	3
y	6			-6			

(2 marks)

(b) On the grid, draw the graph of $y = x^2 - x - 6$ for values of x from -3 to 3



(2 marks)

(c) Use your graph to find estimates of the solutions to the equation $x^2 - x - 6 = -2$

(2 marks)

Algebra
Non-Linear Graphs
Drawing Quadratics

 **Video Solutions**



Algebra
Non-Linear Graphs
Drawing Quadratics

5	(a)	0, -4, -6, -4, 0	B2 (B1	fully correct figures at least 2 correct figures)	
	(b)	Graph	M1 A1	(dep B1) for at least 5 points correctly plotted ft from (a) fully correct graph	Must be a curve
	(c)	2.6 and -1.6	M1	for $y = -2$ drawn or intersections with $y = -2$ or $y = x^2 - x - 4$ drawn or 1 correct value	If answers stated as coordinates, award M1 for both coordinates and M0 for one coordinate
			A1	ft a quadratic graph or for answers in the range 2.5 to 2.7 and -1.5 to -1.7	



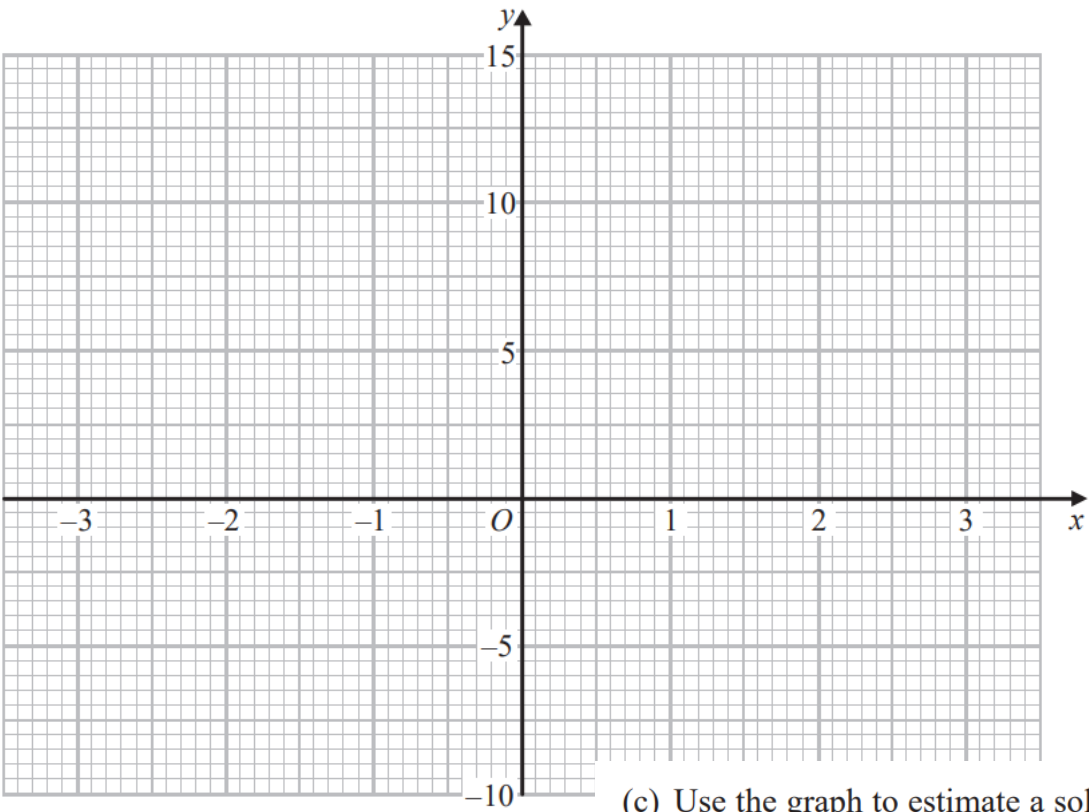
November 2018 Paper 3H (Calc)

3 (a) Complete this table of values for $y = x^2 + x - 4$

x	-3	-2	-1	0	1	2	3
y		-2	-4		-2		

(2 marks)

(b) On the grid, draw the graph of $y = x^2 + x - 4$ for values of x from -3 to 3



(2 marks)

(c) Use the graph to estimate a solution to $x^2 + x - 4 = 0$

Algebra

Non-Linear Graphs

Drawing Quadratics

 **Video Solutions**



3	(a)	2, -4, 2, 8	B2	all 4 values correct
			(B1	for 2 or 3 correct values)
	(b)	Graph	M1	(dep B1) for at least 5 points plotted correctly ft from part a
			A1	for a fully correct curve drawn
	(c)	-2.6 or 1.6	B1	for 1 correct value, ft a non linear graph

Accept freehand curves drawn that are not line segments; there must be some attempt to draw the minimum point below $y = -4$

Award for -2.6 or 1.6 or both values but do not award the mark if a correct value is given with an incorrect value.
Accept 1.56 or -2.56
Note for ft to be applied if the graph may be joined by line segments



November 2021 Paper 2H (Calc)

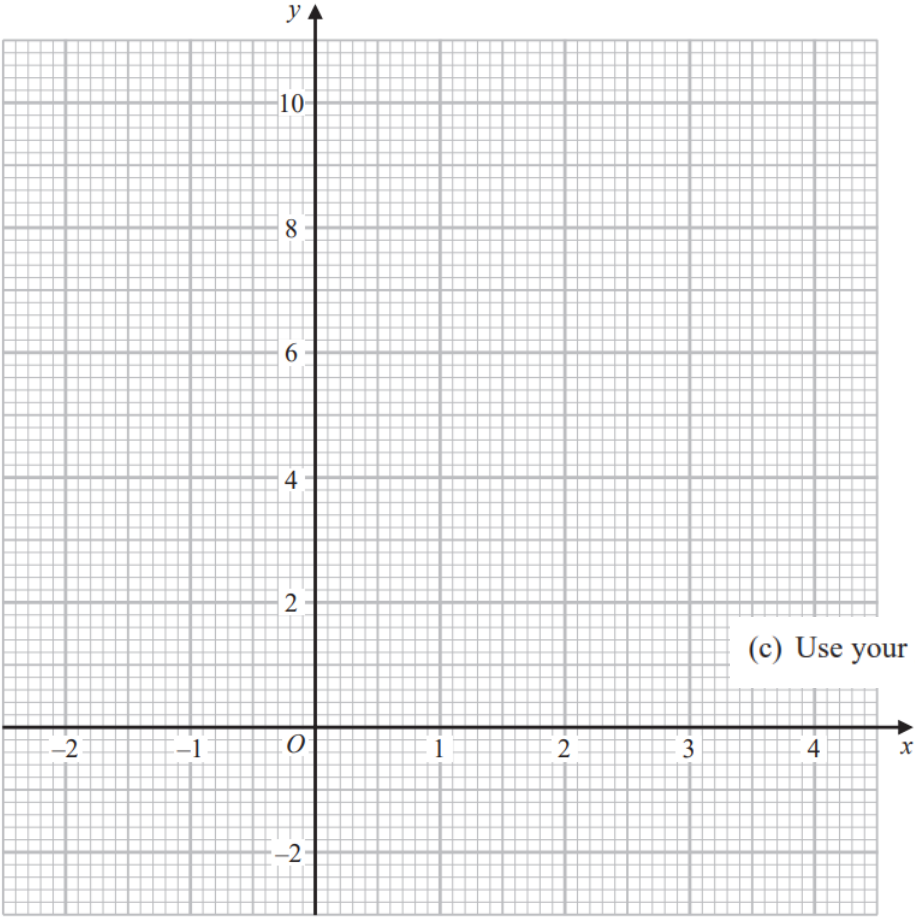
4 (a) Complete the table of values for $y = x^2 - 2x + 2$

x	-2	-1	0	1	2	3	4
y	10		2			5	

(2)

(b) On the grid, draw the graph of $y = x^2 - 2x + 2$ for values of x from -2 to 4

(2)



(c) Use your graph to find estimates of the solutions of the equation $x^2 - 2x + 2 = 4$

(2)

Algebra

Non-Linear Graphs

Drawing Quadratics



4	(a)	(10), 5, (2), 1, 2, (5), 10	B2	for all 4 values correct
			(B1	for 2 or 3 correct values)
	(b)	Graph	M1	fit (dep on B1) for plotting at least 5 of their points correctly
			A1	for a fully correct curve drawn
	(c)	−0.65 to −0.8 and 2.65 to 2.8	M1	for $y = 4$ drawn or intersection with $y = 4$ or $y = x^2 - 2x - 2$ drawn or 1 correct value fit a quadratic graph
			A1	fit a quadratic graph or for answers in the range 2.65 to 2.8 and −0.65 to −0.8

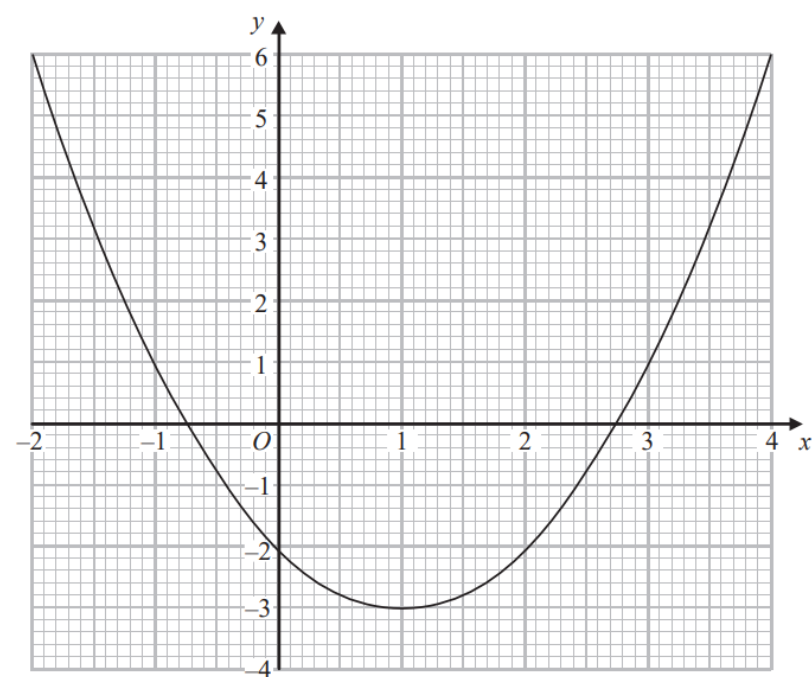
Accept a freehand curve drawn that is not made of line segments

If answers stated as coordinates, award M1 for both coordinates and M0 for one coordinate



Summer 2017 Paper 1H (Non-Calc)

11 The graph of $y = f(x)$ is drawn on the grid.



Algebra
Non-Linear Graphs
Quadratics

(a) Write down the coordinates of the turning point of the graph.

(..... ,)
(1)

(b) Write down estimates for the roots of $f(x) = 0$

.....
(1)

(c) Use the graph to find an estimate for $f(1.5)$

.....
(1)

 **Video Solutions**



Algebra
Non-Linear Graphs
<i>Quadratics</i>

11	(a)		$1, -3$	B1	cao
	(b)		$-0.75, 2.75$	B1	accept -0.7 to -0.8 , 2.7 to 2.8
	(c)		-2.8	B1	cao

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Summer 2020 Paper 2H (Calc)

Algebra
Non-Linear Graphs
<i>Drawing Cubics</i>

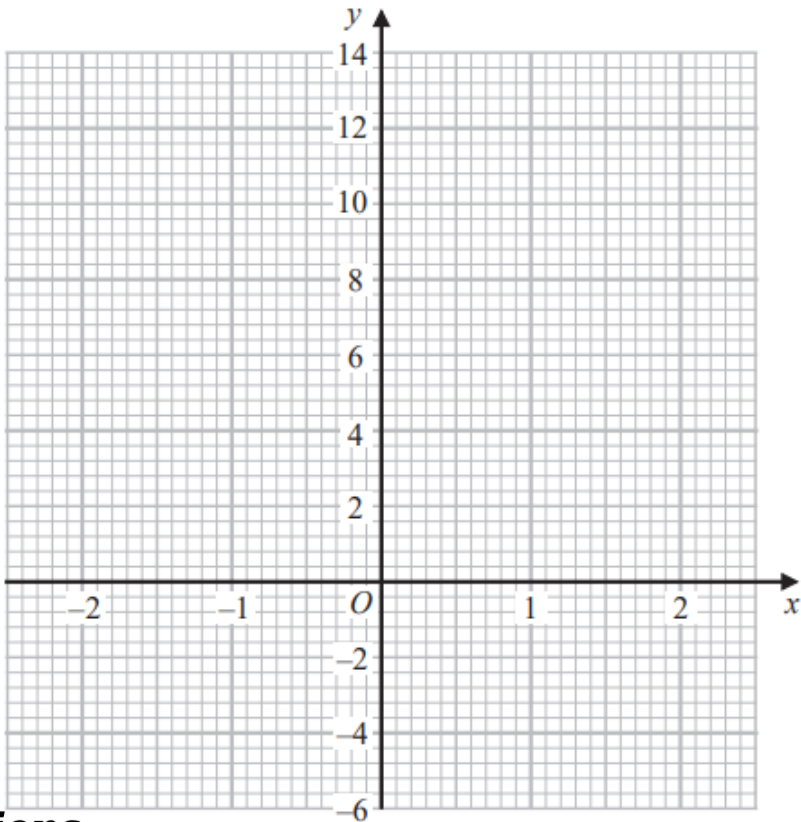
4 (a) Complete the table of values for $y = 5 - x^3$

x	-2	-1	0	1	2
y		6			

(2 marks)

(2)

(b) On the grid below, draw the graph of $y = 5 - x^3$ for values of x from -2 to 2



(2)

 **Video Solutions**

(2 marks)

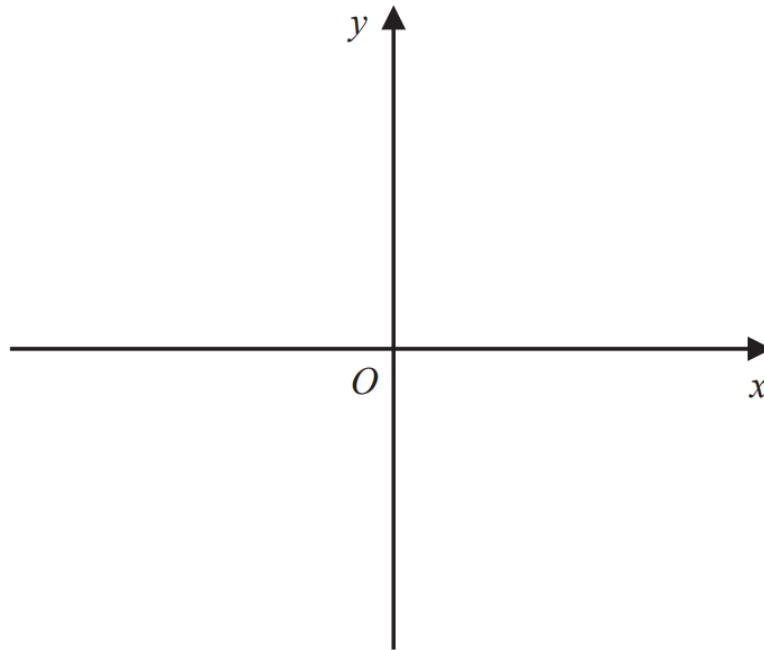


4	(a)	13, (6), 5, 4, −3	B2	for all 4 values correct	
			(B1	for 2 or 3 correct values)	
	(b)	Correct graph	M1	fit (dep on B1) for plotting at least 4 of the points from their table correctly	
			A1	for a fully correct curve drawn	

Accept a freehand curve drawn that is not made of line segments
Line sections outside the required range can be ignored.



- 14 On the grid, sketch the curve with equation $y = 2^x$
Give the coordinates of any points of intersection with the axes.



Algebra

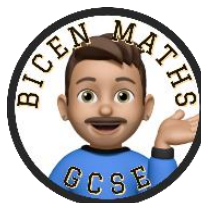
Non-Linear Graphs

*Drawing
Exponentials*

 **Video Solutions**

(2 marks)

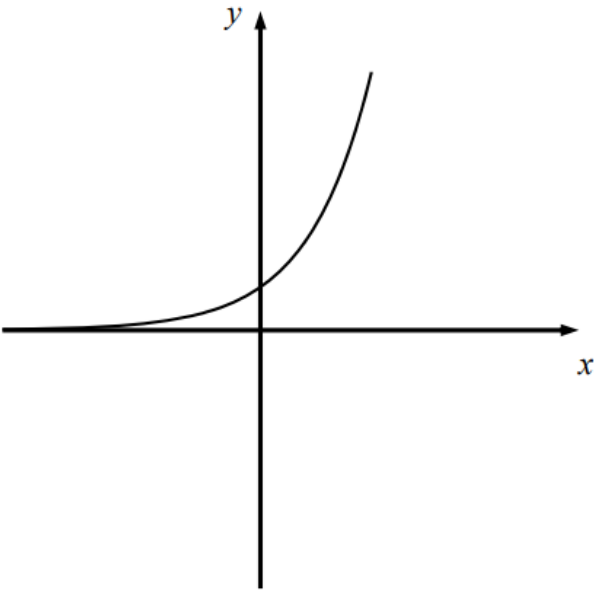
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HOME

Algebra
Non-Linear Graphs
Drawing Exponentials

14	curve	C1	sketch of graph which starts above x -axis for negative x , and makes an increasing exponential rise into positive x	Condone graph “touching” the x axis. Do not award from a graph for positive x only.
	(0,1) labelled	C1	for showing a label of (0,1) on the y axis	Do not award if a point is given for crossing the x -axis. Accept the coordinates shown as a label of “1” written on the y axis at the intersection.

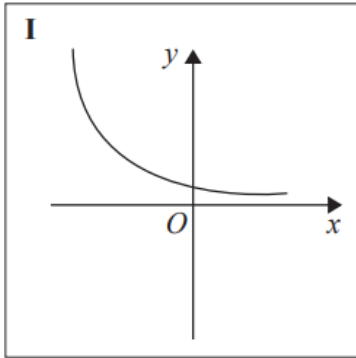
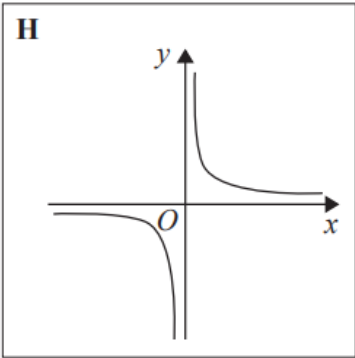
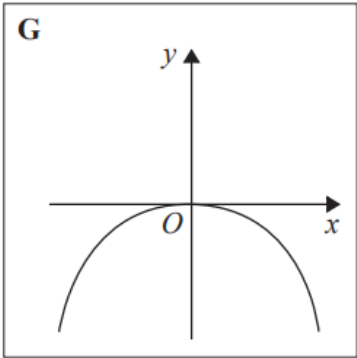
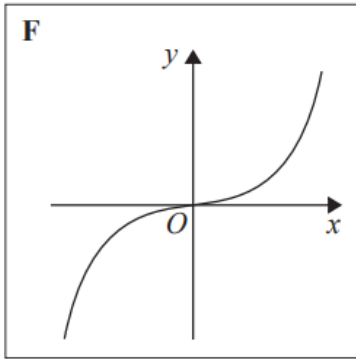
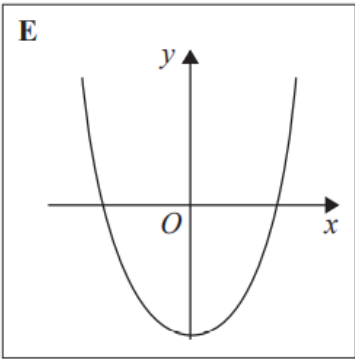
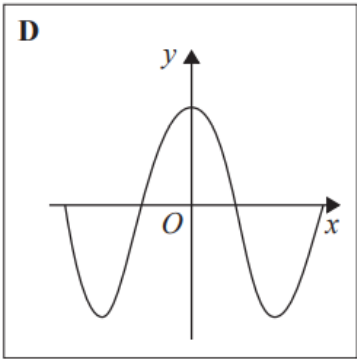
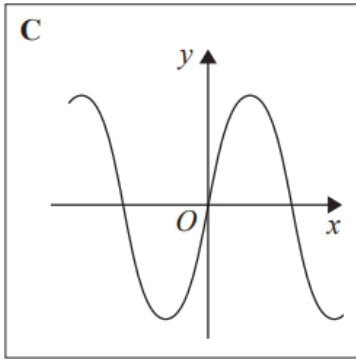
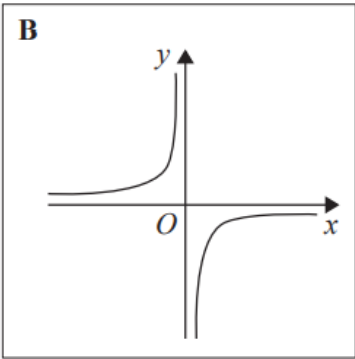
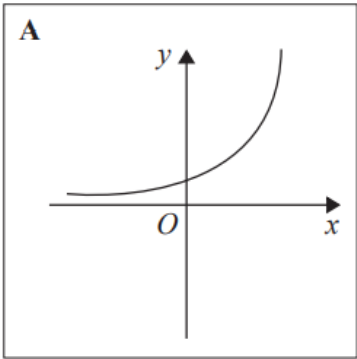


 **Video Solutions**



Summer 2017 Paper 2H (Calc)

14 Here are some graphs. In the table below, match each equation with the letter of its graph.



Algebra

Non-Linear Graphs

Types of Graphs



Video Solutions

Equation	Graph
$y = \sin x$	
$y = x^3 + 4x$	
$y = 2^x$	
$y = \frac{4}{x}$	

(3 marks)



HOME

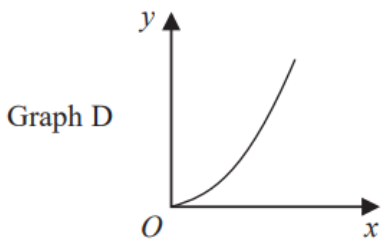
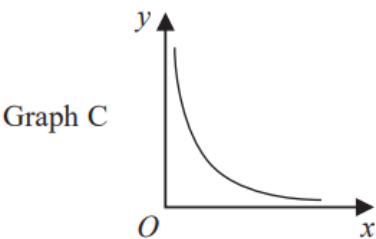
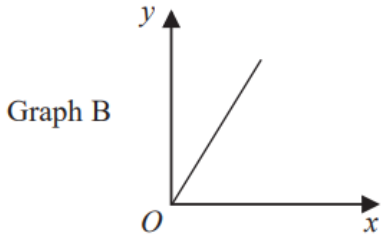
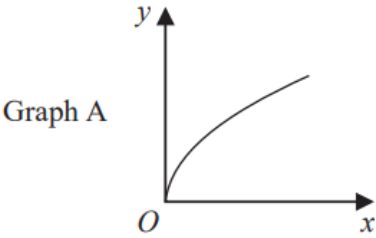
Algebra
Non-Linear Graphs
<i>Types of Graphs</i>

14		C, F, A, H	B3 [B2 [B1	for a fully correct table for 2 or 3 correct] for 1 correct]
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 **Video Solutions**



Algebra
Non-Linear Graphs
Types of Graphs



The graphs of y against x represent four different types of proportionality.
Match each type of proportionality in the table to the correct graph.

Type of proportionality	Graph letter
$y \propto x$	
$y \propto x^2$	
$y \propto \sqrt{x}$	
$y \propto \frac{1}{x}$	

 **Video Solutions**

(2 marks)



Algebra
Non-Linear Graphs
<i>Types of Graphs</i>

12	BDAC	B2	all correct
		(B1	for at least 2 correct)

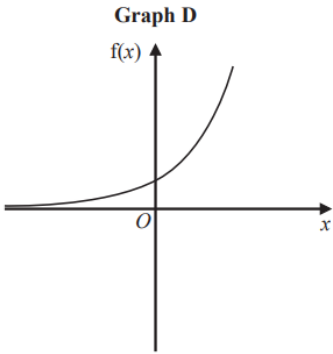
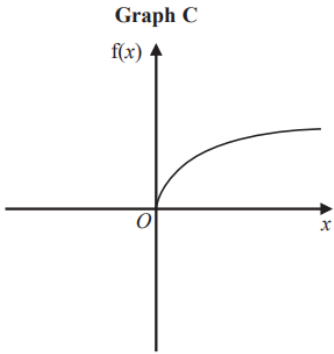
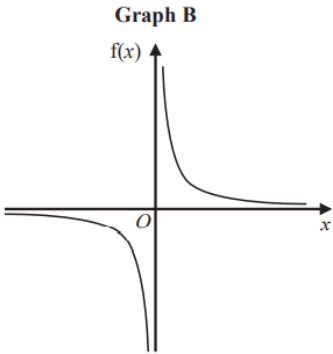
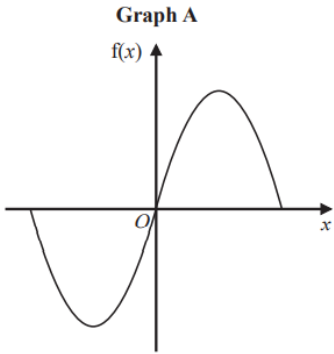
 **Video Solutions**



Summer 2019 Paper 3H (Calc)

Algebra
Non-Linear Graphs
<i>Types of Graphs</i>

17 Here are four graphs.



The graphs represent four different types of function f.

Match each description of the function in the table to the letter of its graph.

Description of function	Graph
$f(x)$ is inversely proportional to x	
$f(x)$ is a trigonometrical function	
$f(x)$ is an exponential function	
$f(x)$ is directly proportional to $\sqrt{x}$	



 **Video Solutions**

(2 marks)



Algebra
Non-Linear Graphs
<i>Types of Graphs</i>

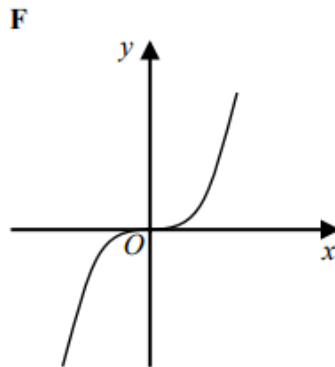
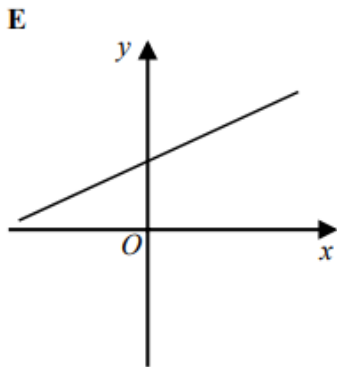
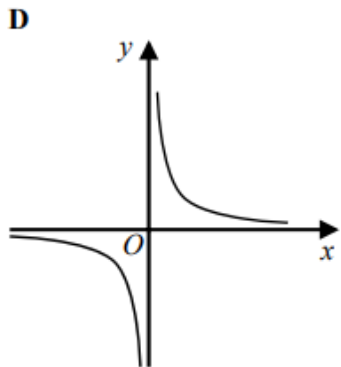
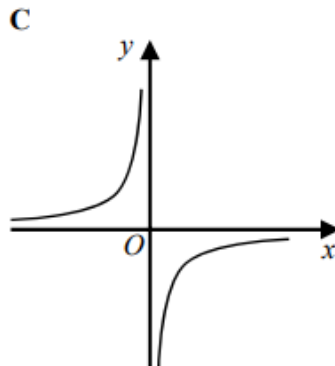
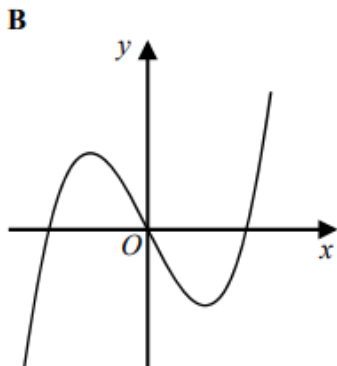
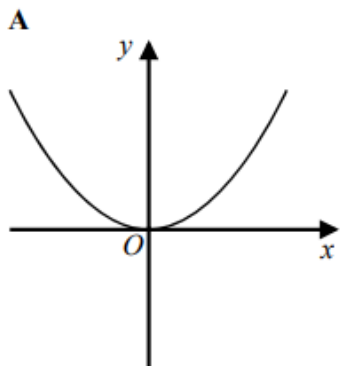
17	B, A, D, C	B2	for all correct
		(B1	for two or three correct)

 **Video Solutions**



November 2019 Paper 2H (Calc)

5 Here are six graphs.



Write down the letter of the graph that could have the equation

(a) $y = x^3$

.....
(1)

(b) $y = \frac{1}{x}$

.....
(1)

Algebra

Non-Linear Graphs

Types of Graphs



 **Video Solutions**

(2 marks)

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Algebra
Non-Linear Graphs
<i>Types of Graphs</i>

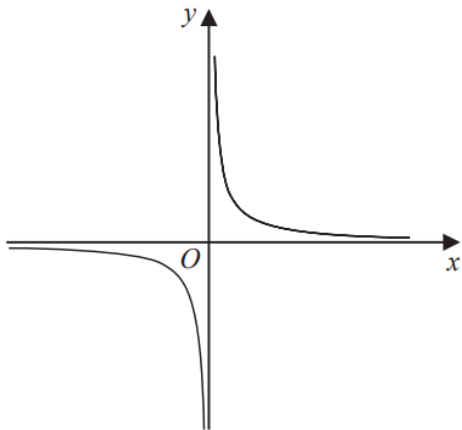
5	(a)	F	B1	cao
	(b)	D	B1	cao

 **Video Solutions**

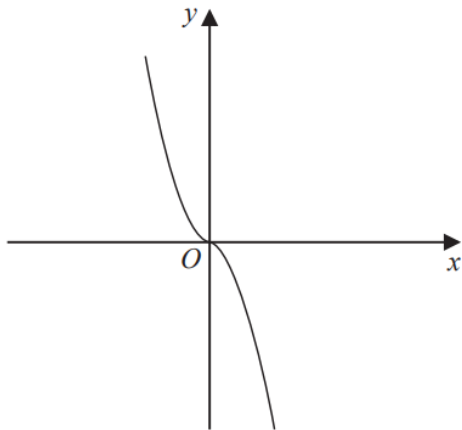


Summer 2020 Paper 1H (Non-Calc)

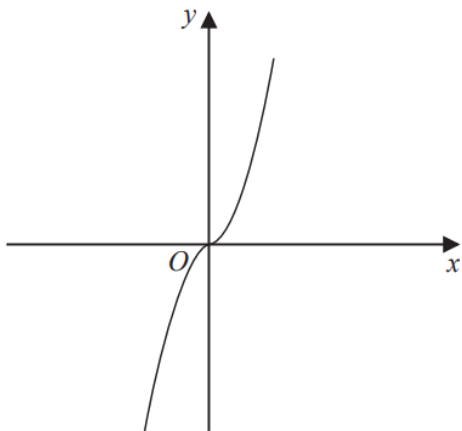
3 The diagram shows four graphs.



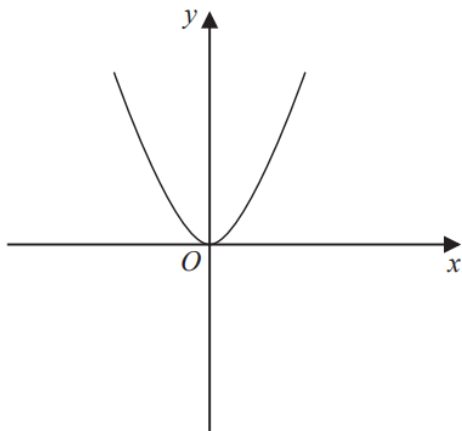
Graph A



Graph B



Graph C



Graph D

Each of the equations in the table is the equation of one of the graphs.
Complete the table.

Equation	Letter of graph
$y = -x^3$	
$y = x^3$	
$y = x^2$	
$y = \frac{1}{x}$	

 **Video Solutions**

(2 marks)



Algebra
Non-Linear Graphs
<i>Types of Graphs</i>

3	B C D A	B2	cao
		(B1	for two or three correct)

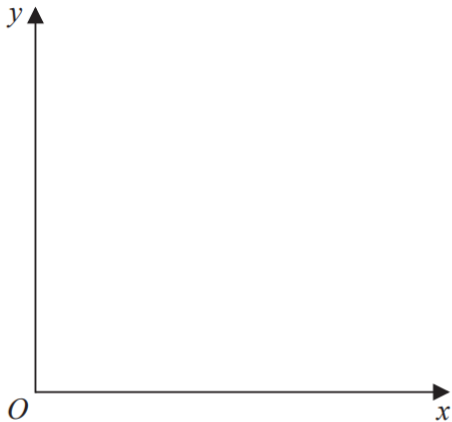
 **Video Solutions**



November 2021 Paper 3H (Calc)

8 (a) Using the axes below, sketch a graph to represent the statement

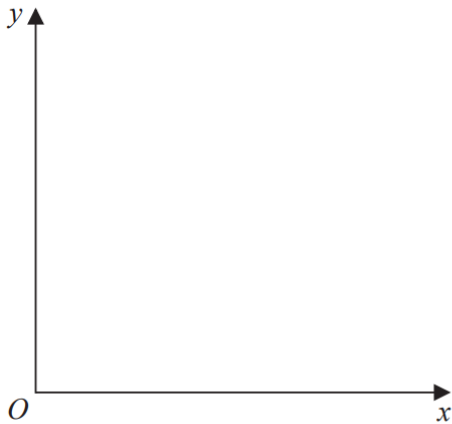
y is directly proportional to x



(1 mark)

(b) Using the axes below, sketch a graph to represent the statement

y is inversely proportional to x



 **Video Solutions**

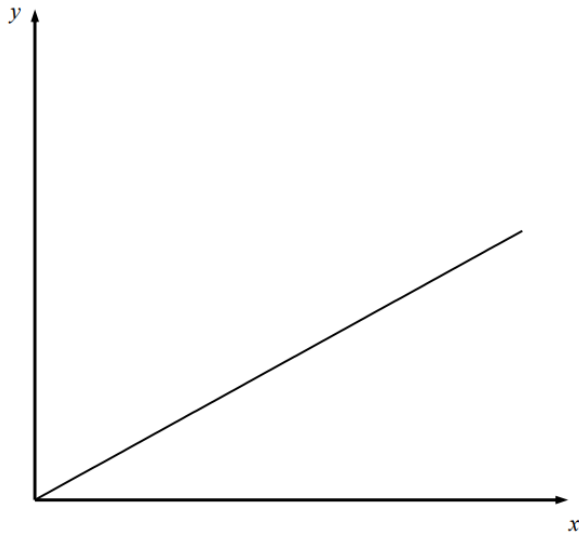
(1 mark)

Algebra
Non-Linear Graphs
<i>Types of Graphs</i>

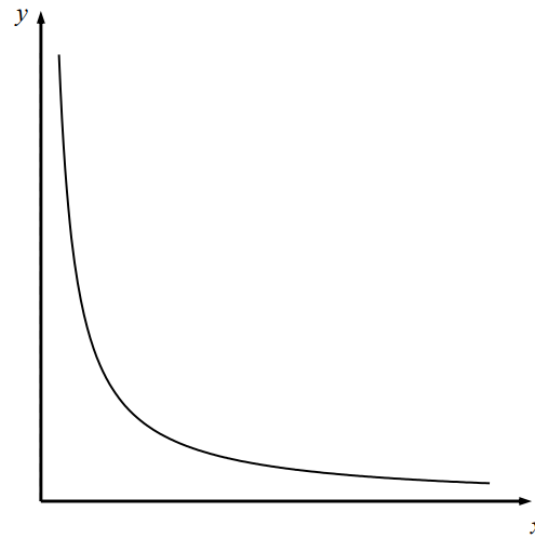


HOME

Question 8(a)



Question 8(b)



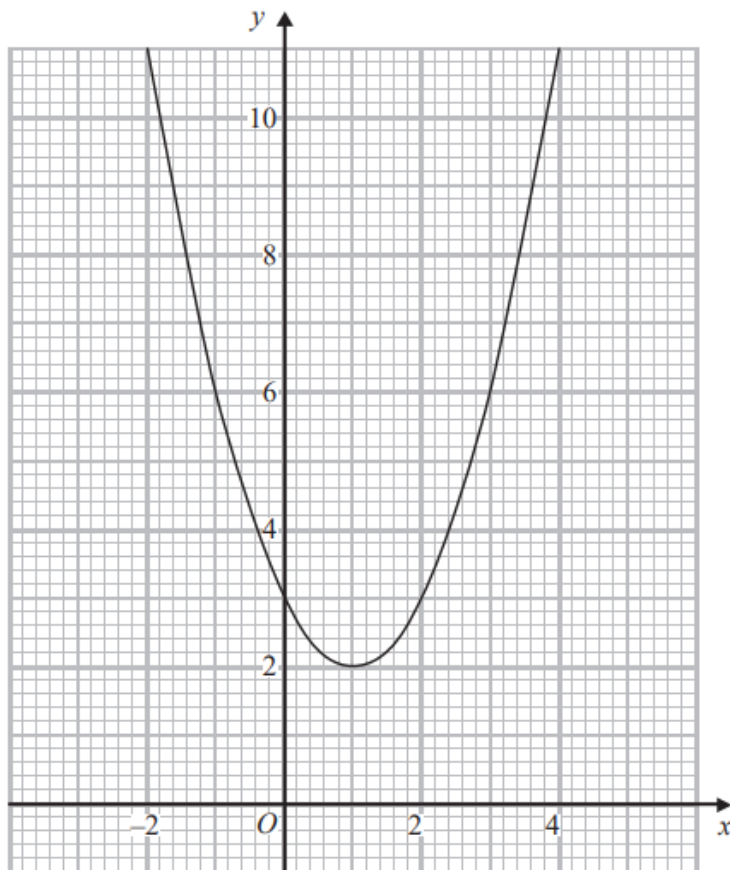
Algebra

Solving Equations with Graphs



Summer 2017 Paper 2H (Calc)

20 The diagram shows part of the graph of $y = x^2 - 2x + 3$



- (a) By drawing a suitable straight line, use your graph to find estimates for the solutions of $x^2 - 3x - 1 = 0$

Algebra

Solving Equations
with Graphs

 **Video Solutions**

(2 marks)

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Algebra
Solving Equations with Graphs

20	(a)		-0.4 to -0.2 and 3.2 to 3.4	M1	for $(y =) x + 4$
				A1	for answers in the range -0.4 to -0.2 and 3.2 to 3.4

 **Video Solutions**

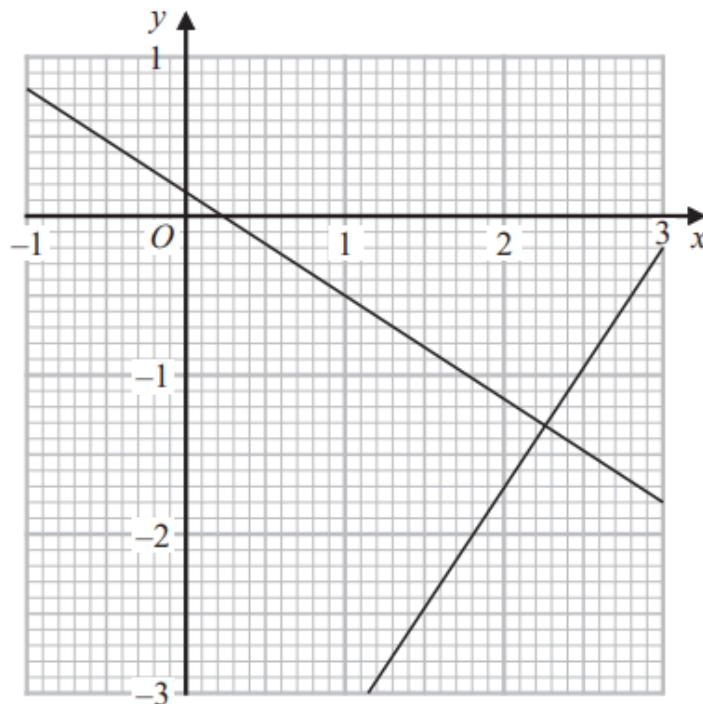


Summer 2019 Paper 1H (Non-Calc)

Algebra

Solving Equations
with Graphs

- 10 The graphs with equations $3y + 2x = \frac{1}{2}$ and $2y - 3x = -\frac{113}{12}$ have been drawn on the grid below.



Using the graphs, find estimates of the solutions of the simultaneous equations

$$3y + 2x = \frac{1}{2}$$

$$2y - 3x = -\frac{113}{12}$$

 **Video Solutions**

(2 marks)

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HOME

10	$x = 2.2$ to 2.3 $y = -1.3$ to -1.4	M1	for recognition of use of intersection point, one of the solutions given, solutions reversed or solutions given as a coordinate.
		A1	x given in the range 2.2 to 2.3 , y given in the range -1.3 to -1.4

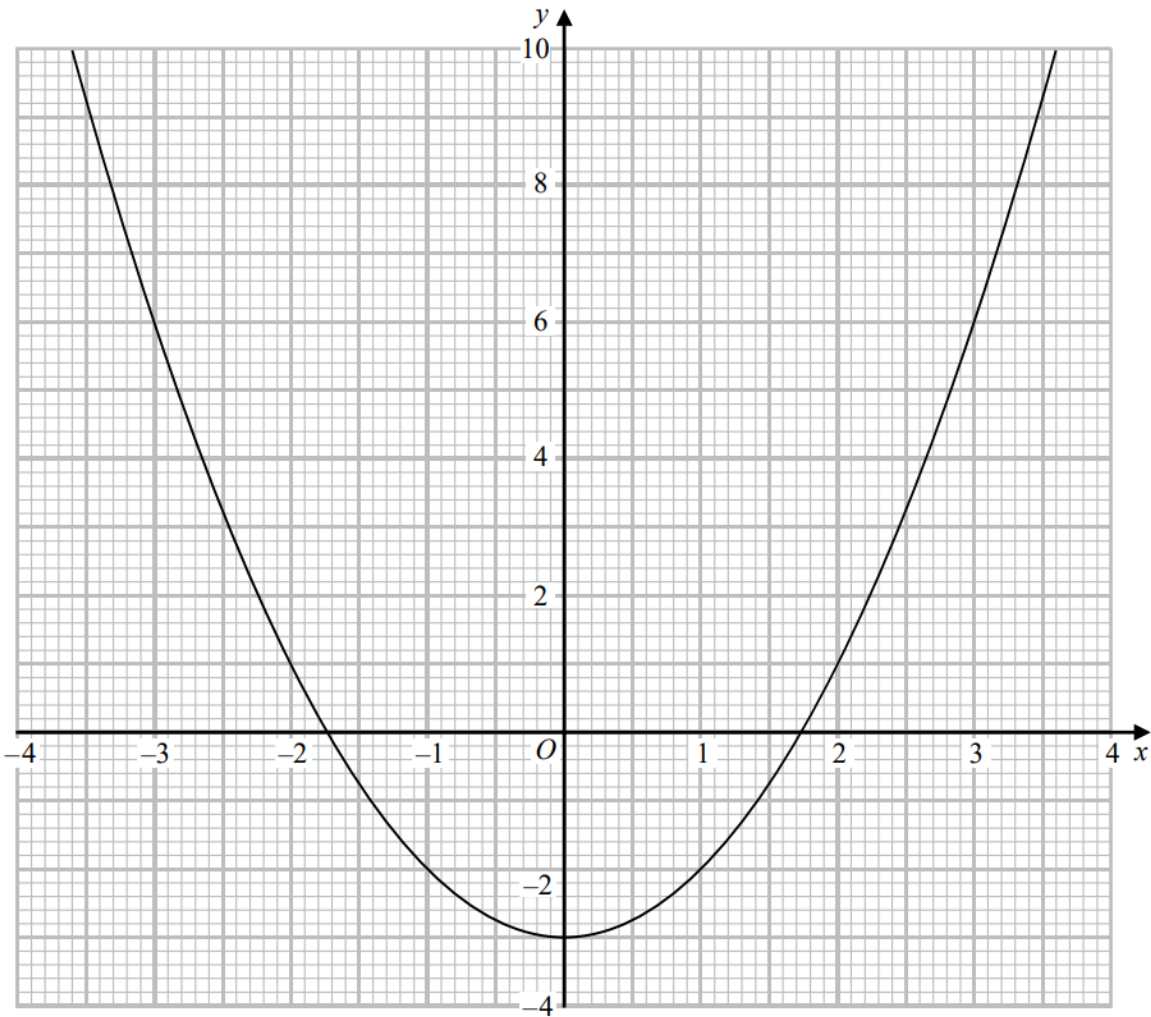
 **Video Solutions**

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HOME

17 Here is the graph of $y = x^2 - 3$



Use the graph to find estimates for the solutions to the equation $x^2 - 2x - 2 = 0$
You must show how you get your solutions.

Algebra
Solving Equations with Graphs

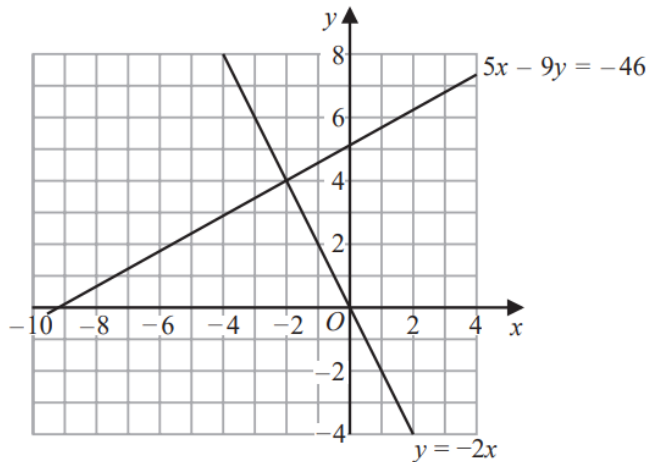
Video Solutions
(4 marks)

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17	2.7 and -0.7	M1	for $x^2-3 = 2x-1$ oe or $x^2-3 -2x + 1 (=0)$ or completing the square eg $(y=)(x-1)^2-1-2$	
		M1	(dep M1) draws graph of $y = 2x-1$ or drawing the translated graph or describing the translation in words or $-1.7 + 1 (= -0.7)$ or $1.7 + 1 (=2.7)$	Line segments required For 1.7 allow from 1.6 to 1.8 For -1.7 allow from -1.8 to -1.6
		M1	shows the points of intersection clearly for the given quadratic graph and linear graph or for one correct solution from appropriate supportive working	Points indicated or attempt to read off x-axis at the appropriate points – maybe indicated by dashes
		A1	for x in the range 2.6 to 2.8 and -0.6 to -0.8 SCB2 for plotting $y = 2x + 1$ and values for x in the range -1.1 to -1.3 and 3.1 to 3.3	No marks will be awarded for correct answers only

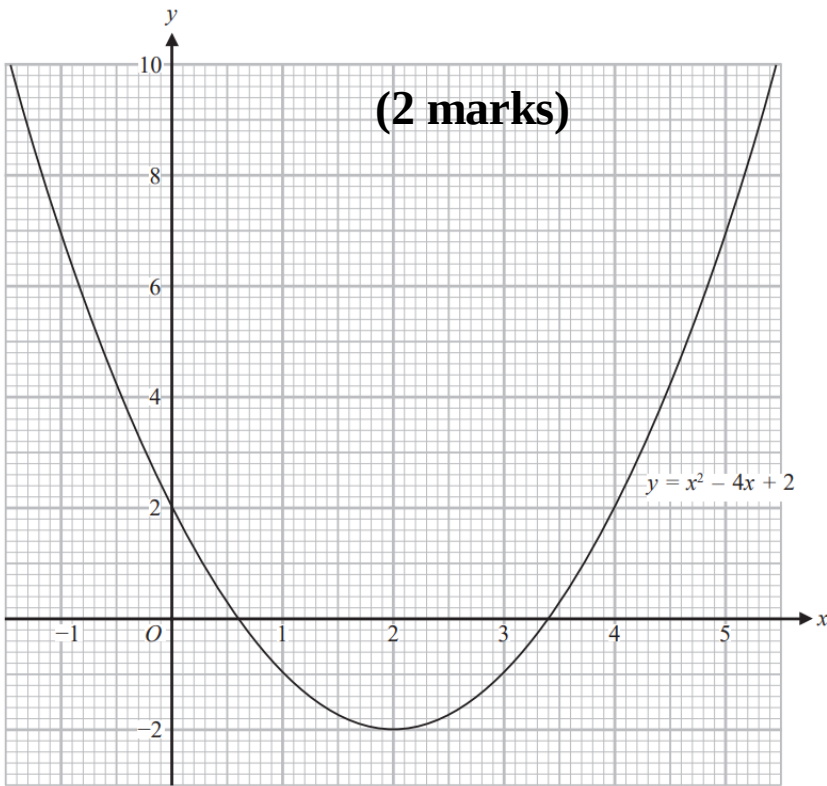




(a) Use these graphs to solve the simultaneous equations

$$\begin{aligned} 5x - 9y &= -46 \\ y &= -2x \end{aligned}$$

(1 mark)



(2 marks)

(b) Use this graph to find estimates for the solutions of the quadratic equation $x^2 - 4x + 2 = 0$

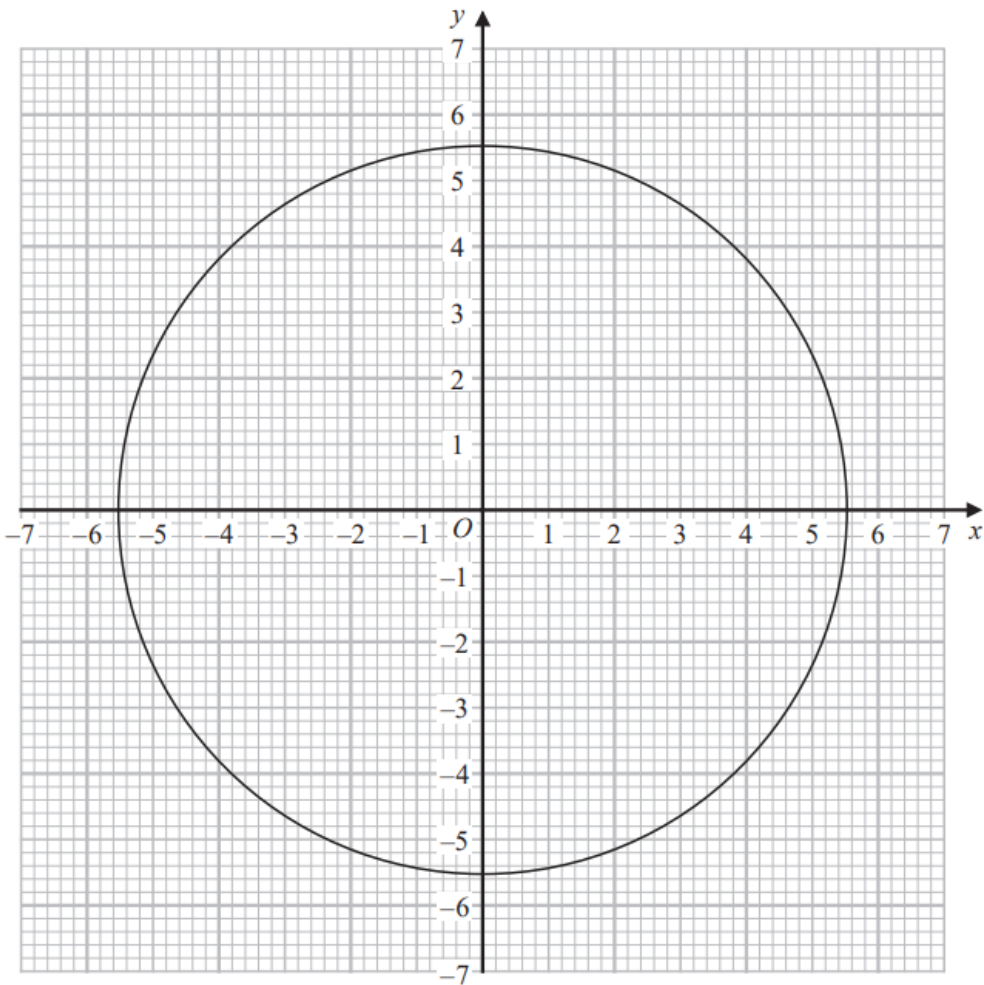
Video Solutions



6	(a)	$-2, 4$	B1	cao	
	(b)	0.55 to 0.65, 3.35 to 3.45	M1	for correct method, eg marking intercepts with x -axis or one correct answer or both solutions given as a coordinate eg (0.6, 3.4) or (0.6, 0) (3.4, 0)	If answers are stated as coordinates, award M1 for both coordinates and M0 for one coordinate.
			A1	for answers in the ranges 0.55 to 0.65 and 3.35 to 3.45	With no extras



20 The diagram shows the graph of $x^2 + y^2 = 30.25$



Use the graph to find estimates for the solutions of the simultaneous equations

$$\begin{aligned} x^2 + y^2 &= 30.25 \\ y - 2x &= 1 \end{aligned}$$

Video Solutions

(3 marks)

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Algebra
Solving Equations with Graphs



HOME

20	$x = 2.1, y = 5.1$ $x = -2.9, y = -4.7$	M1	for drawing the graph of $y - 2x = 1$	For both A marks accept answers in the ranges $x = 2.0$ to $2.2, y = 5.0$ to 5.2 $x = -2.8$ to $-3.0, y = -4.6$ to -4.8 Accept values given as coordinates
		A1	for one correct pair of values or for both correct x values, or for both correct y values	
		A1	for both correct pairs, correctly matched	



Algebra

Completing the Square



13 Write $x^2 + 6x - 7$ in the form $(x + a)^2 + b$ where a and b are integers.

 **Video Solutions**

(2 marks)

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Algebra
Completing the Square
Simple

13

|

|

$(x + 3)^2 - 16$

M1
A1

for $(x + 3)^2$ or $(x^2 + 6x - 7 =) x^2 + 2ax + a^2 + b$
cao

 **Video Solutions**



HOME

21 Sketch the graph of

$$y = 2x^2 - 8x - 5$$

showing the coordinates of the turning point and the exact coordinates of any intercepts with the coordinate axes.

 **Video Solutions**

(5 marks)

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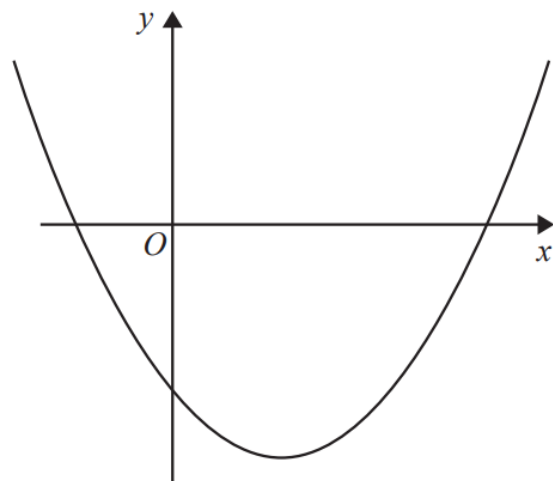


HOME

21	Sketch graph with TP at (2, -13) and intercepts at (0, -5), $(2 + \sqrt{\frac{13}{2}}, 0)$ and $(2 - \sqrt{\frac{13}{2}}, 0)$	B1	for a parabola drawn with intercept at the point (0, -5)	Turning point may be just seen and labelled on the sketch
		M1	for the start of a method to find the roots of $y = 0$, eg. $2(x - 2)^2 - 13 (= 0)$ oe or $(x =) \frac{- -8 \pm \sqrt{(-8)^2 - 4 \times 2 \times -5}}{2 \times 2}$	
		M1	(dep) for method to find the roots, eg. $2 \pm \sqrt{\frac{13}{2}}$ oe	
		B1	for turning point at (2, -13)	
		C1	for a fully correct parabola drawn with turning point at (2, -13) and intercepts at (0, -5), $(2 + \sqrt{\frac{13}{2}}, 0)$ oe and $(2 - \sqrt{\frac{13}{2}}, 0)$ oe clearly shown	



17 Here is a sketch of a curve.



The equation of the curve is $y = x^2 + ax + b$ where a and b are integers.

The points $(0, -5)$ and $(5, 0)$ lie on the curve.

Find the coordinates of the turning point of the curve.

Algebra
Completing the Square
Finding equations of quadratics, Turning Points

▶ **Video Solutions**

(4 marks)



HOME

17	(2, -9)	P1	substitutes $x = 0, y = -5$ into $y = x^2 + ax + b$ ($b = -5$) or substitutes $x = 5, y = 0$ into $y = x^2 + ax + b$ ($0 = 25 + 5a + b$) or starts process to find other intercept, eg writes $y = (x - 5)(x - k)$	
		P1	for complete process to find two intercepts, eg. substitutes the second point into $y = x^2 + ax + b$ and solves to find a ($= -4$) and b ($= -5$) or substitutes $x = 0, y = -5$ into $y = (x - 5)(x - k)$ and solves to find k ($= -1$)	
		P1	(dep on P2) for factorising or completing the square of $x^2 + "-4" x + "-5"$ and identifying the x -coordinate of the turning point or for a complete process to find the x -coordinate of the turning point, eg $(5 + "-1")/2$	
		A1	cao	x -coordinate of 2 with no or incorrect working gets NO marks



Algebra
Completing the Square
Turning Points

19 Given that $x^2 - 6x + 1 = (x - a)^2 - b$ for all values of x ,

(i) find the value of a and the value of b .

(2 marks)

(ii) Hence write down the coordinates of the turning point on the graph of $y = x^2 - 6x + 1$

 **Video Solutions**

(1 mark)



Summer 2019 Paper 1H (Non-Calc)

Algebra
Completing the Square
Turning Points

19	(i)	3, 8	M1	for $a = 3$, may be seen in working or as part of an expression, eg $(x - 3)^2 - 9$	9 does not have to be seen for this mark
			A1	for $a = 3, b = 8$	
	(ii)	3, -8	B1	for 3, -8 or ft (i)	

 **Video Solutions**

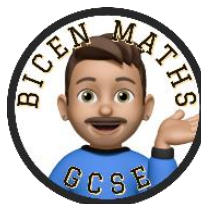


17 Write down the coordinates of the turning point on the graph of $y = (x + 12)^2 - 7$

 **Video Solutions**

(1 mark)

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Algebra
Completing the Square
<i>Turning Points</i>

17	$-12, -7$	B1	cao
----	-----------	----	-----

 **Video Solutions**



November 2021 Paper 1H (Non-Calc)

- 22 Find the coordinates of the turning point on the curve with equation $y = 9 + 18x - 3x^2$
You must show all your working.

Algebra

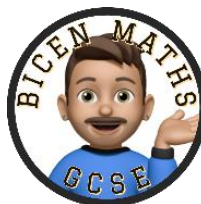
Completing the
Square

Turning Points

 **Video Solutions**

(4 marks)

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22	(3, 36)	P1	for factorising -3 from the expression, eg $-3(x^2 - 6x - 3)$ or $-3(x^2 - 6x) + 9$	ft from their factorising if only one error
		P1	for starting the process to complete the square, eg $(x - 3)^2 - 9$	
		P1	for completing the process of completing the square, eg $-3[(x - 3)^2 - 12]$ or $-3(x - 3)^2 + 36$	
		A1	cao	An answer only and no working is 0 marks



Algebra

Functions



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Summer 2018 Paper 2H (Calc)

11 f and g are functions such that

$$f(x) = \frac{2}{x^2} \quad \text{and} \quad g(x) = 4x^3$$

(a) Find $f(-5)$

(1 mark)

(b) Find $fg(1)$

Algebra
Functions
Composite

 **Video Solutions**

(2 marks)

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Algebra
Functions
Composite

11	(a)	$\frac{2}{25}$	B1	accept 0.08	All powers and products must be evaluated
	(b)	$\frac{1}{8}$	M1	$fg(x) = \frac{2}{(4x^3)^2}$ oe or $g(1) = 4$ or $\frac{2}{(4 \times 1^3)^2}$ oe	
			A1	oe	



November 2018 Paper 3H (Calc)

10 $f(x) = 4\sin x^\circ$

(a) Find $f(23)$

Give your answer correct to 3 significant figures.

(1 mark)

$$g(x) = 2x - 3$$

(b) Find $fg(34)$

Give your answer correct to 3 significant figures.

(2 marks)

$$h(x) = (x + 4)^2$$

Ivan needs to solve the following equation $h(x) = 25$

He writes

$$(x + 4)^2 = 25$$

$$x + 4 = 5$$

$$x = 1$$

This is not fully correct.

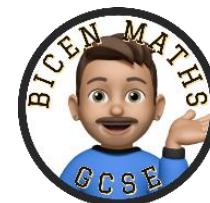
(c) Explain why.

Algebra
Functions
Mixed

 **Video Solutions**

(1 mark)

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HOME

Algebra
Functions
Mixed

10	(a)	1.56	B1	1.56 to 1.563	If an answer in the range is seen in working and then incorrectly rounded award full marks.
	(b)	3.63	M1	for a complete method to find $\sin(34)$ eg $4 \sin 65(=3.625..)$ or $\sin(x)$ eg $4 \sin(2x-3)$	
			A1	for answer in the range 3.6 to 3.63	
	(c)	Statement	C1	for statement eg positive and negative square root required. Acceptable examples The other answer is -9 The quadratic should have 2 solutions. Not acceptable examples He has not expanded the brackets. He needed to $(x+4)$ twice as there is a squared sign. $(x+4)^2$ is 16 not 25. Didn't expand the bracket.	



22 The functions f and g are such that

$$f(x) = 5x + 3 \quad g(x) = ax + b \quad \text{where } a \text{ and } b \text{ are constants.}$$

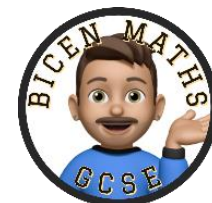
$$g(3) = 20 \quad \text{and} \quad f^{-1}(33) = g(1)$$

Find the value of a and the value of b .

 **Video Solutions**

(5 marks)

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HOME

Algebra
Functions
Mixed

22		7, -1	P1	for strategy to use $g(3) = 20$, e.g. $3a + b = 20$
			P1	for $g(1) = a + b$
			P1	for a process to find inverse of f. e.g. $f^{-1}(x) = \frac{x-3}{5}$ or $f^{-1}(33) = 6$
			P1	for using $f^{-1}(33) = g(1)$ to find an equation e.g. $\frac{33-3}{5} = a + b$
			A1	for $a = 7, b = -1$



November 2018 Paper 1H (Non-Calc)

19 For all values of x

$$f(x) = (x + 1)^2 \quad \text{and} \quad g(x) = 2(x - 1)$$

(a) Show that $gf(x) = 2x(x + 2)$

(2 marks)

(b) Find $g^{-1}(7)$

Algebra
Functions
Mixed

 **Video Solutions**

(2 marks)

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HOME

Algebra
Functions
Mixed

19	(a)	shown	C1	for first step, eg $2((x + 1)^2 - 1)$ or $2(x^2 + 2x + 1 - 1)$ oe
			C1	for fully correct chain of reasoning
	(b)	4.5	M1	process to find inverse of g, eg $g^{-1}(x) = \frac{1}{2}x + 1$ or for $2(x - 1) = 7$
			A1	for 4.5 oe

It is insufficient to state $gf(x) = 2x(x + 2)$ without showing the first step, and the following sequence of algebraic steps leading to it.

Could be shown in the form of a flowchart, which must show inverse operations.



Summer 2019 Paper 1H (Non-Calc)

Algebra
Functions
Mixed

21 The functions f and g are such that

$$f(x) = 3x - 1 \quad \text{and} \quad g(x) = x^2 + 4$$

(a) Find $f^{-1}(x)$

(2 marks)

Given that $fg(x) = 2gf(x)$,

(b) show that $15x^2 - 12x - 1 = 0$

 **Video Solutions**

(5 marks)



Algebra
Functions
Mixed

21	(a)	$\frac{x+1}{3}$	M1	first step to change the subject of $y = 3x - 1$ or $x = 3y - 1$, eg $y + 1 = 3x$
			A1	oe
	(b)	Shown	M1	for method to find $fg(x)$, eg $fg(x) = 3(x^2 + 4) - 1$
			M1	for method to find $gf(x)$, eg $gf(x) = (3x - 1)^2 + 4$
			M1	(dep on previous two M marks) for setting up equation, eg $3(x^2 + 4) - 1 = 2[(3x - 1)^2 + 4]$
			M1	(dep 2nd M1) for correct expansion of $(3x - 1)^2$ eg $9x^2 - 3x - 3x + 1$
			C1	for $15x^2 - 12x - 1 = 0$ from correct working



18 The function f is given by

$$f(x) = 2x^3 - 4$$

(a) Show that $f^{-1}(50) = 3$

Algebra
Functions
Mixed

(2 marks)

The functions g and h are given by

$$g(x) = x + 2 \quad \text{and} \quad h(x) = x^2$$

(b) Find the values of x for which

$$hg(x) = 3x^2 + x - 1$$

 **Video Solutions**

(4 marks)

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Algebra
Functions
Mixed

18	(a)	Shown	C1	for $f^{-1}(x) = \sqrt[3]{\frac{x+4}{2}}$ OR for $2x^3 - 4 = 50$ OR for substituting $x = 3$ to find $f(3)$	
			C1	for substituting $x = 50$ to show the result giving $f^{-1}(50) = 3$ OR solving for x to give $x = 3$ OR for showing that $f(3) = 50$	
	(b)	$x = -1$ and $x = 2.5$	P1	for $hg(x) = (x + 2)^2$	
			P1	(dep) for start to a process to derive a quadratic equation eg. $x^2 + 4x + 4 = 3x^2 + x - 1$	$(x + 2)^2$ must be correctly expanded
			P1	for a process to solve the quadratic equation $2x^2 - 3x - 5 = 0$ eg $(2x - 5)(x + 1) (= 0)$ or $\frac{- -3 \pm \sqrt{(-3)^2 - 4 \times 2 \times -5}}{2 \times 2}$ or $2\left[\left(x - \frac{3}{4}\right)^2 - \frac{9}{16} - \frac{5}{2}\right] (= 0)$	
			A1	for $x = -1$ and $x = 2.5$	2.5 or $2\frac{1}{2}$ or $\frac{5}{2}$ acceptable



19 f and g are functions such that

$$f(x) = \frac{12}{\sqrt{x}} \quad \text{and} \quad g(x) = 3(2x + 1)$$

(a) Find $g(5)$

(1 mark)

(b) Find $gf(9)$

(2 marks)

(c) Find $g^{-1}(6)$

 **Video Solutions**

(2 marks)



Algebra
Functions
Mixed

19	(a)	33	B1	cao	
	(b)	27	M1	for $f(9) = 12 \div \sqrt{9} (=4)$ and a clear intention to find $g(“4”)$ or for $3 \times (2 \times \frac{12}{\sqrt{9}} + 1)$ or for stating gf eg $3(2 \times \frac{12}{\sqrt{x}} + 1)$ oe	
			A1	cao	
	(c)	$\frac{1}{2}$	M1	for g^{-1} as $\frac{x-3}{6}$ oe or for starting to solve $3(2x + 1) = 6$	Accept $\frac{y-3}{6}$
			A1	for $\frac{1}{2}$ oe	



Algebra
Functions
Mixed

21 The functions f and g are such that

$$f(x) = 3x^2 + 1 \quad \text{for } x > 0 \quad \text{and} \quad g(x) = \frac{4}{x^2} \quad \text{for } x > 0$$

(a) Work out $gf(1)$

(2 marks)

The function h is such that $h = (fg)^{-1}$

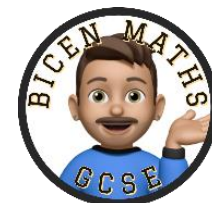
(b) Find $h(x)$

 **Video Solutions**

(4 marks)



21	(a)	$\frac{1}{4}$	M1	for $f(1) = 3 \times 1^2 + 1 (= 4)$ and a clear intention to find $g("4")$ or for $\frac{4}{(3 \times 1^2 + 1)^2}$ or for stating $gf(x)$, eg $\frac{4}{(3x^2 + 1)^2}$ oe
			A1	oe
	(b)	$\sqrt[4]{\frac{48}{x-1}}$	M1	for finding $fg(x)$, eg $3 \times \left(\frac{4}{x^2}\right)^2 + 1$ or $\frac{48}{x^4} + 1$
			M1	for start of method to find the inverse of $fg(x)$, eg $y - 1 = 3 \times \left(\frac{4}{x^2}\right)^2$ or $y - 1 = \frac{48}{x^4}$ or $x - 1 = \frac{48}{y^4}$ or $x - 1 = 3 \times \left(\frac{4}{y^2}\right)^2$
			M1	for $y^4 = \frac{48}{x-1}$ or $x^4 = \frac{48}{y-1}$ or for a final answer of $\sqrt[4]{\frac{48}{y-1}}$
			A1	oe



Algebra

Transformations of Graphs



Algebra
Transformations of Graphs
Coordinates

15 The graph of the curve C with equation $y = f(x)$ is transformed to give the graph of the curve S with equation $y = f(-x) - 3$

The point on C with coordinates (7, 2) is mapped to the point Q on S.

Find the coordinates of Q.

 **Video Solutions**

(2 marks)

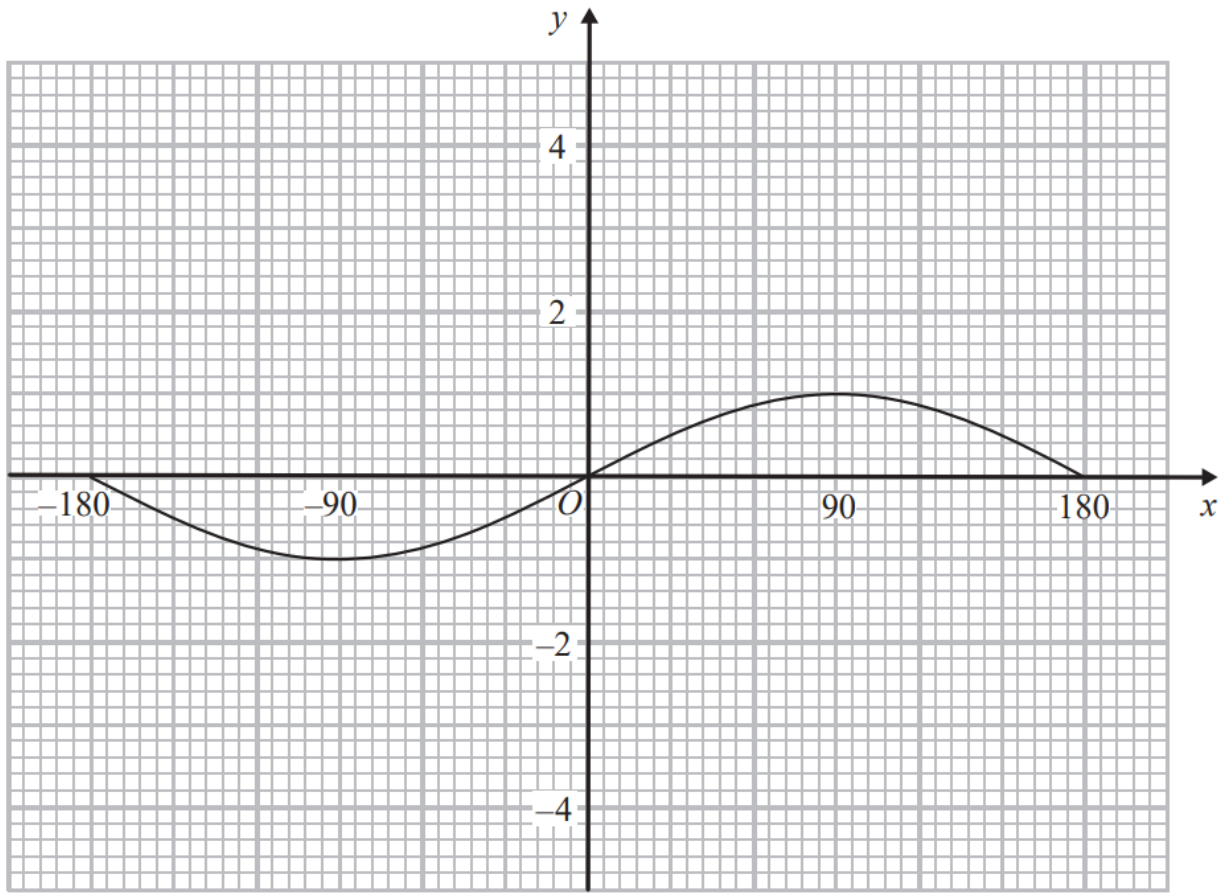


15	$(-7, -1)$	M1	for a method which shows understanding of the type of transformation eg reflection in the y axis or translation $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$ or “(0 units right and) 3 units down” or for x coordinate as -7 or y coordinate as -1	“Reflection” or “Translation” alone is insufficient. Note that the -7 or the -1 may appear in the working space, not necessarily in the final answer.
		A1	for $(-7, -1)$	

Summer 2018 Paper 1H (Non-Calc)

Algebra
Transformations of Graphs
Drawing

18 Here is the graph of $y = \sin x^\circ$ for $-180 \leq x \leq 180$



On the grid, sketch the graph of $y = \sin x^\circ - 2$ for $-180 \leq x \leq 180$



 **Video Solutions**

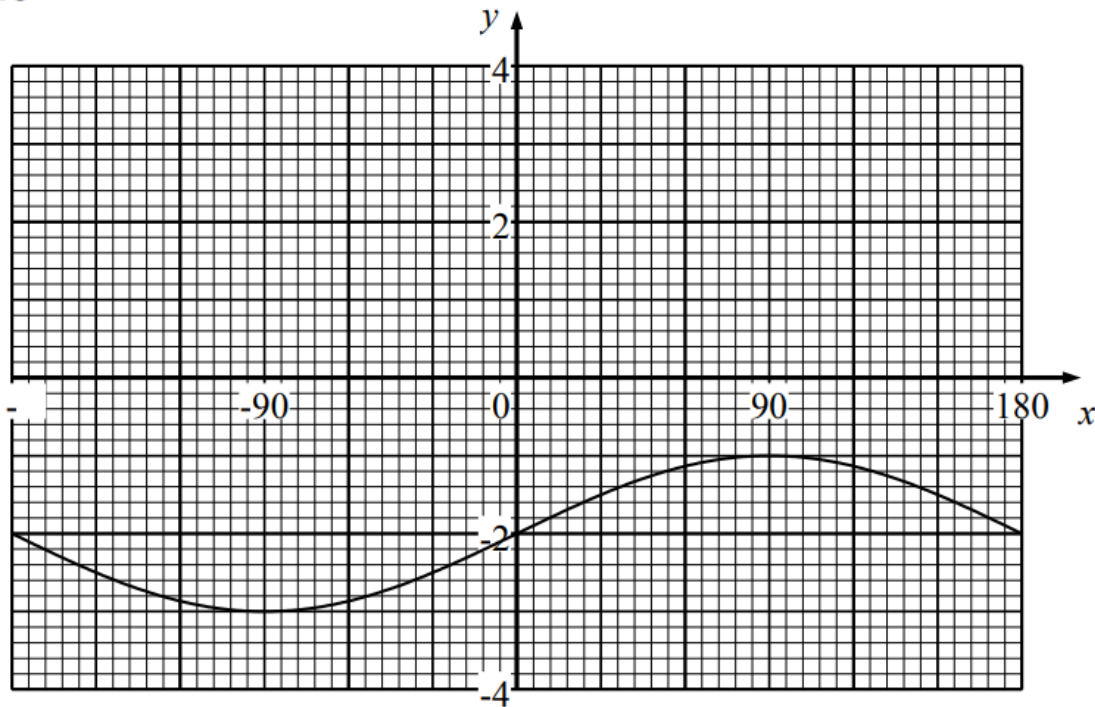
(2 marks)

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HOME

Q18



Algebra
Transformations of Graphs
Drawing

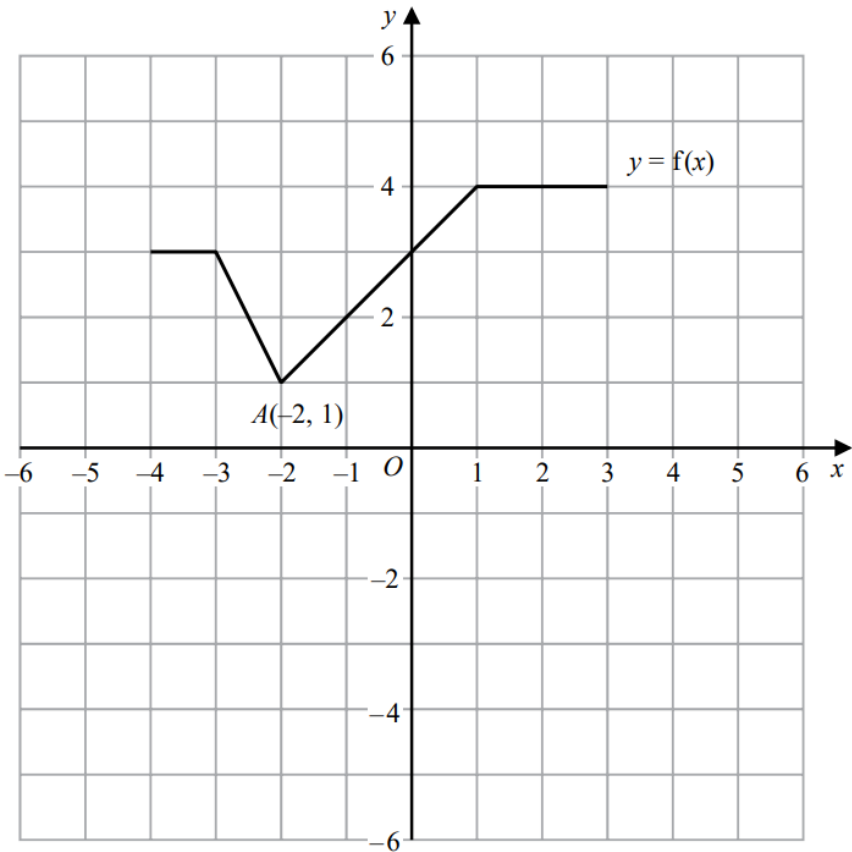
18	Graph drawn	C2 (C1	for graph translated by -2 in the y direction for a graph translated in the y direction OR for a correct graph through four of the five key points)	Key points: $(-180, -2)$, $(-90, -3)$, $(0, -2)$, $(90, -1)$, $(180, -2)$
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 **Video Solutions**



Algebra
Transformations of Graphs
Drawing, coordinates

20 The graph of $y = f(x)$ is shown on the grid.



 **Video Solutions**

- (a) On the grid, draw the graph with equation $y = f(x + 1) - 3$
(2 marks)
 Point $A(-2, 1)$ lies on the graph of $y = f(x)$.
 When the graph of $y = f(x)$ is transformed to the graph with equation $y = f(-x)$, point A is mapped to point B .
- (b) Write down the coordinates of point B .
(1 mark)



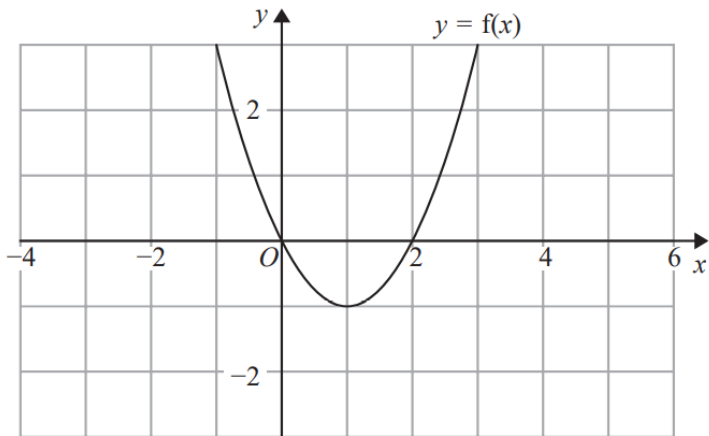
Algebra
Transformations of Graphs
<i>Drawing, coordinates</i>

20	(a)	graph	C2	for a translation of the graph by the vector $\begin{pmatrix} -1 \\ -3 \end{pmatrix}$	Condone graph of $y = f(-x)$ also being drawn on the grid
			(C1	for a translation of the graph by the vector $\begin{pmatrix} -1 \\ b \end{pmatrix}$ where $b \neq -3$ or $\begin{pmatrix} a \\ -3 \end{pmatrix}$ where $a \neq -1$	Correct vector gets 1 mark
				or for a translation by the vector $\begin{pmatrix} -1 \\ -3 \end{pmatrix}$ of 3 or 4 critical points)	
	(b)	2, 1	B1	cao	



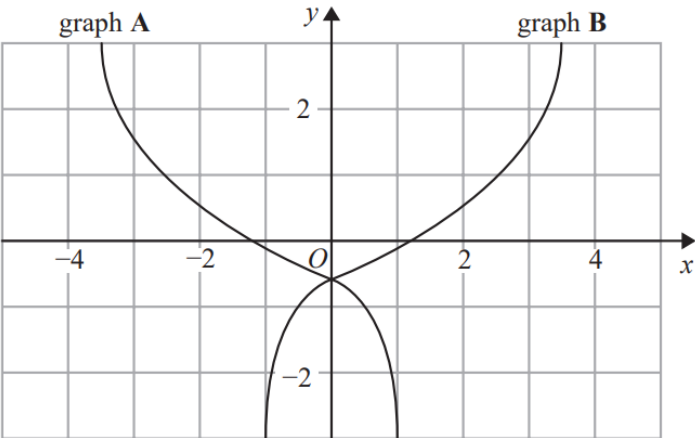
November 2018 Paper 1H (Non-Calc)

18 The graph of $y = f(x)$ is shown on the grid below.



(a) On the grid above, sketch the graph of $y = f(x - 2)$

(1 mark)



On the grid, graph A has been reflected to give graph B.

The equation of graph A is $y = g(x)$

(b) Write down the equation of graph B.

(1 mark)



 **Video Solutions**



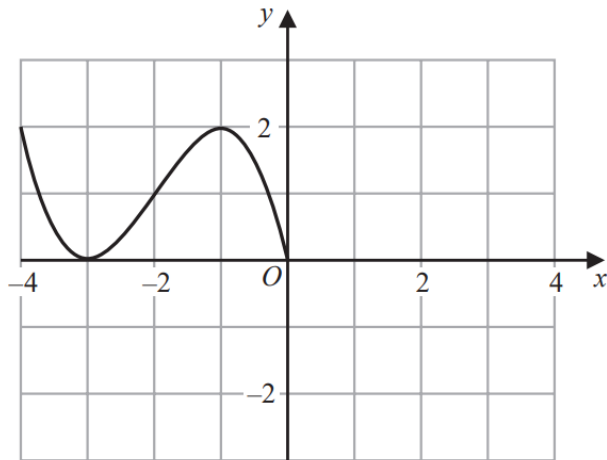
Algebra
Transformations of Graphs
<i>Drawing, Writing Equations</i>

18	(a)	sketch	B1	for appropriate sketch which crosses the x axis at $(2,0)$ and $(4,0)$, minimum point at $(3,-1)$ and end points at $(1,3)$ and $(5,3)$	Allow some tolerance on the points if the intention is clear.
	(b)	$y = g(-x)$	B1	cao	



Summer 2020 Paper 2H (Calc)

21 The graph of the curve with equation $y = f(x)$ is shown on the grid below.

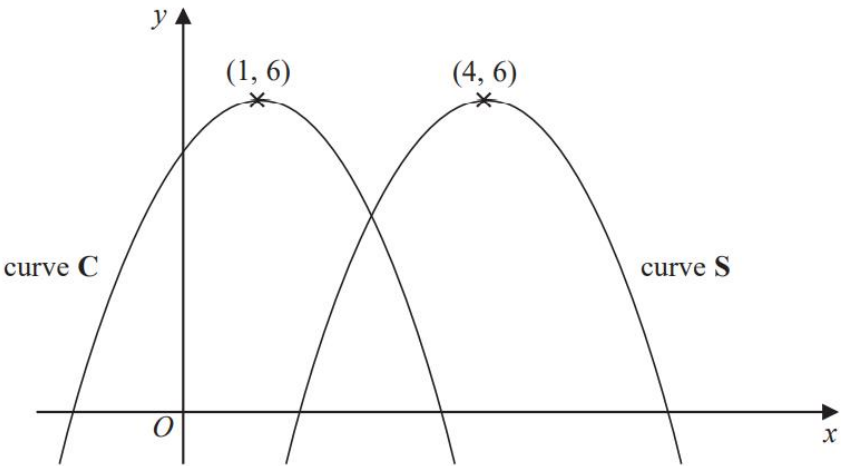


Algebra
Transformations of Graphs
Drawing, Writing Equations

 **Video Solutions**

(a) On the grid above, sketch the graph of the curve with equation $y = f(-x)$

(2 marks)



The curve **C** with equation $y = 5 + 2x - x^2$ is transformed by a translation to give the curve **S** such that the point $(1, 6)$ on **C** is mapped to the point $(4, 6)$ on **S**.

(b) Find an equation for **S**.

(2 marks)



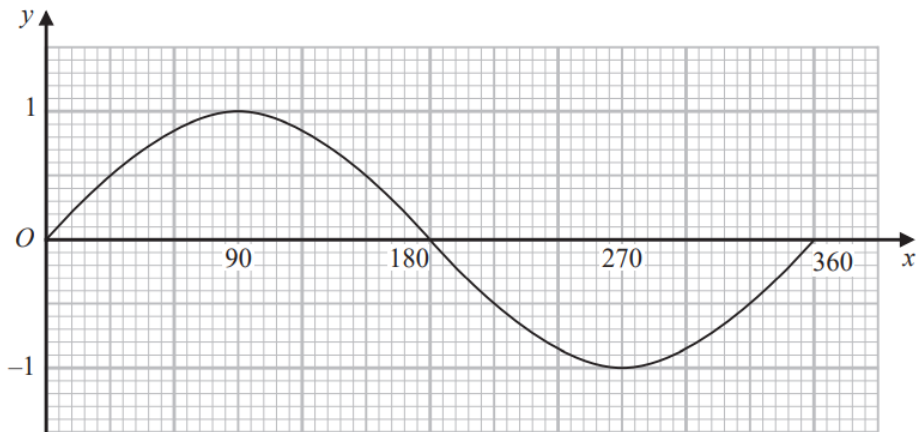
Algebra
Transformations of Graphs
<i>Drawing, Writing Equations</i>

21	(a)	Graph drawn	C2	for graph reflected in the y -axis	Key points: (0, 0), (1, 2), (2, 1), (3, 0), (4, 2) Award C1 if line segments but goes through all key points
			(C1	for a graph reflected in the x -axis or for a correct graph through four of the five key points)	
	(b)	$y = 5 + 2(x - 3) - (x - 3)^2$	C2	for $y = 5 + 2(x - 3) - (x - 3)^2$ oe eg $y = -x^2 + 8x - 10$, $y = -[(x - 4)^2 - 6]$	For either C mark accept equivalent expressions If a correct answer for C2 is given and is then incorrectly simplified, award C1 a need not be positive
			(C1	for $y = 5 + 2(x + 3) - (x + 3)^2$ or $y = 5 + 2(x - a) - (x - a)^2$, $a \neq 3$, $a \neq 0$ or $y = f(x - 3)$ or $y = (x - 4)^2 + 6$ or correct expression missing “ $y =$ ”	



November 2021 Paper 2H (Calc)

18 Here is a graph of $y = \sin x^\circ$ for $0 \leq x \leq 360$

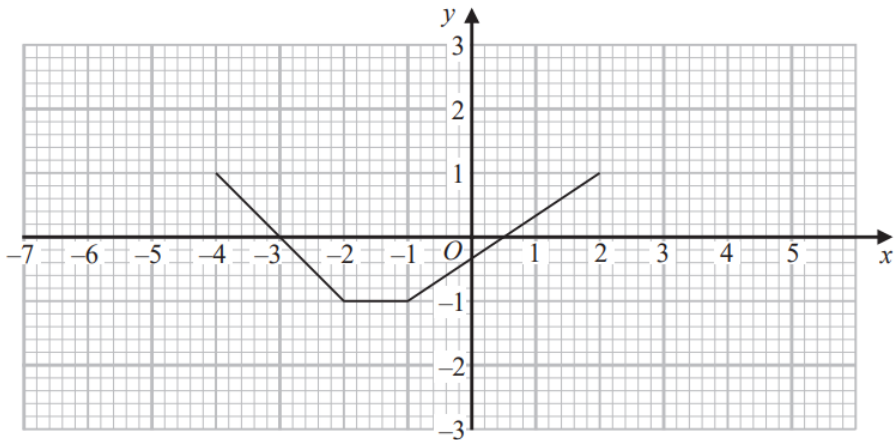


(a) Using this graph, find estimates of all **four** solutions of

$$\sin x^\circ = 0.6 \quad \text{for } 0 \leq x \leq 720$$

(2 marks)

Here is a graph of $y = f(x)$



(c) On the grid, draw the graph of $y = f(x - 2)$

(1 mark)

Algebra
Transformations of Graphs
Drawing, Writing Equations

 **Video Solutions**

The graph of $y = \sin x^\circ$ is reflected in the x -axis. **(1 mark)**

(b) Write down an equation of the reflected graph.



HOME

Algebra
Transformations of Graphs
Drawing, Writing Equations

18	(a)	37, 143, 397, 503	M1	for any two correct angles within the ranges below or for a correct method to find a solution beyond 360, eg. “angle read from 0 to 360” + 360	Accept given as coordinates for M1 only
			A1	for all 4 angles in the range, 35 to 40, 140 to 145, 395 to 400 and 500 to 505	
	(b)	$y = -\sin x^\circ$	B1	for any acceptable equations, eg. $y = -\sin x^\circ$ or $y = \sin(-x^\circ)$ or $-y = \sin x^\circ$ or $y = \cos(x^\circ + 360n + 90)$ or for any positive integer n , $y = \sin(x^\circ - (2n - 1)180)$ or $y = \cos(x^\circ + 360n)$	Quoted are just the more likely solutions but check all attempts Condone missing degrees sign
	(c)	graph	C1	for correct graph shown translated 2 in the positive x -direction	



Algebra

Proof



Summer 2019 Paper 1H (Non-Calc)

Algebra

Proof

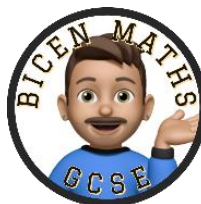
Evens and odds logic

13 Given that n can be any integer such that $n > 1$, prove that $n^2 - n$ is never an odd number.

 **Video Solutions**

(2 marks)

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HOME

13	Proof shown	C2	for complete argument, eg $n(n - 1)$ is the product of two consecutive integers and must be even as either n or $n - 1$ must be even or gives correct reasoning for n odd and n even n odd: $\text{odd} \times \text{odd} = \text{odd}$ and $\text{odd} - \text{odd} = \text{even}$ n even: $\text{even} \times \text{even} = \text{even}$ and $\text{even} - \text{even} = \text{even}$ or n odd: $(2n + 1)^2 - (2n + 1) = 4n^2 + 2n = 2(2n^2 + n)$ n even: $(2n)^2 - (2n) = 4n^2 - 2n = 2(2n^2 - n)$
		(C1	for factorising, eg $n(n - 1)$ OR gives correct reasoning for n odd or n even OR gives a partial explanation using n odd and n even, eg $\text{odd}^2 - \text{odd} = \text{even}$ and $\text{even}^2 - \text{even} = \text{even}$)



Algebra
Proof
<i>Algebraic</i>

16 n is an integer greater than 1

Prove algebraically that $n^2 - 2 - (n - 2)^2$ is always an even number.

 **Video Solutions**

(4 marks)

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Algebra
Proof
<i>Algebraic</i>

16		$2(2n-3)$ even	C1 C1 C1 C1	correct expansion of brackets to give at least 3 terms from $n^2-2n-2n+4$ arrives at n^2-2-n^2+4n-4 oe reduces to $2(2n-3)$ or $4n-6$ for conclusion e.g. $2(2n-3)$ always even, $4n-6$ is always even since both are even numbers, they are multiples of 2.
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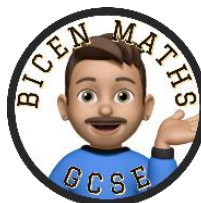
17 n is an integer.

Prove algebraically that the sum of $\frac{1}{2}n(n+1)$ and $\frac{1}{2}(n+1)(n+2)$ is always a square number.

 **Video Solutions**

(2 marks)

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Algebra
Proof
<i>Algebraic</i>

17		Completes proof	M1	Expands both expressions eg $\frac{1}{2}(n^2 + n + n^2 + n + 2n + 2)$ or $n^2 + n$ and $n^2 + n + 2n + 2$ or factorises $\frac{1}{2}(n+1)(n+n+2)$
			C1	Completes proof with explanation and reference to $(n+1)^2$

 **Video Solutions**



12 Prove that the square of an odd number is always 1 more than a multiple of 4

 **Video Solutions**

(4 marks)

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Algebra
Proof
<i>Algebraic</i>

12	Statement supported by algebra	B1	writing a general expression for an odd number eg $2n+1$	Could be $2n - 1$, $2n + 3$, etc Note that $4n^2 + 4n + 2$ or $2n^2 + 4n + 1$ in expansion of $(2n + 1)^2$ is to be regarded as 3 correct terms
		M1	(dep) for expanding (“odd number”)² with at least 3 out of 4 correct terms	
		A1	for correct simplified expansion, eg $4n^2 + 4n + 1$	
		C1	(dep A1) for a concluding statement eg $4(n^2 + n) + 1$ (is one more than a multiple of 4)	

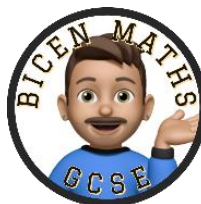


- 15 Prove algebraically that the difference between the squares of any two consecutive odd numbers is always a multiple of 8

 **Video Solutions**

(3 marks)

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Algebra
Proof
Algebraic

15	proof	C1	for writing an expression for an odd number, eg $2n + 1$ or $2n - 1$ (assuming n is any integer) or states n is even and eg $(n + 1)$ or $(n + 3)$ as odd numbers	
		C1	for a correct expression of the form $(2n + 1)^2 - (2n - 1)^2$ expanded eg $4n^2 + 12n + 9 - (4n^2 + 4n + 1)$ or $4n^2 + 4n + 1 - (4n^2 - 4n + 1)$ or $(2n + 1 + 2n - 1)(2n + 1 - (2n - 1))$ or when n is even and eg $(n^2 + 6n + 9) - (n^2 + 2n + 1) (=4n + 8)$	Expansion of $(2n - 1)^2 - (2n + 1)^2$ oe is acceptable
		C1	for a correct simplified expression as a multiple of 8 eg $8n + 8$ or $8n$ or when n is even and eg $4n + 8$ and full explanation as to why $4(n+2)$ is always a multiple of 8	



- 15** Prove algebraically that the sum of the squares of any two consecutive even numbers is always a multiple of 4

 **Video Solutions**

(3 marks)

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HOME

Algebra
Proof
<i>Algebraic</i>

15	Proof	M1	for correct expressions for two consecutive even numbers eg $2n$ and $2n+2$	$\begin{aligned}(2n)^2 + (2n + 2)^2 \\&= 4n^2 + 4n^2 + 8n + 4 \\&= 8n^2 + 8n + 4 = 4(2n^2 + 2n + 1)\end{aligned}$
		M1	(dep M1) for expanding both expressions with at least one expansion fully correct eg $4n^2$ and $4n^2 + 4n + 4n + 4$ or for factorising both terms and intention to square correctly eg $(2n)^2$ and $2^2(n+1)^2$	Or $\begin{aligned}(2n)^2 + (2n - 2)^2 \\&= 4n^2 + 4n^2 - 8n + 4 \\&= 8n^2 - 8n + 4 = 4(2n^2 - 2n + 1)\end{aligned}$
		A1	complete proof	Or $\begin{aligned}(2n)^2 + (2n + 2)^2 \\&= 4(n)^2 + 4(n + 1)^2 \\&= 4(n^2 + (n + 1)^2)\end{aligned}$



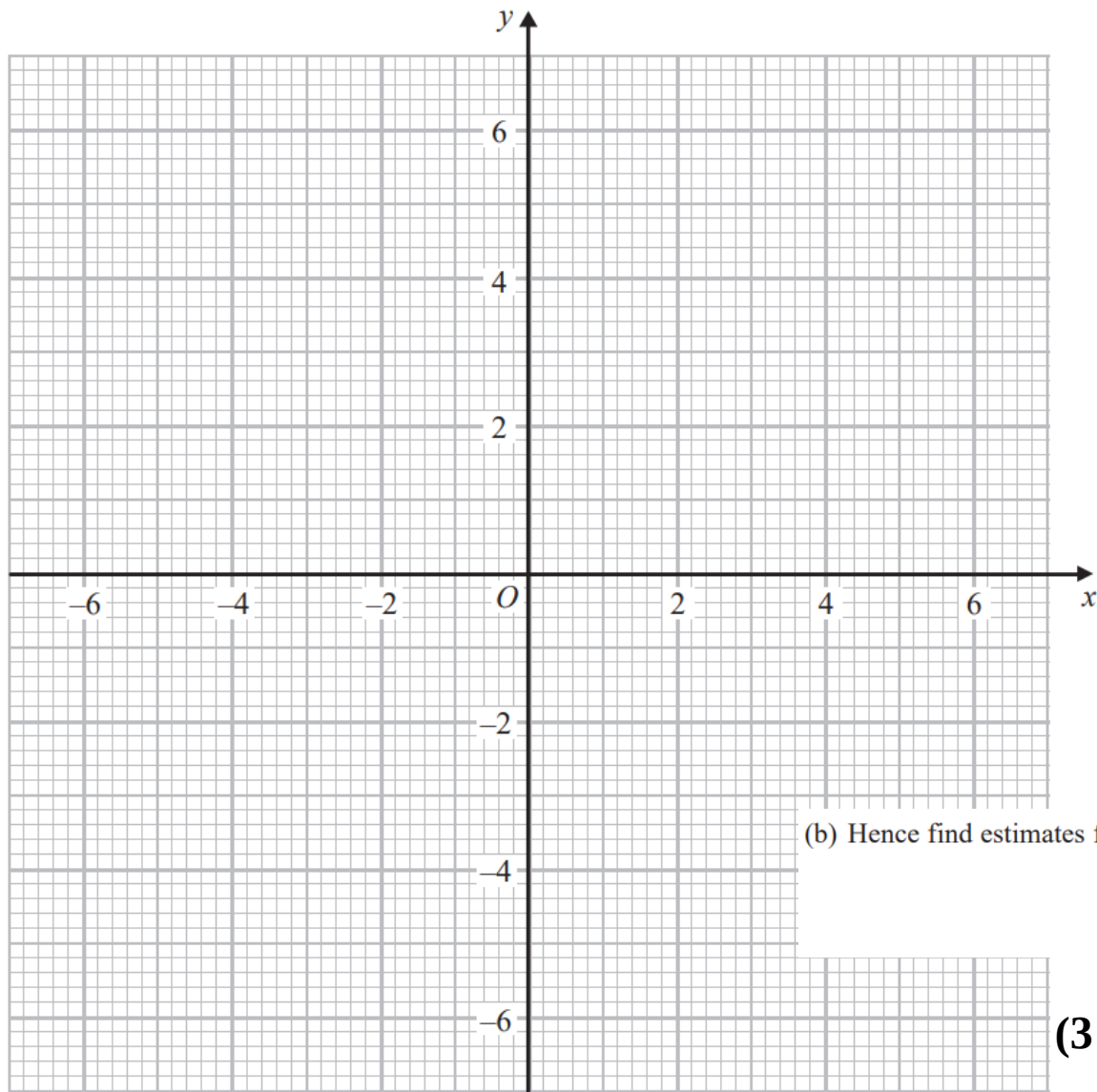
Algebra

Equations of Circles & Tangents



Summer 2018 Paper 2H (Calc)

16 (a) On the grid, draw the graph of $x^2 + y^2 = 12.25$



(2 marks)

(b) Hence find estimates for the solutions of the simultaneous equations

$$\begin{aligned} x^2 + y^2 &= 12.25 \\ 2x + y &= 1 \end{aligned}$$

(3 marks)

Algebra
Equations of Circles & Tangents
Drawing and solving

 **Video Solutions**



16	(a)	Correct graph	B2	for a circle radius 3.5, centre (0, 0)	Circle could be drawn freehand as long as it approximates to a circle
			(B1	for a circle centre (0, 0) of a different radius, or for a circle drawn of radius 3.5 centre not (0, 0) or incomplete correct circle)	
	(b)	$x = 2.0, y = -2.9$ $x = -1.2, y = 3.3$	M1	for $2x + y = 1$ drawn, or for correctly eliminating one variable, eg $x^2 + 1 - 4x + 4x^2 = 12.25$ or $x^2 + (1 - 2x)^2 = 12.25$	
			A1	for the pair of x values, or the correct pair of y values, or one correct pair of x/y values ft from (a) (dep on B1)	
			A1	for both correct pair of x/y values, unambiguously matched ft from (a) (dep on B1)	$2x + y = 1$ does not have to be shown Use professional judgment Accept values given as coordinates. Check graph for answers



Summer 2017 Paper 2H (Calc)

23 **L** is the circle with equation $x^2 + y^2 = 4$

$P\left(\frac{3}{2}, \frac{\sqrt{7}}{2}\right)$ is a point on **L**.

Find an equation of the tangent to **L** at the point P .

Algebra

Equations of Circles
& Tangents

... with surds

 **Video Solutions**

(3 marks)

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23

$$y = \frac{-3}{\sqrt{7}}x + \frac{8}{\sqrt{7}}$$

M1

for method to find gradient of OP , eg $\frac{\sqrt{7}}{2} \div \frac{3}{2} \left(= \frac{\sqrt{7}}{3} \text{ or } 0.88 \dots \right)$ oe

M1

(dep) for method to find gradient of tangent, m ,
eg. $\frac{\frac{\sqrt{7}}{2}}{\frac{3}{2}} \times m = -1 \left(m = \frac{-3}{\sqrt{7}} \text{ or } -1.13\dots \right)$

A1

for $y - \frac{\sqrt{7}}{2} = \frac{-3}{\sqrt{7}} \left(x - \frac{3}{2} \right)$ or $y = \frac{-3\sqrt{7}}{7}x + \frac{8\sqrt{7}}{7}$ oe or $y - 1.32\dots = -1.13\dots(x - 1.5)$



Summer 2017 Paper 3H (Calc)

Algebra
Equations of Circles & Tangents
... <i>sketching</i> <i>transformation</i>

- 20 The equation of a curve is $y = a^x$
 A is the point where the curve intersects the y -axis.

(a) State the coordinates of A .

(1 mark)

The equation of circle **C** is $x^2 + y^2 = 16$

The circle **C** is translated by the vector $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$ to give circle **B**.

(b) Draw a sketch of circle **B**.

Label with coordinates
the centre of circle **B**
and any points of intersection with the x -axis.

 **Video Solutions**

(3 marks)

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Algebra
Equations of Circles & Tangents
... <i>sketching</i> <i>transformation</i>

20	(a)		(0,1)	B1	(0,1)
	(b)		Circle radius 4 Centre (3,0) and (-1,0) and (7,0) labelled	M1	For centre (3,0) implied by drawing or label or a circle of radius 4 or intersections on the x -axis at -1 or 7 implied by drawing or labels
				M1	for 2 of centre (3,0) implied by drawing or label intersections on the x -axis at -1 and 7 implied by drawing or label circle drawn with radius 4
				A1	for a fully correct answer



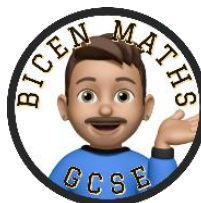
15 The equation of a circle is $x^2 + y^2 = 42.25$

Find the radius of the circle.

 **Video Solutions**

(1 mark)

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15 | 6.5 | B1 | oe

| Accept (eg) $6\frac{1}{2}$ and $\sqrt{42.25}$

 **Video Solutions**

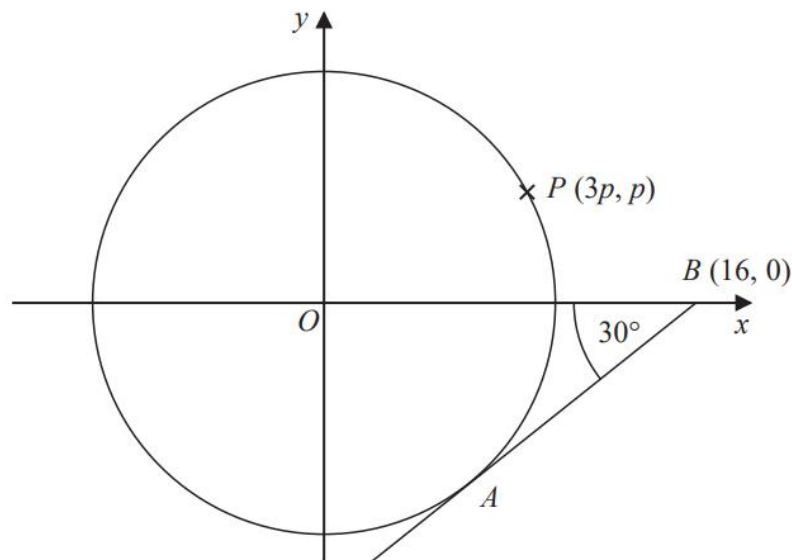
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Summer 2019 Paper 3H (Calc)

22 The diagram shows a circle, centre O .



AB is the tangent to the circle at the point A .
Angle $OBA = 30^\circ$

Point B has coordinates $(16, 0)$
Point P has coordinates $(3p, p)$

Find the value of p .
Give your answer correct to 1 decimal place.
You must show all your working.

Algebra

Equations of Circles
& Tangents

 **Video Solutions**

(4 marks)

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HOME

22	2.5	P1	use of $\sin 30 = \frac{1}{2}$ to find $OA (= 8)$ or $OAB = 90^\circ$ eg $OA = 16\sin 30^\circ$ or right angle marked on diagram	
		P1	recognition that equation of circle is $x^2 + y^2 = r^2$	Accept $3p^2 + p^2 = r^2$ for the award of this mark
		P1	Correct substitution of p , $3p$ and r in $x^2 + y^2 = r^2$ eg $9p^2 + p^2 = OA^2$ or $(3p)^2 + p^2 = "8"$	Do not accept $3p^2 + p^2 = 8^2$ for the award of this mark
		A1	for answer in the range 2.5 to 2.53	Accept $\sqrt{6.4}$ or $\frac{4\sqrt{10}}{5}$ If an answer within the given range is seen in working and rounded incorrectly award full marks. Award 0 marks for the answer without supportive working.



22 C is a circle with centre the origin.

A tangent to C passes through the points $(-20, 0)$ and $(0, 10)$

Work out an equation of C .

You must show all your working.

 **Video Solutions**

(5 marks)

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HOME

22	$x^2 + y^2 = 80$	P1	for process to find gradient of tangent eg $\frac{10-0}{0--20} (= \frac{1}{2})$ or for $20^2 + 10^2 (= 500)$ or start to method to find angle between tangent and x axis, eg $\tan \theta = \frac{10}{20}$	
		P1	for process to find gradient of normal/radius eg $\frac{-1}{\text{"0.5"}} (= -2)$ or for $\sqrt{20^2 + 10^2}$ or $\sqrt{500}$ or 22.36... or 22.4 or completes process to find angle between tangent and x axis. eg $\theta = \tan^{-1}\left(\frac{10}{20}\right) (= 26.565\dots)$	
		P1	for equation of tangent eg $y = \text{"0.5"}x + 10$ oe or for equation of radius eg $y = \text{"-2"}x$ oe or for using similar triangles eg $\frac{r}{10} = \frac{20}{\text{"}\sqrt{500}\text{"}}$ or for $\sin(\text{"26.565..."}) = \frac{r}{20}$	
		P1	for process to find the x coordinate eg $\text{"0.5"}x + 10 = \text{"-2"}x$ ($x = -4$) or for $r = \frac{20}{\text{"}\sqrt{500}\text{"}} \times 10$ or $r = 20 \times \sin(\text{"26.565..."})$	
		A1	oe	Accept $(4\sqrt{5})^2$ for 80



Algebra

Iteration

Solving Equations

Using a Formula



16 Using $x_{n+1} = -2 - \frac{4}{x_n^2}$

with $x_0 = -2.5$

(a) find the values of x_1 , x_2 and x_3

(3 marks)

(b) Explain the relationship between the values of x_1 , x_2 and x_3 and the equation $x^3 + 2x^2 + 4 = 0$

 **Video Solutions**

(2 marks)



Algebra
Iteration
<i>Solving equations</i>

16	(a)	$x_1 = -2.64$ $x_2 = -2.57392$ $x_3 = -2.603767255$	M1 M1 A1	for substitution of -2.5 into the equation (to get $x_1 = -2.64$) for substitution of " $x_1 = -2.64$ " and " $x_2 = -2.57392$ " to give x_2 and x_3 for $x_1 = -2.64$ or $x_2 = -2.57(392)$ and $x_3 = -2.6(03767255)$ Condone $x_3 = -2.61$ if $x_2 = -2.57$ is used in the substitution
	(b)	Statements	C1 C1	Connection between equation and iterative form in (a) e.g. rearrangement Statement e.g. iteration is an estimation of a solution



15 (a) Show that the equation $x^3 + 7x - 5 = 0$ has a solution between $x = 0$ and $x = 1$

(2 marks)

(b) Show that the equation $x^3 + 7x - 5 = 0$ can be arranged to give $x = \frac{5}{x^2 + 7}$

(2 marks)

(c) Starting with $x_0 = 1$, use the iteration formula $x_{n+1} = \frac{5}{x_n^2 + 7}$ three times to find an estimate for the solution of $x^3 + 7x - 5 = 0$

(3 marks)

(d) By substituting your answer to part (c) into $x^3 + 7x - 5$, comment on the accuracy of your estimate for the solution to $x^3 + 7x - 5 = 0$

 **Video Solutions**

(2 marks)



Algebra
Iteration
<i>Solving equations</i>

15	(a)		Shown	M1	for method to establish at least one root between $x = 0$ and $x = 1$, eg $f(0) = -5$ and $f(1) = 3$
				C1	for correct values and a deduction about the roots eg as there is a sign change there must be at least one root between $x = 0$ and $x = 1$ (as f is continuous)
	(b)		Shown	C1	for a correct first step in rearrangement, eg $x(x^2 + 7) - 5 = 0$ or $x^3 + 7x = 5$
				C1	for clear and correct steps showing complete rearrangement
	(c)	$x_1 = 0.625$ $x_2 = 0.6765327696$ $x_3 = 0.6704483001$	0.6704(483001)	M1	for substitution of 1 into the formula (to get 0.625)
				M1	for substitution of " $x_1 = 0.625$ " and " $x_2 = 0.6765327696$ " to give x_2 and x_3
				A1	0.6704(483001)
	(d)		Comment	M1	substitutes answer to (c) into expression (to get $-0.00549\dots$)
				C1	appropriate comment, eg accurate as answer is close to 0



18 (a) Show that the equation $x^3 + x = 7$ has a solution between 1 and 2

(2 marks)

(b) Show that the equation $x^3 + x = 7$ can be rearranged to give $x = \sqrt[3]{7 - x}$

(1 mark)

(c) Starting with $x_0 = 2$,
use the iteration formula $x_{n+1} = \sqrt[3]{7 - x_n}$ three times to find an estimate for a
solution of $x^3 + x = 7$

 **Video Solutions**

(3 marks)



Algebra
Iteration
<i>Solving equations</i>

18	(a)	Correct statement	C1	for substituting both 1 and 2 into $x^3 + x$ or into $x^3 + x - 7$	All arithmetic shown must be correct. Ignore any additional trials shown. $x_1 = 1.70997\dots$ $x_2 = 1.74241\dots$ $x_3 = 1.73884\dots$ Accept an accuracy of 2 dp or more rounded or truncated for values of x_1 and x_2 Award the marks for 1.7 on the answer line provided correct iterations are shown in the working space.
			C1	for values 2 and 10 plus explanation that these are above and below 7, or for values -5 and 3 plus explanation that there is a change of sign, thus implying a solution lies between 1 and 2	
	(b)	Correct rearrangement	C1	for correct algebraic rearrangement	
	(c)	1.74	M1	for substitution of 2 into the formula eg $\sqrt[3]{7-2}$ ($= 1.70997\dots$)	
			M1	for a substitution of x_1 to give x_2 ($= 1.74241\dots$)	
			A1	for answer in the range 1.738 to 1.74	



- 16 (a) Use the iteration formula $x_{n+1} = \sqrt[3]{10 - 2x_n}$ to find the values of x_1 , x_2 and x_3
Start with $x_0 = 2$

(3 marks)

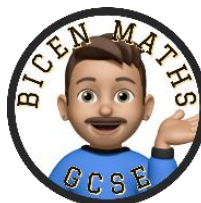
The values of x_1 , x_2 and x_3 found in part (a) are estimates of the solution of an equation of the form $x^3 + ax + b = 0$ where a and b are integers.

- (b) Find the value of a and the value of b .

 **Video Solutions**

(1 mark)

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Algebra
Iteration
<i>Solving equations</i>

16	(a)	$x_1 = 1.817$	M1	for a correct method to find x_1 eg $\sqrt[3]{10-2 \times 2}$ ($= 1.8171\dots$)	Accept an accuracy of 2dp or more rounded or truncated
		$x_2 = 1.853$	M1	(dep on M1) for substitution of x_1 to give x_2 and x_2 to give x_3	
		$x_3 = 1.846$	A1	for $x_1 = 1.81(71\dots)$, $x_2 = 1.85(33\dots)$ and $x_3 = 1.84(62\dots)$	
	(b)	$a = 2, b = -10$	C1	cao	



- 13** The number of animals in a population at the start of year t is P_t
The number of animals at the start of year 1 is 400

Given that

$$P_{t+1} = 1.01P_t$$

work out the number of animals at the start of year 3

 **Video Solutions**

(2 marks)

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Algebra

Iteration

Using a formula

13	408	M1	for $1.01 \times 400 (= 404)$ or 408.04 or 412.08	412(.08) on the answer line M1A0 1.01×400 may be seen as part of a calculation
		A1	cao	

 **Video Solutions**



18 At time $t = 0$ hours a tank is full of water.

Water leaks from the tank.

At the end of every hour there is 2% less water in the tank than at the start of the hour.

The volume of water, in litres, in the tank at time t hours is V_t

Given that

$$V_0 = 2000$$

$$V_{t+1} = kV_t$$

write down the value of k .

Algebra
Iteration
<i>Using a formula</i>

18		0.98	B1	cao
----	--	------	----	-----

 **Video Solutions**

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HOME

- 22 The number of rabbits on a farm at the end of month n is P_n .
The number of rabbits at the end of the next month is given by $P_{n+1} = 1.2P_n - 50$

At the end of March there are 200 rabbits on the farm.

- (a) Work out how many rabbits there will be on the farm at the end of June.

(3 marks)

- (b) Considering your results in part (a), suggest what will happen to the number of rabbits on the farm after a long time.

 **Video Solutions**

(1 mark)

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HOME

22	(a)	163 or 164	P1	uses formula eg $1.2 \times 200 - 50 (= 190)$
			P1	for complete process, eg May: $1.2 \times "190" - 50 (= 178)$ and June: $1.2 \times "178" - 50 (= 163.6)$
			A1	for 163 or 164
	(b)	Statement	C1	(dep P1) ft statement, eg there won't be any rabbits, fewer rabbits, decrease



Algebra
Iteration
Using a formula

- 19 A hot air balloon is descending.
The height of the balloon n minutes after it starts to descend is h_n metres.
The height of the balloon $(n + 1)$ minutes after it starts to descend, h_{n+1} metres, is given by

$$h_{n+1} = K \times h_n + 20 \text{ where } K \text{ is a constant.}$$

The balloon starts to descend from a height of 1200 metres at 09 15
At 09 16 the height of the balloon is 1040 metres.

Work out the height of the balloon at 09 18



Algebra
Iteration
Using a formula

19	788.4	P1	for substituting values, eg $1040 = K \times 1200 + 20$
		P1	for process to find K , eg $(1040 - 20) \div 1200$ oe $(= 0.85)$
		P1	for complete process, eg 09 17: $"0.85" \times 1040 + 20 (= 904)$; 09 18: $"0.85" \times "904" + 20$
		A1	for 788.4 or 788 or 789

 **Video Solutions**



November 2021 Paper 3H (Calc)

19 At the start of year n , the number of animals in a population is P_n

At the start of the following year, the number of animals in the population is P_{n+1} where

$$P_{n+1} = kP_n$$

At the start of 2017 the number of animals in the population was 4000

At the start of 2019 the number of animals in the population was 3610

Find the value of the constant k .

Algebra

Iteration

Using a formula



 **Video Solutions**

(3 marks)

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Algebra
Iteration
Using a formula

19	0.95	P1	for initial use of the formula eg $3610 = kP_n$ or $P_{n+1} = 4000k$ or for $P_{n+2} = k^2P_n$ or for $3610 = k^2 \times 4000$	Accept n or any integer replacement for n
		P1	for a complete method to find k eg $\sqrt{\frac{3610}{4000}}$ or ± 0.95	This may be seen in steps
		A1	oe	



Geometry & Measures

Scale Drawings and Constructions



Geometry & Measures
Scale Drawings and Constructions
Scale Drawings, Bearings

8 The accurate scale drawing shows the positions of port P and a lighthouse L .



Scale: 1 cm represents 4 km.

Aleena sails her boat from port P on a bearing of 070°
 She sails for $1\frac{1}{2}$ hours at an average speed of 12 km/h to a port Q .
 Find

- (i) the distance, in km, of port Q from lighthouse L , (1 mark)
- (ii) the bearing of port Q from lighthouse L . (4 marks)



Geometry & Measures
Scale Drawings and Constructions
Scale Drawings, Bearings

8	(i)	Distance in the range 20 to 23	P1	for a process to draw a bearing of 070° , eg. a line drawn 70° from the North line at P	Accept a line of any length as long as the intention is clear.
	(ii)	Bearing in the range 317 to 330	P1	for a process to work out the distance PQ , eg. $12 \times 1.5 (= 18)$	
			P1	(dep previous P1) for the process to use the given scale, eg. $"18" \div 4 (= 4.5 \text{ cm})$	Award P3 for Q shown in the correct place on the diagram. 4.5 scores 2 marks provided there is a link to $12 \times 1.5 (= 18)$
			A1	(dep P3) for distance in the range 20 to 23	Award no marks if no supportive processes
			A1	(dep P3) for bearing in the range 317 to 330	Award no marks if no supportive processes
					Award A0A0 if Q is not in the correct place



Geometry & Measures
Scale Drawings and Constructions
<i>Perpendicular from point to line</i>

- 4 Use a ruler and compasses to construct the line from the point P perpendicular to the line CD . You must show **all** construction lines.

$\times P$

C _____ D

(2 marks)



Geometry & Measures
Scale Drawings and Constructions
<i>Perpendicular from point to line</i>

4	perpendicular line constructed	C2	for a fully correct construction with all relevant arcs drawn	Perpendicular line segment between P and CD must be within guidelines Accept dotted lines
		(C1	for a perpendicular line drawn from P to the line CD or all relevant arcs drawn)	



Geometry & Measures

Compound Measures

Speed, Distance,
Time

Pressure, Force,
Area

Mass, Density,
Volume



Summer 2017 Paper 2H (Calc)

Geometry &
Measures

Compound Measures

Speed, distance, time

- 4 Olly drove 56 km from Liverpool to Manchester.
He then drove 61 km from Manchester to Sheffield.

Olly's average speed from Liverpool to Manchester was 70 km/h.
Olly took 75 minutes to drive from Manchester to Sheffield.

- (a) Work out Olly's average speed for his total drive from Liverpool to Sheffield.

(4 marks)

Janie drove from Barnsley to York.

Janie's average speed from Barnsley to Leeds was 80 km/h.
Her average speed from Leeds to York was 60 km/h.

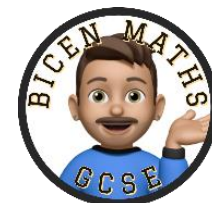
Janie says that the average speed from Barnsley to York can be found by working out the mean of 80 km/h and 60 km/h.

- (b) If Janie is correct, what does this tell you about the two parts of Janie's journey?

 **Video Solutions**

(1 mark)

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Geometry & Measures
Compound Measures
<i>Speed, distance, time</i>

4 (a)		57.1	P1	for a process to find time from Liverpool to Manchester, eg. $56 \div 70$ (= 0.8 (hrs) or 48 (mins))
			P1	for a process to find total distance, eg. $56 + 61$ (= 117) or the total time, eg. "48" + 75 (= 123) or "0.8" + $\frac{75}{60}$ (= 2.05) with consistent units of time
			P1	(dep P2) for a correct process to find average speed with consistent units of time, eg. "117" $\div$ "2.05" or "117" $\div$ "123"
			A1	for answer in the range 57 to 57.1
(b)		explanation	C1	for explaining that the time taken for the two parts of the journey must be the same or the distance from Leeds to York is $\frac{3}{4}$ of the distance from Barnsley to Leeds



- 9 James and Peter cycled along the same 50 km route.

James took $2\frac{1}{2}$ hours to cycle the 50 km.

Peter started to cycle 5 minutes after James started to cycle.

Peter caught up with James when they had both cycled 15 km.

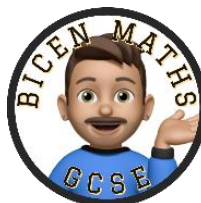
James and Peter both cycled at constant speeds.

Work out Peter's speed.

 **Video Solutions**

(5 marks)

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Geometry & Measures
Compound Measures
<i>Speed, distance, time</i>

9		22.5	P1	for process to find James' speed eg $50 \div 2.5 (=20)$ or $50 \div 150 (= \frac{1}{3})$
			P1	for process to find James' time for 15 km eg $15 \div "20" (=0.75)$ or $15 \div \frac{1}{3} (=45)$
			P1	for process to find Peter's time for 15 km eg $"45" - 5 (=40)$
			P1	for process to find Peter's speed eg $15 \div "40"$ or $15 \div \frac{"40"}{60}$
			A1	oe



5 Lara is a skier.

She completed a ski race in 1 minute 54 seconds.
The race was 475 m in length.

Lara assumes that her average speed is the same for each race.

- (a) Using this assumption, work out how long Lara should take to complete a 700 m race.
Give your answer in minutes and seconds.

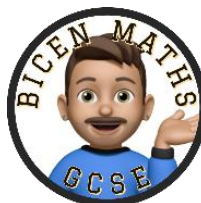
(3 marks)

Lara's average speed actually increases the further she goes.

- (b) How does this affect your answer to part (a)?

 **Video Solutions**

(1 mark)



Geometry & Measures
Compound Measures
<i>Speed, distance, time</i>

5	(a)	2 mins 48 secs	P1	for an appropriate first step eg $700 \div 475 (=1.47..)$ or $475 \div [\text{time}] (= 4.16.. \text{ m/s})$ or $[\text{time}] \div 475 (= 0.24 \text{ s/m})$	[time] what candidate indicates as time of first race Units are not needed and can be ignored if given
			P1	for a complete method to find the required time eg $700 \div 475 \times [\text{time}] (=168)$ or $700 \div (475 \div [\text{time}]) (=168)$ or $[\text{time}] \div 475 \times 700 (=168)$	Allow calculation in stages and appropriate rounding.
			A1	cao	
	(b)	Statement	C1	eg takes less time Acceptable examples Quicker time Faster time Reduces my answer to part (a) Not acceptable examples It is an underestimate The amount of time could/may increase Laura goes faster	



- 6 Nimer was driving to a hotel.
He looked at his Sat Nav at 13 30

Time	13 30
Distance to destination	65 miles

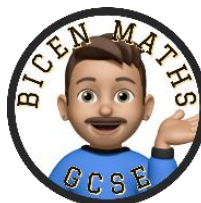
Nimer arrived at the hotel at 14 48

Work out the average speed of the car from 13 30 to 14 48
You must show all your working.

 **Video Solutions**

(4 marks)

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  **HOME**

Geometry & Measures
Compound Measures
<i>Speed, distance, time</i>

6	50	B1	for finding the time difference, eg, 1hr 18 mins or 78 mins oe	Allow 1.18 for this mark 118 scores B0
		P1	for correct process to convert minutes to hours, eg $18 \div 60 (=0.3)$ or $78 \div 60 (=1.3)$ or for a correct process to convert speed in miles per minute to mph eg “0.833..” $\times 60$	For a conversion of time or speed
		P1	for using speed = distance $\div$ time eg, $65 \div [\text{time}]$ or $65 \div 78 (=0.833..)$	[time] is what the candidate clearly indicates as time difference
		A1	cao SCB2 for 83(.333...) seen as the answer	



November 2019 Paper 1H (Non-Calc)

Geometry &
Measures

Compound Measures

Speed, distance, time

9 A car travels for 18 minutes at an average speed of 72 km/h.

(a) How far will the car travel in these 18 minutes?

(2 marks)

David says,

“72 kilometres per hour is faster than 20 metres per second.”

(b) Is David correct?

You must show how you get your answer.

 **Video Solutions**

(2 marks)

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Geometry & Measures
Compound Measures
<i>Speed, distance, time</i>

9	(a)	21.6	M1	for a method using distance = speed $\times$ time, eg. $72 \times \frac{18}{60}$ or 7.2 km in 6 minutes, so 7.2×3 oe partitioning method	Accept 72×18
			A1	for 21.6 oe	
	(b)	No (supported)	M1	for a method to convert 20 m/s to km/h or 72 km/h to m/s, eg. $20 \times \frac{3600}{1000}$ (= 72) or $72 \times \frac{1000}{3600}$ (= 20)	
			C1	for No since 72 km/h = 20 m/s oe	Accept methods to convert both speeds to km/s or m/h



- 2 Andy cycles a distance of 30 km at an average speed of 24 km/h.
He then runs a distance of 12 km at an average speed of 8 km/h.

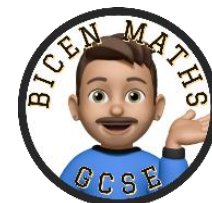
Work out the total time Andy takes.

Give your answer in hours and minutes.

 **Video Solutions**

(3 marks)

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2	2 hours 45 minutes	P1	for $30 \div 24 (= 1.25)$ or $12 \div 8 (= 1.5)$	May be written in hours and/or minutes or 3 h 15 min or 2 h 75 min
		P1	for finding the sum of their two times eg “1.25” + “1.5” (= 2.75) or 165 (minutes)	
		A1	cao	

Summer 2018 Paper 2H (Calc)

- 6 A force of 70 newtons acts on an area of 20 cm^2

The force is increased by 10 newtons.

The area is increased by 10 cm^2

Helen says,

“The pressure decreases by less than 20%”

Is Helen correct?

You must show how you get your answer.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Geometry &
Measures

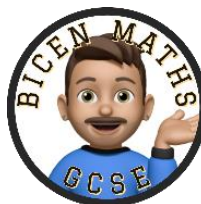
Compound Measures

Pressure, force, area

 **Video Solutions**

(3 marks)

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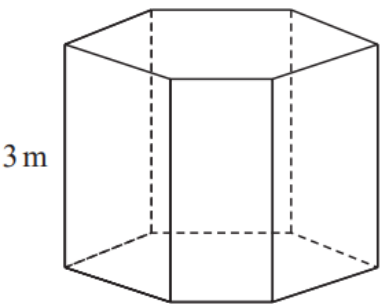
Geometry & Measures
Compound Measures
Pressure, force, area

6	No (supported)	P1 For a process to calculate the initial or new pressure, eg $(70 + 10) \div (20 + 10)$ (=2.6 to 2.7) or $80 \div 30$ (=2.6 to 2.7) or $70 \div 20$ (=3.5) P1 For a complete process to make a comparison eg. $0.8 \times \text{"3.5"} (=2.8)$ OR $\frac{\text{"3.5"} - \text{"2.6"}}{\text{"3.5"}} \times 100$ (=22 to 26) OR $\text{"3.5"} \times 0.2$ (=0.7) and $80 \div 30$ (=2.6 to 2.7) OR $\frac{\text{"2.6"}}{\text{"3.5"}} (\times 100)$ (=0.74 to 0.78 or 74 to 78) A1 for a correct conclusion supported by accurate figures eg 2.8 and 2.6(6...) OR decrease is 24% (or 22% to 26%) OR 0.7 and 2.6 to 2.7 and 3.5 OR 0.7 and 0.9 OR 0.76 (or 0.74 to 0.78) OR 76% (or 74% to 78%)	Accept any value in the range 2.6 to 2.7 if unsupported by working Allow truncation or rounding of figures
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Summer 2020 Paper 1H (Non-Calc)

8 The diagram shows a prism placed on a horizontal floor.



$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

The prism has height 3 m

The volume of the prism is 18 m³

The pressure on the floor due to the prism is 75 newtons/m²

Work out the force exerted by the prism on the floor.

Geometry &
Measures

Compound Measures

Pressure, force, area

 **Video Solutions**

(3 marks)

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Geometry & Measures
Compound Measures
Pressure, force, area

8	450	M1	for $18 \div 3 (=6)$	Ignore units
		M1	for substitution eg. $75 = \frac{F}{"6"}$ or $75 \times "6"$	
		A1	cao	

 **Video Solutions**



13 Liquid A and liquid B are mixed together in the ratio 2 : 13 by volume to make liquid C.

Liquid A has density 1.21 g/cm^3

Liquid B has density 1.02 g/cm^3

A cylindrical container is filled completely with liquid C.

The cylinder has radius 3 cm and height 25 cm.

Work out the mass of the liquid in the container.

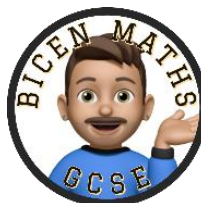
Give your answer correct to 3 significant figures.

You must show all your working.

 **Video Solutions**

(4 marks)

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13	739	P1	process to find the volume of C, eg $\pi \times 3^2 \times 25$ (= 706.8583471 or 225π)	For use of 3.14 Volume of C is 706.5
		P1	process to find the volume of A or the volume of B, eg “706.8...” $\times \frac{2}{2+13}$ (= 94.24777961 or 30π) or “706.8...” $\times \frac{13}{2+13}$ (= 612.6105675 or 195π) or process to work with density and ratio, eg $(2 \times 1.21 + 13 \times 1.02)$ (= 15.68)	Volume of A is 94.2 Volume of B is 612.3
		P1	process to find the mass of C, eg “ 30π ” $\times 1.21$ (= 114.0398133) + “ 195π ” $\times 1.02$ (= 624.8627788) or “225 π ” $\times$ “15.68” $\div (2+13)$	Mass of A is 113.982 Mass of B is 624.546
		A1	for an answer in the range 738.5 to 739	Do not award accuracy mark if the figure is from obvious incorrect working



Summer 2017 Paper 3H (Calc)

Geometry & Measures
Compound Measures
<i>Mass, density, volume</i>

6 The density of apple juice is 1.05 grams per cm^3 .

The density of fruit syrup is 1.4 grams per cm^3 .

The density of carbonated water is 0.99 grams per cm^3 .

25 cm^3 of apple juice are mixed with 15 cm^3 of fruit syrup and 280 cm^3 of carbonated water to make a drink with a volume of 320 cm^3 .

Work out the density of the drink.
Give your answer correct to 2 decimal places.

.....g/ cm^3

 **Video Solutions**

(4 marks)



Geometry & Measures
Compound Measures
<i>Mass, density, volume</i>

6		1.01	P1	fruit syrup $15 \times 1.4 (= 21)$ or water $280 \times 0.99 (= 277.2)$ or apple juice $25 \times 1.05 (= 26.25)$
			P1	(dep P1) for complete process to find the total mass e.g. “277.2” + “26.25” + “21” (= 324.45) or a weighted density eg $15 \times 1.4 \div 320 (= 0.065625)$ or $280 \times 0.99 \div 320 (= 0.86625)$ or $25 \times 1.05 \div 320 (= 0.08203125)$
			P1	(dep P2) for complete process to find the density eg “324.45” $\div 320 (= 1.01..)$ or “0.065625” + “0.86625” + “0.08203125” (= 1.0139..)
			A1	1.01 to 1.014



Geometry & Measures
Compound Measures
<i>Mass, density, volume</i>

3 A gold bar has a mass of 12.5 kg.

The density of gold is 19.3 g/cm³

Work out the volume of the gold bar.
Give your answer correct to 3 significant figures.

..... cm³

 **Video Solutions**

(3 marks)



Geometry & Measures
Compound Measures
<i>Mass, density, volume</i>

3		648	M2	a complete method, eg $12.5 \times 1000 \div 19.3$
			[M1	for using volume = mass/density, eg $12500 \div 19.3$ (condone inconsistent units or incorrect conversions) may be implied by digits 647... or 648...]
			A1	for answer in range 647 to 648

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Summer 2019 Paper 3H (Calc)

**Geometry &
Measures**

Compound Measures

Mass, density, volume

- 13** The density of ethanol is 1.09 g/cm^3
The density of propylene is 0.97 g/cm^3

60 litres of ethanol are mixed with 128 litres of propylene to make 188 litres of antifreeze.

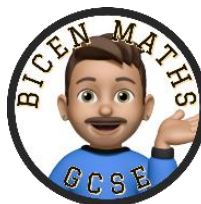
Work out the density of the antifreeze.

Give your answer correct to 2 decimal places.

 **Video Solutions**

(4 marks)

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Geometry & Measures
Compound Measures
Mass, density, volume

13	1.01	P1	for $1.09 \times 60 (= 65.4 \text{ or } \frac{327}{5})$ or $0.97 \times 128 (= 124.16 \text{ or } \frac{3104}{25})$	Note that the volumes may be converted to ml, eg $1.09 \times 60000 (= 65400)$
		P1	for $1.09 \times 60 (= 65.4 \text{ or } \frac{327}{5})$ and $0.97 \times 128 (= 124.16 \text{ or } \frac{3104}{25})$ or “65.4” + “124.16” $(= 189.56 \text{ or } \frac{4739}{25})$	
		P1	for a complete process to find the density of antifreeze eg “65.4” + “124.16” $\div 188$ or $189.56 \div 188$ or $\frac{4739}{25} \div 188$	Candidates working in ml must use 188,000
		A1	for answer in the range 1.00 to 1.01	If an answer within the range is seen in working but then rounded incorrectly award full marks. Accept 1 for 1.00 Note that the correct value is 1.008.....



13 Liquid **A** and liquid **B** are mixed to make liquid **C**.

Liquid **A** has a density of 70 kg/m^3

Liquid **A** has a mass of 1400 kg

Liquid **B** has a density of 280 kg/m^3

Liquid **B** has a volume of 30 m^3

Work out the density of liquid **C**.

 **Video Solutions**

(3 marks)

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Summer 2020 Paper 1H (Non-Calc)

Geometry &
Measures

Compound Measures

Mass, density, volume

13	196	P1	for vol A = $1400 \div 70 (=20)$ or for mass B = $280 \times 30 (=8400)$	An answer of 350 from $70 + 280$ gets no marks
		P1	for density C = $\frac{1400 + "8400"}{"20" + 30} (= \frac{9800}{50})$ or answer with digits 196	
		A1	cao	

 **Video Solutions**

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November 2021 Paper 2H (Calc)

- 7 Liquid **A** has a density of 1.8 g/cm^3
Liquid **B** has a density of 1.2 g/cm^3

80 cm^3 of liquid **A** is mixed with 40 cm^3 of liquid **B** to make 120 cm^3 of liquid **C**.

Work out the density of liquid **C**.

Geometry &
Measures

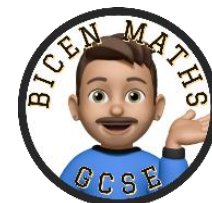
Compound Measures

Mass, density, volume

 **Video Solutions**

(3 marks)

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Geometry & Measures
Compound Measures
<i>Mass, density, volume</i>

7	1.6	P1	for $1.8 \times 80 (= 144)$ or $1.2 \times 40 (= 48)$ or for 192 or for $80 : 40 = 2 : 1$
		P1	for (“144” + “48”) $\div (80 + 40)$ or $192 \div 120$ or for $(1.8 \times 2 + 1.2) \div 3$ or $4.8 \div 3$
		A1	oe

 **Video Solutions**

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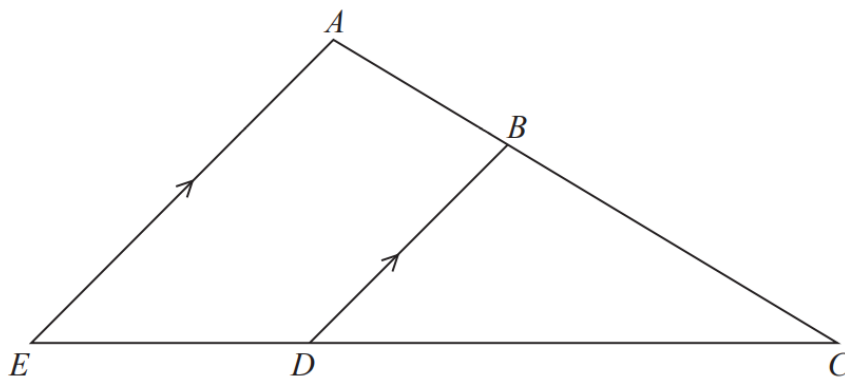
Geometry & Measures

Similarity

Similar Shapes

Length, Area, Volume
Scale Factors





ABC and EDC are straight lines.
 EA is parallel to DB .

$EC = 8.1$ cm.

$DC = 5.4$ cm.

$DB = 2.6$ cm.

(a) Work out the length of AE .

(2 marks)

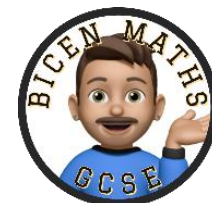
$AC = 6.15$ cm.

(b) Work out the length of AB .

 **Video Solutions**

(2 marks)

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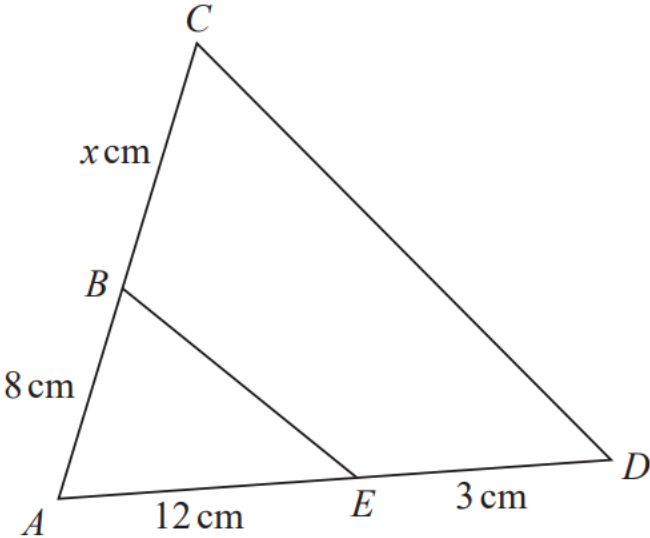
HOME

Geometry & Measures
Similarity
<i>Similar shapes</i>

5 (a)		3.9	M1	for a ratio of $\frac{8.1}{5.4}$ (=1.5) oe or $\frac{5.4}{8.1}$ (=0.66..) oe or $\frac{2.6}{5.4}$ (= 0.48..) oe or $\frac{5.4}{2.6}$ (= 2.07..) oe
			A1	cao
(b)		2.05	M1	for $\frac{5.4}{8.1} \times 6.15$ oe (= 4.1) or $\frac{2.7}{8.1} \times 6.15$ oe or ft “scale factor” from (a)
			A1	cao



22 The two triangles in the diagram are similar.



There are two possible values of x .
 Work out each of these values.
 State any assumptions you make in your working.

Geometry & Measures
Similarity
Similar shapes

Video Solutions

(5 marks)



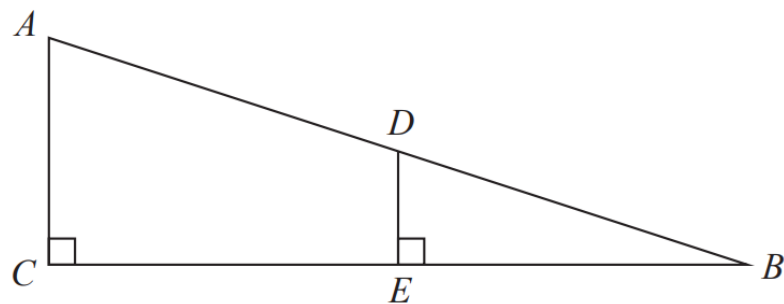
Geometry & Measures
Similarity
<i>Similar shapes</i>

22		2, 14.5	P1 A1 P1 A1 C1	for scale factor of $\frac{12}{3}$ or $\frac{3}{12}$ or $\frac{15}{12}$ or $\frac{12}{15}$ or $\frac{8}{12}$ or $\frac{12}{8}$ or $\frac{15}{8}$ oe or correctly identifies 2 pairs of corresponding sides for $x=2$ for complete method to find other value for x eg $\frac{15}{8} \times 12 - 8$ for $x = 14.5$ Describes both assumptions for similarity
----	--	---------	----------------------------	--

 **Video Solutions**



10 The diagram shows two right-angled triangles ACB and DEB .



- $AD = 9\text{ cm}$
- $DE = 2\text{ cm}$
- $DB = 6\text{ cm}$

Calculate the length of CB .
 Give your answer correct to 2 decimal places.

Geometry & Measures
Similarity
Similar shapes, Pythagoras

 **Video Solutions**

(4 marks)



10	14.14	P1 works out scale factor eg $(9 + 6) \div 6 (= 2.5)$ OR for start of process to find angle DBE eg $\sin B = \frac{2}{6}$ oe P1 uses Pythagoras eg $6^2 - 2^2 (= 32)$ or $\sqrt{32} (= 5.6...)$ OR calculates AC eg $2 \times "2.5" (= 5)$ OR for complete process to find angle DBE eg $\sin^{-1} \left(\frac{2}{6} \right) (= 19.4...)$ P1 complete process to find CB eg $"2.5" \times "\sqrt{32}" (= 10\sqrt{2})$ or $\sqrt{(9+6)^2 - "5" ^2} (= 10\sqrt{2})$ OR uses trigonometry, eg $15 \times \cos "19.4..."$ A1 14.1 to 14.15	Note method can be carried out in either order May be seen on diagram If the answer is given within the range but then rounded incorrectly award full marks.
----	-------	--	---

14 Cone **A** and cone **B** are mathematically similar.

The ratio of the volume of cone **A** to the volume of cone **B** is $27 : 8$

The surface area of cone **A** is 297 cm^2

Show that the surface area of cone **B** is 132 cm^2

 **Video Solutions**

(3 marks)

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Geometry & Measures
Similarity
<i>Length, area, volume scale factors</i>

14		Shown	M1	for $\sqrt[3]{\frac{8}{27}}$ ($= \frac{2}{3}$) or $\sqrt[3]{\frac{27}{8}}$ ($= \frac{3}{2}$) or 2 : 3 or 3 : 2
			M1	for $\left(\sqrt[3]{\frac{8}{27}}\right)^2$ ($= \frac{4}{9}$) or $\left(\sqrt[3]{\frac{27}{8}}\right)^2$ ($= \frac{9}{4}$) or 4 : 9 or 9 : 4
			A1	132 from correct arithmetic



Summer 2018 Paper 3H (Calc)

13 Here are two similar solid shapes.



Geometry & Measures
Similarity
<i>Length, area, volume scale factors</i>

surface area of shape **A** : surface area of shape **B** = 3 : 4

The volume of shape **B** is 10 cm³

Work out the volume of shape **A**.
Give your answer correct to 3 significant figures.

 **Video Solutions**

(3 marks)



Geometry & Measures
Similarity
<i>Length, area, volume scale factors</i>

13	6.50	M1	for method to find ratio or scale factor of lengths or volumes eg $\sqrt{3} : 2$ or $1 : 1.15(47\dots)$ or $0.86(60\dots) : 1$ or $\sqrt{27} : 8$ oe	Scale factors may just be seen as 1.15..., 0.86...etc
		M1	for complete method to find ratio of volumes and use to find required volume eg $10 \div ("1.15\dots")^3$ or $10 \times ("0.86\dots")^3$	
		A1	for answer in the range 6.49 to 6.53	If an answer is given within the range then incorrectly rounded to 3 sig figs, award full marks. Accept 6.5



15 Three solid shapes **A**, **B** and **C** are similar.

The surface area of shape **A** is 4 cm^2

The surface area of shape **B** is 25 cm^2

The ratio of the volume of shape **B** to the volume of shape **C** is $27:64$

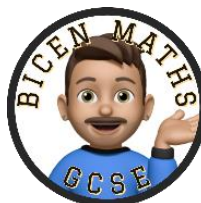
Work out the ratio of the height of shape **A** to the height of shape **C**.

Give your answer in its simplest form.

 **Video Solutions**

(4 marks)

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Geometry & Measures
Similarity
<i>Length, area, volume scale factors</i>

15	3 : 10	P1	process to find ratio of lengths $\mathbf{A:B} = \sqrt{4}:\sqrt{25} (= 2:5 \text{ or } \frac{2}{5} \text{ or } 2, 5)$	Accept working in fractions for the award of process marks but the final answer must be in correct simplified ratio notation
		P1	for process to find ratio of lengths $\mathbf{B:C} = \sqrt[3]{27}:\sqrt[3]{64} (= 3:4 \text{ or } \frac{3}{4} \text{ or } 3, 4)$	
		P1	for process to write as one ratio eg. finding a common multiple of 3 and 5 or 6 : 15 : 20 oe	
		A1	cao	



19 **A**, **B** and **C** are three spheres.

The volume of sphere **A** is 125 cm^3

The volume of sphere **B** is 27 cm^3

The ratio of the radius of sphere **B** to the radius of sphere **C** is $1:2$

Work out the ratio of the surface area of sphere **A** to the surface area of sphere **C**.

 **Video Solutions**

(3 marks)

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Geometry & Measures
Similarity
<i>Length, area, volume scale factors</i>

19	25 : 36	P1	for $\sqrt[3]{125}$ (= 5) and $\sqrt[3]{27}$ (= 3) oe OR for correct process to find the radius of A and radius of B (3.10... and 1.86...)	Accept scale factors expressed as fractions or decimals eg 1.66, 1.67, 0.6 or better Ignore units throughout
		P1	for method to find values in ratio of length between A and C eg 5 and 2×3 (= 6) oe or “3.10...” and “1.86...” $\times 2$ (=3.72...) OR 25 and 36 OR for correct process to find SA of A and SA of C (120.(8...)) and (174.(0...))	For both P marks the lengths need not be written as a ratio
		A1	for 25 : 36 oe eg 1: 1.44	



Summer 2019 Paper 2H (Calc)

Geometry &
Measures

Similarity

Area scale factors

9 The circumference of circle **B** is 90% of the circumference of circle **A**.

(a) Find the ratio of the area of circle **A** to the area of circle **B**.

(2 marks)

Square **E** has sides of length e cm.

Square **F** has sides of length f cm.

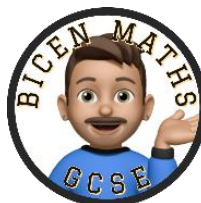
The area of square **E** is 44% greater than the area of square **F**.

(b) Work out the ratio $e:f$

 **Video Solutions**

(2 marks)

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Geometry & Measures
Similarity
Area scale factors

9	(a)	100 : 81	M1	for a scale factor of 0.9 oe used; OR for 10 : 9 oe OR 81 : 100 oe OR 81%	
			A1	for 100 : 81 oe	eg. 1 : 0.81, accept 1.23(4...) : 1
	(b)	6 : 5	P1	for 1.44 oe used as the scale factor or 1.2 oe OR for 144 : 100 oe or $\sqrt{144} : \sqrt{100}$ oe OR 5 : 6 oe	
			A1	for 6 : 5 oe	eg 1.2 : 1, accept 1 : 0.83(3...)



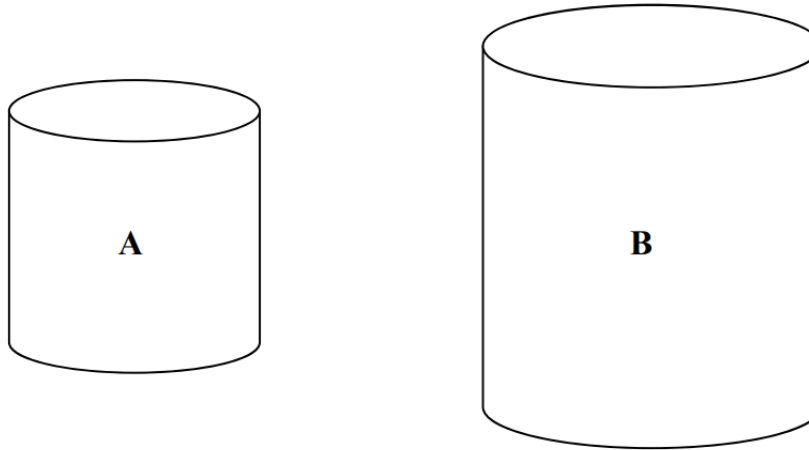
November 2019 Paper 1H (Non-Calc)

Geometry &
Measures

Similarity

Area scale factors

17 **A** and **B** are two similar cylindrical containers.



the surface area of container **A** : the surface area of container **B** = 4 : 9

Tyler fills container **A** with water.

She then pours all the water into container **B**.

Tyler repeats this and stops when container **B** is full of water.

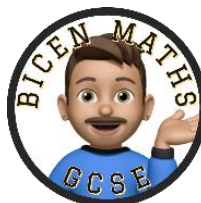
Work out the number of times that Tyler fills container **A** with water.

You must show all your working.

 **Video Solutions**

(4 marks)

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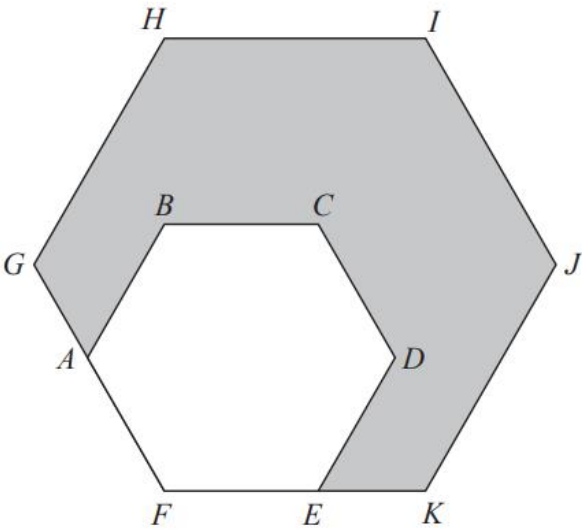


HOME

Geometry & Measures
Similarity
Area scale factors

17	4	P1	for process to find ratio of corresponding lengths, eg. $\sqrt{4}:\sqrt{9} (= 2 : 3)$	This may be seen by checking their volume, eg. $"8" \times 4 (= 32)$ and $"8" \times 3 (= 24)$ An answer of 4 with no supportive working gets no marks
		P1	for process to find ratio of volumes, eg $"2"{}^3 : "3"{}^3 (= 8 : 27)$	
		P1	for $"27" \div "8" (= 3.375)$	
		A1	for rounding to give an answer of 4 from correct working	





Geometry & Measures
Similarity
Area scale factors, $\frac{1}{2} ab \sin C$

$ABCDEF$ is a regular hexagon with sides of length x .
This hexagon is enlarged, centre F , by scale factor p to give hexagon $FGHIJK$.
Show that the area of the shaded region in the diagram is given by $\frac{3\sqrt{3}}{2} (p^2 - 1)x^2$

 **Video Solutions**

(4 marks)



Geometry & Measures
Similarity
Area scale factors, $\frac{1}{2}absinC$

19

Proof

P1	for start to process to find area of $ABCDEF$, eg area of equilateral triangle $= \frac{1}{2} \times x \times x \times \sin 60 (= \frac{\sqrt{3}}{4}x^2)$ OR for start to process to find area of $FGHIJK$, eg area of equilateral triangle $= \frac{1}{2} \times px \times px \times \sin 60 (= \frac{\sqrt{3}}{4}p^2x^2)$
P1	for complete process of finding area of $ABCDEF$, eg $6 \times \frac{1}{2} \times x \times x \times \sin 60$ or $6 \times \frac{1}{2} \times x \times x \times \frac{\sqrt{3}}{2} \left(= \frac{3\sqrt{3}}{2}x^2 \right)$ oe OR for complete process of finding area of $FGHIJK$, eg $6 \times \frac{1}{2} \times px \times px \times \frac{\sqrt{3}}{2} \left(= \frac{3\sqrt{3}}{2}p^2x^2 \right)$ oe
P1	for process of finding area of $ABCDEF$ eg $\frac{3\sqrt{3}}{2}x^2$ oe AND for process of finding area of $FGHIJK$, eg $p^2 \times \frac{3\sqrt{3}}{2}x^2$ oe
C1	correct algebra leading to given result, $\frac{3\sqrt{3}}{2}(p^2 - 1)x^2$

Any correct process to find the area of part of the hexagon is acceptable for this mark,

eg $\frac{1}{2} \times x \times x \times \sin 120$
or $\frac{1}{2} \times (x + 2x) \times \frac{\sqrt{3}}{2}x$

Allow $\sin 60$ left in expressions for the first 3 marks.

Accept $\frac{3\sqrt{3}}{2}x^2(p^2 - 1)$ as final result.



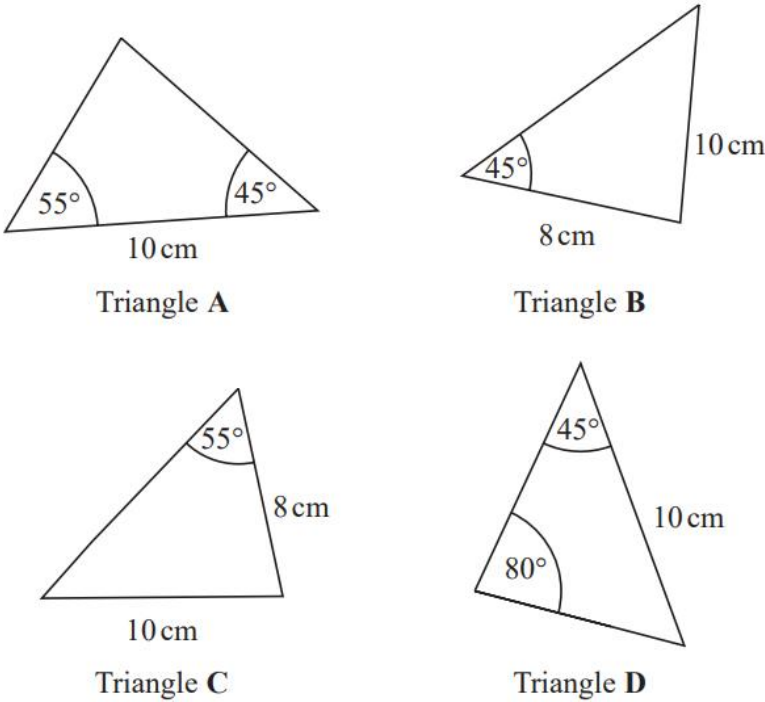
Geometry & Measures

Congruency



Geometry & Measures
Congruency
Simple Congruency

4 The diagram shows four triangles.



Two of these triangles are congruent.
Write down the letters of these two triangles.

..... and

 **Video Solutions**

(1 mark)



Summer 2020 Paper 1H (Non-Calc)

Geometry & Measures
Congruency
<i>Simple Congruency</i>

4	A & D	B1	cao
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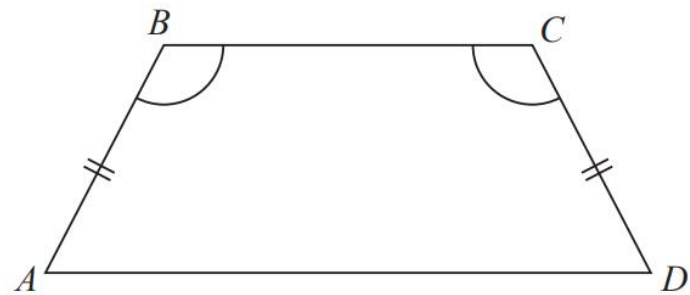
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21 $ABCD$ is a quadrilateral.



$AB = CD$.
 Angle $ABC =$ angle BCD .
 Prove that $AC = BD$.

Geometry & Measures
Congruency
Proof


Video Solutions

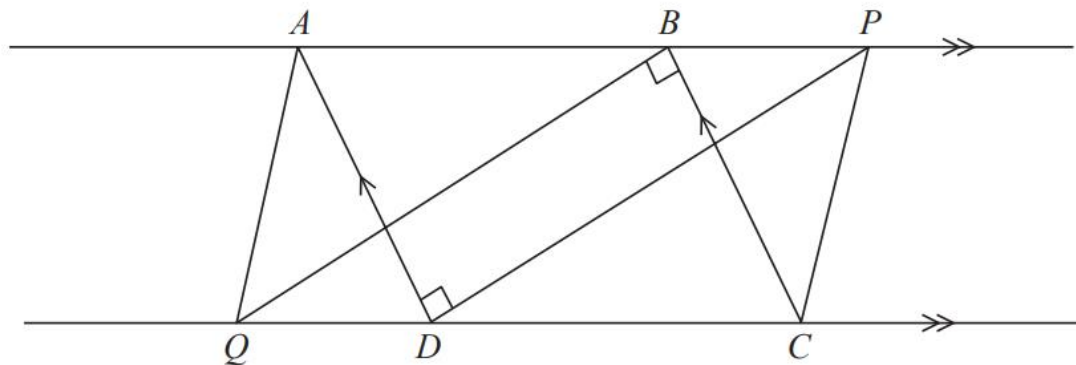
(4 marks)



Geometry & Measures
Congruency
<i>Proof</i>

21			C1	states (angle) $ABC = (\text{angle}) BCD$
			C1	states 2 nd link $AB = CD$
			C1	states 3 rd link with reason: $BC = BC$ (common)
			C1	concludes proof by stating (triangle) $ABC \equiv (\text{triangle}) DCB$ with reason SAS and $AC = BD$





$ABCD$ is a parallelogram.
 ABP and QDC are straight lines.
 Angle $ADP = \text{angle } CBQ = 90^\circ$

(a) Prove that triangle ADP is congruent to triangle CBQ .

(3 marks)

(b) Explain why AQ is parallel to PC .

 **Video Solutions**

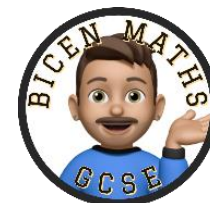
(2 marks)

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Geometry &
Measures

Congruency

... with parallel lines



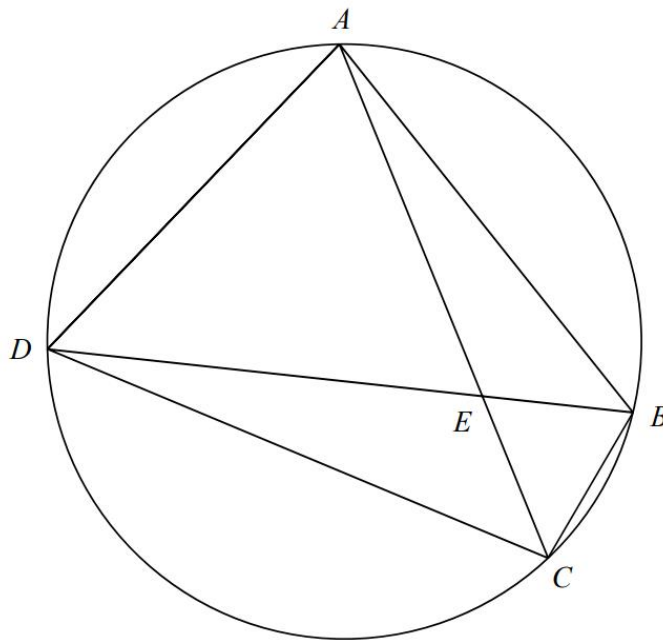
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Geometry & Measures
Congruency
... with parallel lines

21	(a)	Proof	C1	for starting the proof, identifying a pair of relevant equal sides or angles with reasons from $AD = BC$ (opposite sides of a parallelogram are equal) angle $PAD =$ angle QCB (opposite angles of a parallelogram are equal) angle $ADP =$ angle CBQ (given or both 90°)	Congruency conclusion must include a reference to ASA
			C1	(dep C1) for complete identification of all three equal aspects with reasons	
			C1	(dep C2) for conclusion of congruency proof	
	(b)	Explanation	C1	for identifying a pair of equal sides or angles in $APCQ$, with reason, eg $AP = QC$ since triangle ADP is congruent to triangle CBQ	
			C1	(dep C1) for reasoning that $APCQ$ is a parallelogram so opposite sides of a parallelogram are parallel	



22 A, B, C and D are four points on a circle.



AEC and DEB are straight lines.

Triangle AED is an equilateral triangle.

Prove that triangle ABC is congruent to triangle DCB .

Geometry &
Measures

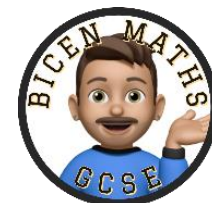
Congruency

... with circle
theorems

 **Video Solutions**

(4 marks)

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HOME

Geometry & Measures
Congruency
... with circle theorems

22

Proof

- C1 for **one** correct pair of equal angles with correct reason from:
angle $ACB = \text{angle } ADB$, (angles in the same segment are equal)
angle $DBC = \text{angle } DAC$, (angles in the same segment are equal)
angle $ABD = \text{angle } ACD$, (angles in the same segment are equal)
- or** for recognising all angles of 60 in triangle AED **and** in triangle CEB)
- C1 for **one** identity, with reason(s), from the following list of alternatives:
Alternatives:
a complete method to show that angle $ACB = \text{angle } DBC (= 60)$,
or
 BC being common to both triangles
or
 $DB = DE + EB = AE + EC = AC$ (sides of an equilateral triangle are equal)
or
angle $ABC = 60 + \text{angle } ABD = 60 + \text{angle } ACD = \text{angle } DCB$
(angles in the same segment are equal)
or
angle $BDC = \text{angle } CAB$ (angles in the same segment are equal)
- C1 for a **second** identity, with reason(s), from the alternatives above
- C1 for concluding the proof with a **third** identity, with reason(s), from the alternatives above, together with the condition for congruency, ASA or SAS or AAS

Underlined words need to be shown; reasons need to be linked to their statement(s)

Pairs of equal angles may be just shown on the diagram



Geometry & Measures

Angles (inc. Circle Theorems)

Triangles

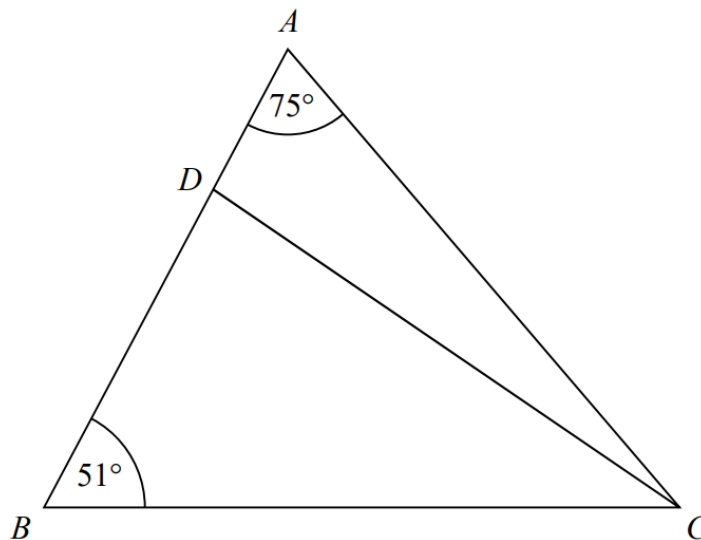
Parallel Lines

Polygons

Circle Theorems



- 5 The diagram shows triangle ABC .



ADB is a straight line.

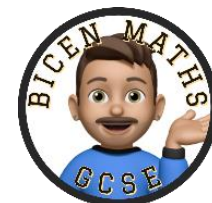
the size of angle DCB : the size of angle $ACD = 2 : 1$

Work out the size of angle BDC .

 **Video Solutions**

(4 marks)

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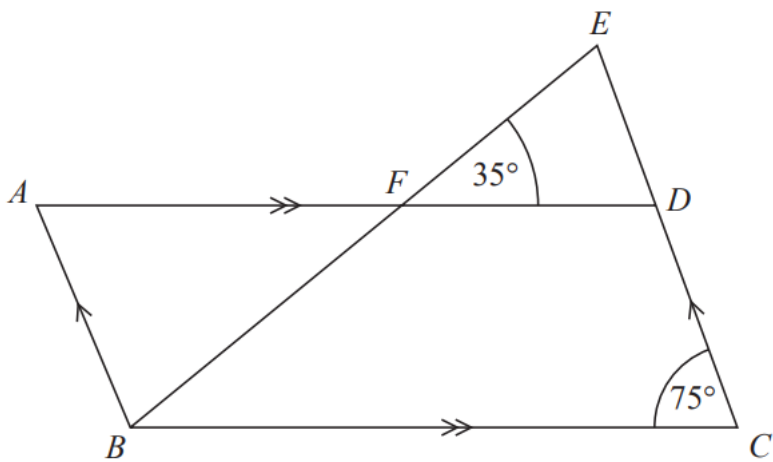
HOME

Geometry & Measures
Angles
<i>Angles in a Triangle, Ratio</i>

5	93	M1	for method to find angle ACB , eg. $180 - 75 - 51 (= 54)$	Angles may be shown on diagram but must not be ambiguous eg. M0 for angle of 54° shown in the wrong place
		M1	(dep M1) for method to use the ratio, eg. $"54" \div (2 + 1) (= 18)$	
		M1	for complete method, eg. $180 - 51 - "18" \times 2$ or $75 + "18"$ oe	
		A1	cao	



3



Geometry & Measures
Angles
Angles in parallel lines

ABCD is a parallelogram.
EDC is a straight line.
F is the point on *AD* so that *BFE* is a straight line.

Angle *EFD* = 35°
 Angle *DCB* = 75°

Show that angle *ABF* = 70°
 Give a reason for each stage of your working.

 **Video Solutions**

(4 marks)

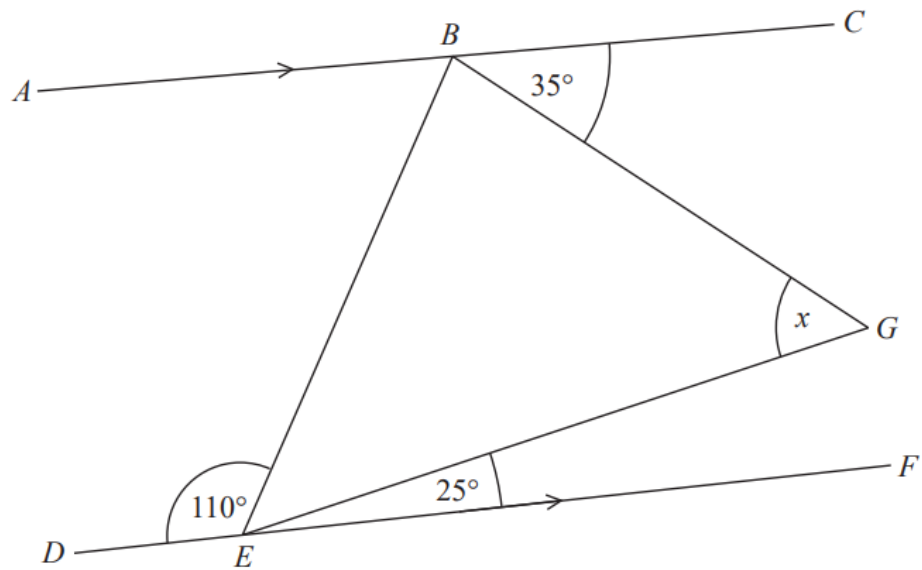


Geometry & Measures
Angles
Angles in parallel lines

3	CB extended to form CG	Reasoning	B1 M1 C2 (C1)	for 35 or 75 or 145 or 105 or $DEF = 70$, marked on the diagram or 3 letter description for 180-70-35 or 180-75-35 or a correct pair of angles that would lead to 75 or 70, eg $AFB = 35$ and $FAB = 75$ or $AFB = 35$ and $ABG = 75$ or $FBC = 35$ and $ABG = 75$ or $EDF = 75$ and $DEF = 70$ or $FDC = 105$ and $FBC = 35$ or $ABC = 105$ and $FBC = 35$ (dep on B1M1) All figures correct with all appropriate reasons stated. Angles must be clearly labelled or on the diagram. Full solution must be seen (dep on B1 or M1) for one reason clearly used and stated.) <u>Corresponding</u> angles are equal, <u>alternate</u> angles are equal, <u>opposite angles</u> in a <u>parallelogram</u> are equal, <u>angles</u> in a <u>triangle</u> sum to 180, <u>angles</u> on a straight <u>line</u> sum to 180, vertically <u>opposite angles</u> are equal, <u>vertically opposite</u> angles are equal, <u>angles</u> in a <u>quadrilateral</u> sum to 360, <u>co-interior</u> angles sum to 180, <u>allied</u> angles sum to 180, <u>angles</u> around a <u>point</u> sum to 360
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3 BEG is a triangle.



ABC and DEF are parallel lines.

Work out the size of angle x .
Give a reason for each stage of your working.

Geometry & Measures
Angles
Angles in parallel lines

▶ **Video Solutions**

(4 marks)



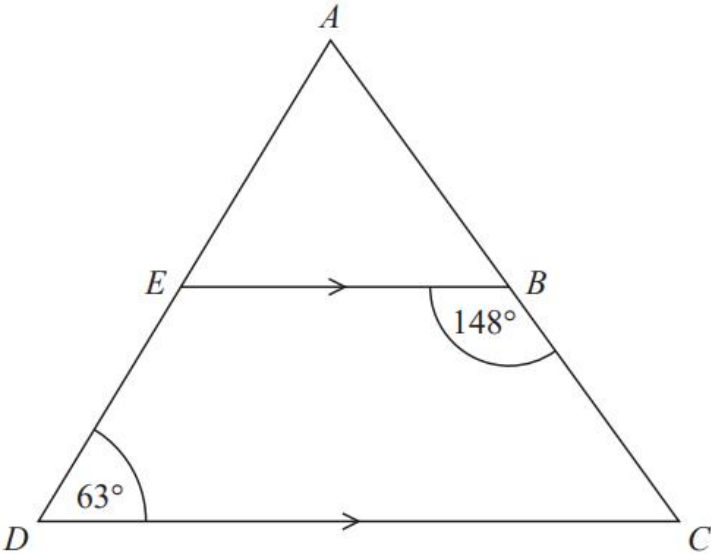
Geometry & Measures
Angles
<i>Angles in parallel lines</i>

3	60	M1	use of parallel lines to find an angle eg $ABE=70$ or $EBG=75$ or $EBC=110$ or shows parts of x as 35 or 25	Parts of x should be identified on the diagram by the insertion of a dividing line through angle x (need not be identified or drawn parallel).
		M1	for a complete method to find angle x ; could be in working or on the diagram	Correct method can be implied from angles on the diagram if no ambiguity or contradiction.
		A1	for $x = 60$	
		C1	(dep on M1) for one reason linked to parallel lines and one other reason, supported by working taken from: <u>alternate</u> angles are equal, <u>allied</u> angles / <u>co-interior</u> angles add up to 180, <u>angles</u> on a straight <u>line</u> add up to 180, <u>angles</u> in a <u>triangle</u> add up to 180°	Underlined words need to be shown; reasons need to be linked to their method; any reasons not linked do not credit. There should be no incorrect reasons given.



Summer 2020 Paper 1H (Non-Calc)

6 ADC is a triangle.



AED and ABC are straight lines.
 EB is parallel to DC .

Angle $EBC = 148^\circ$
Angle $ADC = 63^\circ$

Work out the size of angle EAB .
You must give a reason for each stage of your working.

Geometry & Measures
Angles
Angles in parallel lines

 **Video Solutions**

(5 marks)

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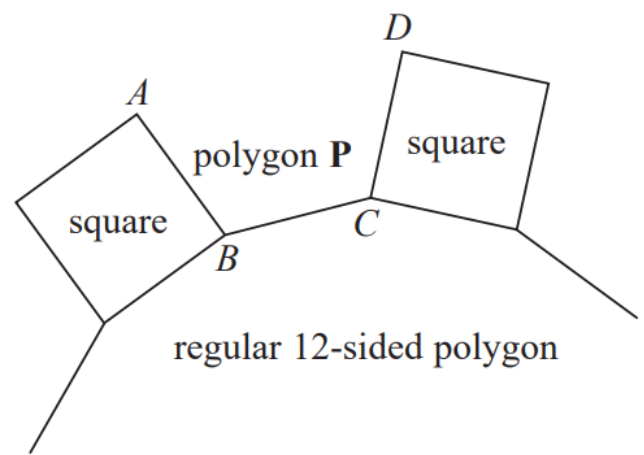


  **HOME**

6	85 with working and reasons	M1	for correct use of corresponding angles eg $AEB = 63$ or co-interior angles eg $BCD = 180 - 148 (= 32)$ or $DEB = 180 - 63 (= 117)$	Angles must be clearly labelled on the diagram or otherwise identified. Full solution must be seen.
		M1	(dep) for a complete method to find angle EAB eg. $180 - "63" - (180 - 148)$ or $148 - "63"$ or $"117" - (180 - 148)$	Correct method can be implied from angles on the diagram if no ambiguity or contradiction.
		A1	for $EAB = 85$ (identified)	
		C2	(dep on M2) all working correct with all appropriate reasons stated. <u>Corresponding</u> angles are equal <u>Allied</u> angles / <u>Co-interior</u> angles add up to 180 <u>Angles</u> on a straight <u>line</u> add up to 180 <u>Angles</u> in a <u>triangle</u> add up to 180 The <u>exterior angle</u> of a triangle is <u>equal</u> to the sum of the <u>interior opposite angles</u> .	When reasons are given the key words underlined must be present. Reasons need to be linked to their method; any reasons not linked, do not credit. There should be no incorrect reasons given.
		(C1	for one reason relating to parallel lines clearly used and stated or for any two reasons clearly stated for their fully correct method)	

Summer 2017 Paper 3H (Calc)

5 In the diagram, AB , BC and CD are three sides of a regular polygon **P**.



Show that polygon **P** is a hexagon.
You must show your working.

Geometry & Measures
Angles
Polygons

 **Video Solutions**

(4 marks)

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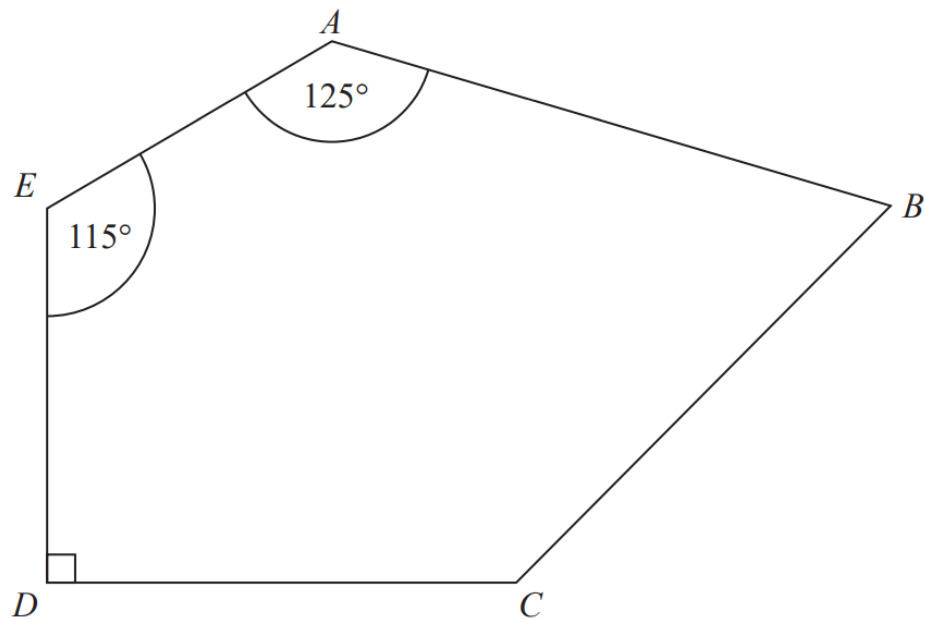
  **HOME**

Geometry & Measures
Angles
Polygons

5		Shows polygon is a hexagon	M1	for a complete method to find the interior or exterior angle of the dodecagon eg $180 - \frac{360}{12}, \frac{180}{12}(12 - 2)$ oe (= 150), $360 \div 12$ (=30)
			M1	for a complete method to find the interior angle of polygon P eg at <i>B</i> or <i>C</i> : $360 - "150" - 90$ (= 120) or $"30" + 90$ (= 120) or for a complete method to find the interior or exterior angle of the hexagon eg $180 - \frac{360}{6}, \frac{180}{6}(6 - 2)$ oe (= 120), $360 \div 6$ (= 60)
			A1 C1	for 30 and 120 or 30 and 60 or 120 and 150 or 60 and 150 complete solution, fully supported by accurate figures



8 $ABCDE$ is a pentagon.



Angle $BCD = 2 \times \text{angle } ABC$

Work out the size of angle BCD .
You must show all your working.

Geometry & Measures
Angles
Polygons

Video Solutions

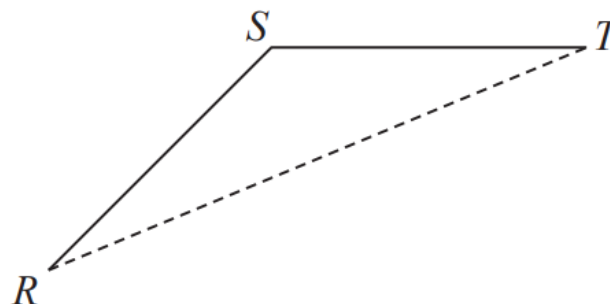
(5 marks)



Geometry & Measures
Angles
Polygons

8	140	P1	for complete process to find sum of the interior angles of a pentagon eg $(5 - 2) \times 180$ or exterior $360 \div 5 = 72$, interior $180 - 72 = 108$, 108×5 OR for complete process to find sum of the exterior angles of the pentagon eg $(180 - x) + (180 - 2x) + (180 - 125) + (180 - 115) + (180 - 90)$	Must be a complete process that could lead to a figure of 540 if that process is evaluated incorrectly
		A1	for sum of interior angles is 540 OR for sum of exterior angles is 360	360 must be identified as the sum of the exterior angles
		P1	for start to process to find angle <i>ABC</i> eg [angles in a pentagon] $- 115 - 125 - 90 (= 210)$ or $115 + 125 + 90 + x + 2x =$ [angles in a pentagon] OR $(180 - x) + (180 - 2x) + (180 - 125) + (180 - 115) + (180 - 90) = 360$	Award provided [angles in a pentagon] is greater than 400 Algebraic route needs to show both sides of the equation. LHS of equation may be simplified
		P1	for process to find angle <i>ABC</i> eg “210” $\div 3 (= 70)$, “210” divided in the ratio 2 : 1 or for process to find angle <i>BCD</i> eg $\frac{2}{3} \times$ “210” or for $3x =$ “210” or $-3x = -$ “210”	Award if 70 is given for either <i>ABC</i> or <i>BCD</i> on the diagram
		A1	cao	Award marks for 140 on the diagram with working and not contradicted by the answer line. Award 0 marks for 140 without working.





RS and ST are 2 sides of a regular 12-sided polygon.

RT is a diagonal of the polygon.

Work out the size of angle STR .

You must show your working.

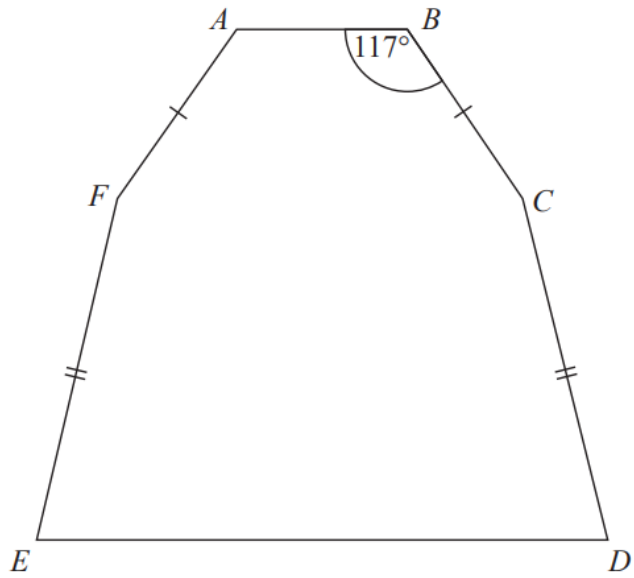
Geometry & Measures
Angles
<i>Polygons</i>

12		15	P1	for a process to find the interior or exterior angle of a regular 12 sided polygon e.g. $\frac{10 \times 180}{12}$ (= 150) or $\frac{360}{12}$ (= 30), must be no contradictions
			P1	for process to find angle <i>STR</i> , eg $\frac{180 - "150"}{2}$ or $\frac{"30"}{2}$
			A1	cao



Summer 2019 Paper 3H (Calc)

- 5 The diagram shows a hexagon.
The hexagon has one line of symmetry.



$FA = BC$
 $EF = CD$
Angle $ABC = 117^\circ$

Angle $BCD = 2 \times \text{angle } CDE$

Work out the size of angle AFE .
You must show all your working.

Geometry & Measures
Angles
Polygons

 **Video Solutions**

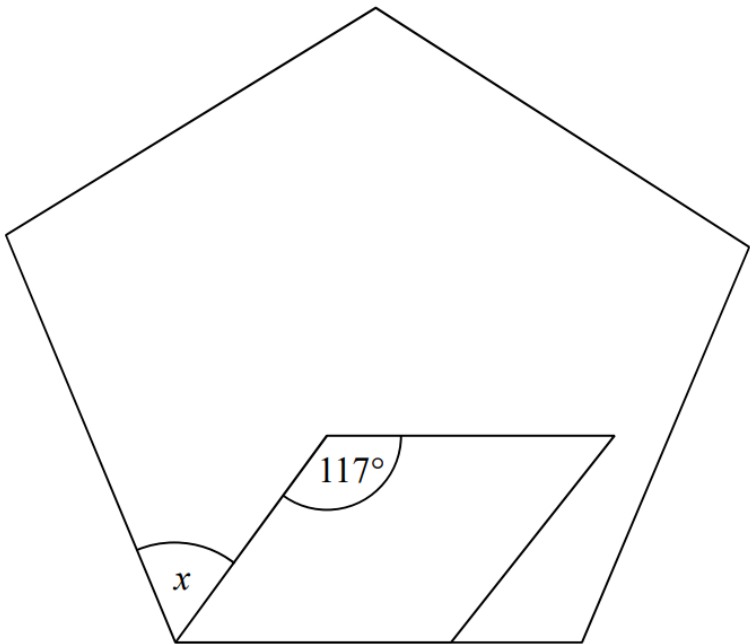
(4 marks)



5	162 supported	M1	for method to find sum of the interior angles of a hexagon eg $(6 - 2) \times 180 (= 720)$ oe OR for method to find sum of the interior angles of a pentagon, eg $(5 - 2) \times 180 (= 540)$ OR for method to find angle AFC or BCF , eg $(360 - 2 \times 117) \div 2 (= 63)$ OR for dropping a perpendicular from A or B to ED with 90° marked on ED and 27° at the top	Must be a complete process that would lead to a figure of 720 if evaluated correctly. For a pentagon there must be an indication that they have divided the hexagon into two halves. 63 may be shown on the diagram for angle AFC or angle BCF
		M1	for method to use ratio 2 : 1 eg marks as $2x$ and x or as x and $\frac{1}{2}x$ on diagram OR for $([\text{angle sum of hexagon}] - 2 \times 117) \div 6 (= 81)$ oe or $([\text{angle sum of hexagon}] \div 2 - 117) \div 3 (= 81)$ oe or $117 + 117 + 2x + 2x + x + x = [\text{angle sum of hexagon}]$ oe OR eg $([\text{angle sum of pentagon}] - 117 - 180) \div 3 (= 81)$ oe or $117 + 180 + 2x + x = [\text{angle sum of pentagon}]$ oe	Ratio must be used correctly if awarded for diagram Award provided $[\text{angle sum of hexagon}]$ is greater than 700 or $[\text{angle sum of pentagon}]$ is greater than 500 Algebraic route needs to show both sides of the equation. LHS of equation may be simplified.
		M1	for finding angle $FED = 81$ or for finding angle $CDE = 81$ OR for complete process to find angle AFE eg $([\text{angle sum of hexagon}] - 2 \times 117) \div 6 \times 2$ oe OR $([\text{angle sum of pentagon}] - 117 - 180) \div 3 \times 2$ oe	This may be shown by solving a correct equation to find the value of x .
		C1	for accurate working leading to angle $AFE = 162$	Award marks for 162 on the diagram with working and not contradicted by the answer line. Award 0 marks for 162 without working.



8 The diagram shows a regular pentagon and a parallelogram.



Work out the size of the angle marked x .
You must show all your working.

Geometry & Measures
Angles
Polygons

Video Solutions

(4 marks)

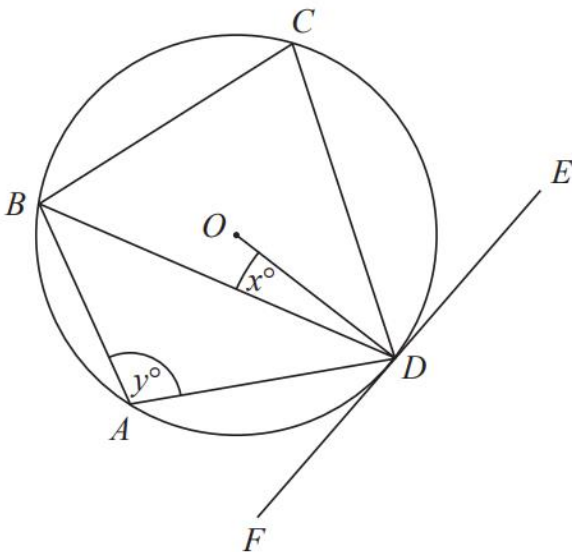


Geometry & Measures
Angles
Polygons

8	45	P1	for $180 - 117 (=63)$ or states, or uses, exterior angle $+ x = 117$	Angles may be shown on the diagram. Any angle labelled correctly as 63 and not contradicted scores this mark
		P1	for process to find the exterior or the interior angle of the pentagon, eg $360 \div 5 (=72)$ or $180 - (360 \div 5) (=108)$ or $((5-2) \times 180) \div 5 (=108)$	Exterior = 108 or interior = 72 does not score the mark
		P1	for a complete process to find x , eg $180 - "72" - "63"$ or $"108" - "63"$ or $117 - "72"$	
		A1	cao	An answer of 45 with no supporting working scores 0



Geometry & Measures
Angles
Circle Theorems



A, B, C and D are points on the circumference of a circle, centre O.
 FDE is a tangent to the circle.

- (a) Show that $y - x = 90$
 You must give a reason for each stage of your working.

(3 marks)

Dylan was asked to give some possible values for x and y.
 He said,
 “y could be 200 and x could be 110, because $200 - 110 = 90$ ”

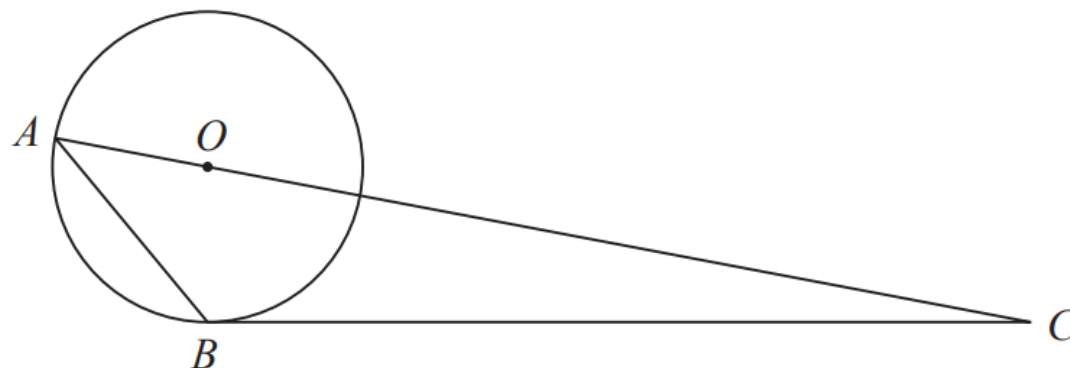
- (b) Is Dylan correct?
 You must give a reason for your answer.



Geometry & Measures
Angles
Circle Theorems

13	(a)	Shown	M1	for finding one missing angle eg $BDE = y$ or $ODE = 90$ or $ODF = 90$ or $DBO = x$ or $BCD = 180 - y$ or (reflex) $BOD = 2y$	Could be shown on the diagram or in working
			A1	for a complete correct method leading to $y - x = 90$	
			C1	(dep on A1) for all correct circle theorems given appropriate for their working eg The <u>tangent</u> to a circle is perpendicular (90°) to the <u>radius</u> (<u>diameter</u>) <u>Alternate segment</u> theorem OR <u>Angle</u> at the <u>centre</u> is <u>twice</u> the <u>angle</u> at the <u>circumference</u> Opposite angles in a <u>cyclic quadrilateral</u> sum to 180°	
	(b)	Explanation	C1	for explanation eg No as y must be less than 180 as it is an angle in a triangle	





A and B are points on a circle, centre O .

BC is a tangent to the circle.

AOC is a straight line.

Angle $ABO = x^\circ$.

Find the size of angle ACB , in terms of x .

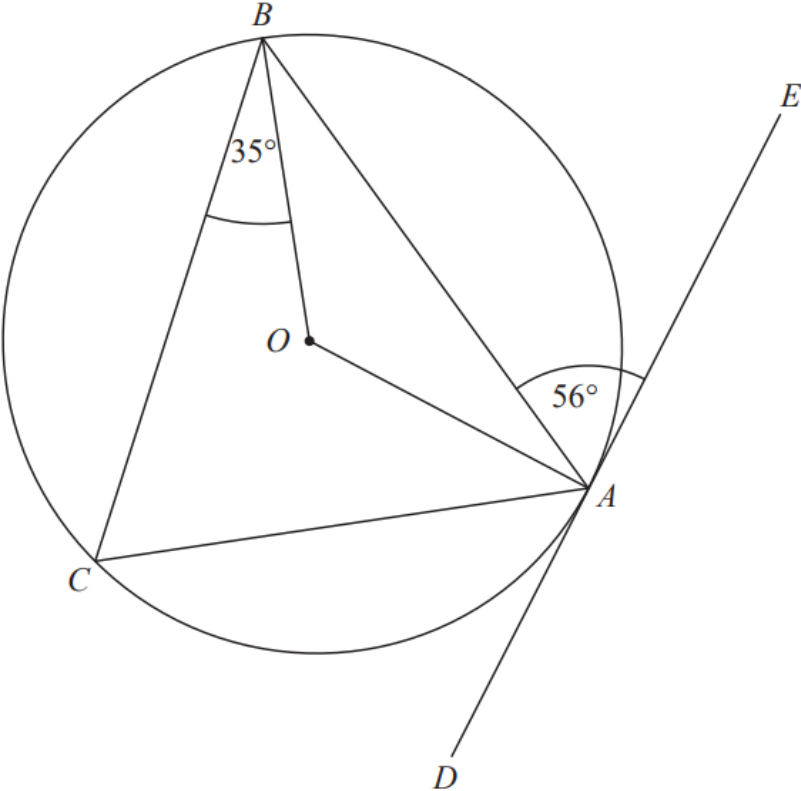
Give your answer in its simplest form.

Give reasons for each stage of your working.

11	$90 - 2x$	M1	for identifying an unknown angle eg $BAO = x$, $AOB = 180 - 2x$, $OBC = 90$, $ABC = 90 + x$	Could be shown on the diagram alone
		M1	full method to find the required angle eg a method leading to $180 - x - x - 90$	Needs to be an algebraic method Accept $x + x + 90 + y = 180$ for M2
		A1	for $90 - 2x$	
		C2	(dep M2) full reasons for their method, from base angles in an <u>isosceles triangle</u> are equal <u>angles</u> in a <u>triangle</u> add up to 180° a <u>tangent</u> to a circle is perpendicular to the <u>radius (diameter)</u> <u>angles</u> on a straight <u>line</u> equal 180° the <u>exterior angle</u> of a triangle is <u>equal</u> to the sum of the <u>interior opposite angles</u>	Underlined words need to be shown; reasons need to be linked to their method; any reasons not linked do not credit.
		(C1	(dep M1) for a <u>tangent</u> to a circle is perpendicular to the <u>radius (diameter)</u>)	Apply the above criteria



Geometry & Measures
Angles
Circle Theorems



*A, B and C are points on the circumference of a circle, centre O.
 DAE is the tangent to the circle at A.*

*Angle BAE = 56°
 Angle CBO = 35°*

*Work out the size of angle CAO.
 You must show all your working.*

 **Video Solutions**

(3 marks)



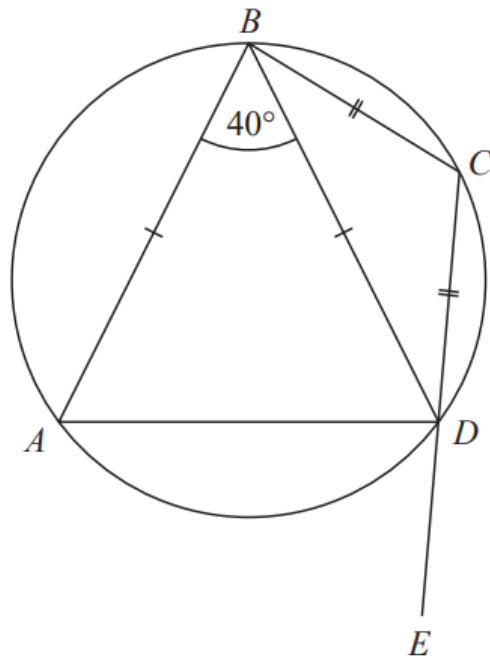
Geometry & Measures
Angles
Circle Theorems

12	21	C1	for angle $OAB = 90 - 56 (= 34)$	Throughout, angles may be written on the diagram; accept as evidence if correct. Ignore absence of degree sign Reasons need not be given.
		C1	for process to find angle $CAD (= 69)$ or angle $BCA (= 56)$ or angle $COA (= 138)$, eg use of alternate segment theorem or angle at centre is twice the angle at the circumference	
		C1	cao	



Summer 2019 Paper 2H (Calc)

18 The points A, B, C and D lie on a circle.
 CDE is a straight line.



$BA = BD$
 $CB = CD$
Angle $ABD = 40^\circ$

Work out the size of angle ADE .
You must give a reason for each stage of your working.

Geometry & Measures
Angles
Circle Theorems

 **Video Solutions**

(5 marks)

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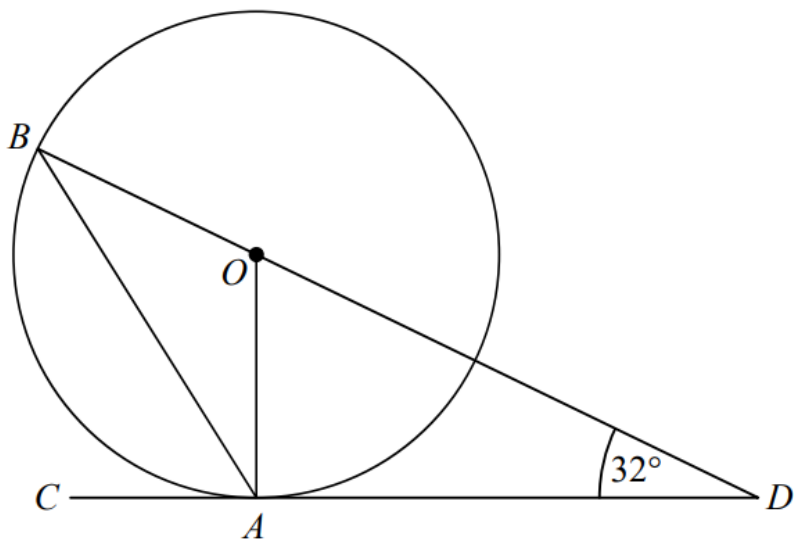


HOME

18	75° with reasons	M1	for finding angle $BAD = \frac{180 - 40}{2}$ (= 70) or angle $BDA = \frac{180 - 40}{2}$ (= 70)	Could be shown on the diagram or in working
		M1	for finding angle $BCD = 180 - "70"$ (=110) or $40 + x + 70 + x = 180$	
		A1	for finding angle $ADE = 75$	
		C2	(dep M2) for <u>Opposite angles</u> of a <u>cyclic quadrilateral</u> add up to 180 and one other reason; all reasons given must be appropriate for their working Base angles of an <u>isosceles triangle</u> are equal <u>Angles</u> in a <u>triangle</u> add up to 180, <u>Angles</u> on a straight <u>line</u> add up to 180 [or <u>exterior angle</u> of a <u>cyclic quadrilateral</u> is equal to the <u>interior opposite angle</u>]	Underlined words need to be shown; reasons need to be linked to their method
		(C1	(dep M2) for <u>Opposite angles</u> of a <u>cyclic quadrilateral</u> add up to 180, or all other reasons given appropriate for their working)	Apply the above criteria



Geometry & Measures
Angles
Circle Theorems



A and *B* are points on a circle with centre *O*.
CAD is the tangent to the circle at *A*.
BOD is a straight line.

Angle $ODA = 32^\circ$

Work out the size of angle *CAB*.
 You must show all your working.

 **Video Solutions**

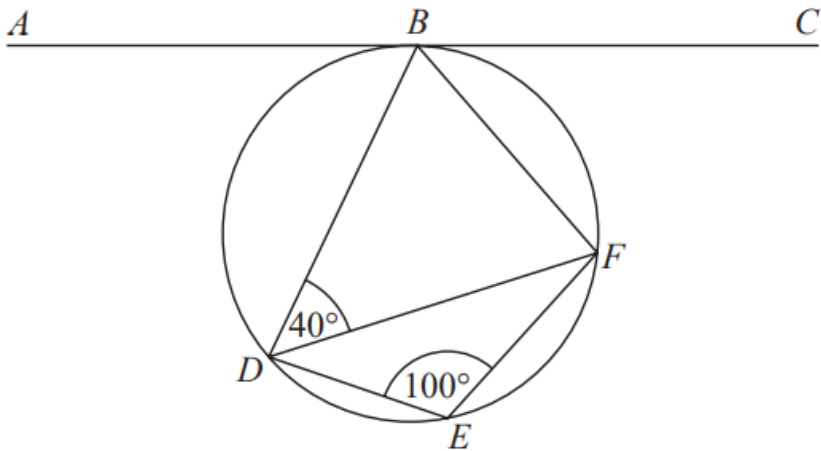
(3 marks)



Geometry & Measures
Angles
Circle Theorems

17	61	B1	angle $OAD = 90$, may be marked on diagram	Angle could be shown by a right-angle symbol
		M1	method to work out angle $OAB (=29)$	Correct method can be implied from angles on the diagram if no ambiguity or contradiction. Reasons need not be given.
		A1	cao	Award 0 marks for an answer of 61 with no other working.





Geometry & Measures
Angles
Circle Theorems

Points B , D , E and F lie on a circle.
 ABC is the tangent to the circle at B .

Find the size of angle ABD .
 You must give a reason for each stage of your working.

Video Solutions

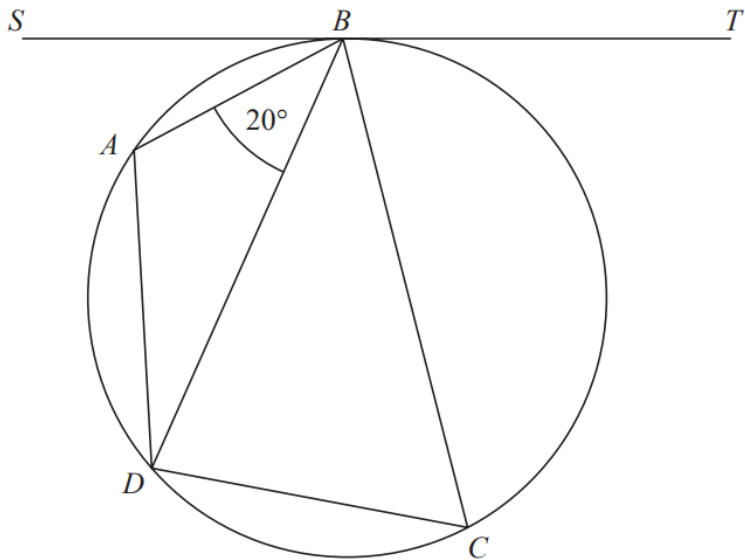
(4 marks)



14	60 (supported)	M1	for angle DBF , eg $180 - 100 (= 80)$	Angles may be shown on the diagram or in working
		M1	for angle BFD , eg $180 - "80" - 40 (= 60)$ or for angle $CBF = 40$	
		A1	for angle $ABD = 60$	
		C1	(dep M2) for at least 2 reasons from <u>Opposite angles of a cyclic quadrilateral</u> add up to 180 <u>Angles in a triangle</u> add up to 180 <u>Alternate segment</u> theorem OR <u>Opposite angles of a cyclic quadrilateral</u> add up to 180 <u>Alternate segment</u> theorem <u>Angles on a straight line</u> add up to 180	

Underlined words need to be shown; reasons need to be linked to their method





A, B, C and D are four points on a circle.
SBT is a tangent to the circle.
Angle $ABD = 20^\circ$

the size of angle BAD : the size of angle $BCD = 3 : 1$

Find the size of angle SBA .
Give a reason for each stage of your working.

Geometry & Measures
Angles
Circle Theorems

 **Video Solutions**

(4 marks)

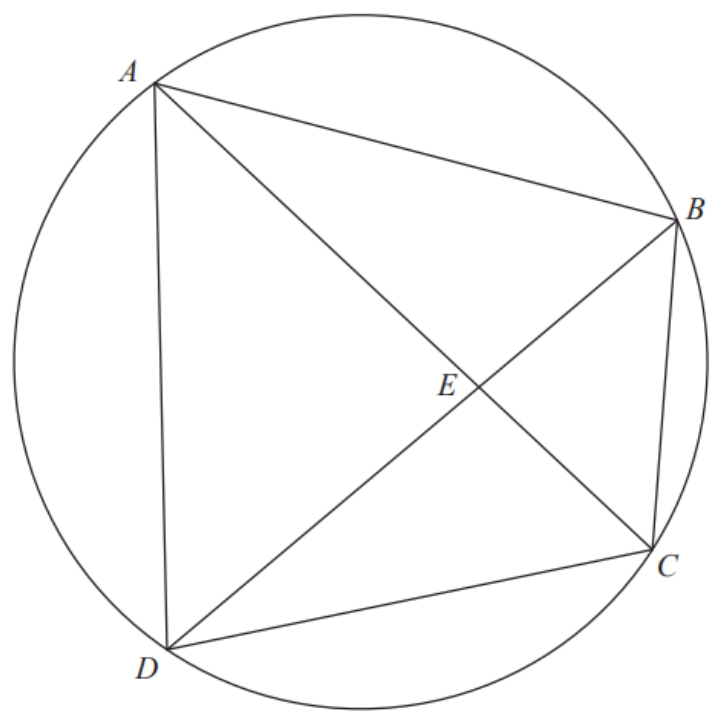


14	25 with reasons	M1	for method to find angle BCD eg $180 \div (3 + 1)$ (= 45) or $BAD = 180 \div (3 + 1) \times 3$ (=135)	Could be shown on the diagram or in working
		M1	for method to find angle BDA eg $180 - 20 - (180 - "45")$ (=25) or method to find angle SBD eg $SBD = BCD$ (=45)	Do not award if it ambiguous as to which angle is being found
		C2	for finding SBA (=25) and both reasons given, eg <u>Opposite angles</u> of a <u>cyclic quadrilateral</u> add up to 180 for angle $SBD = 45$ because <u>alternate segment</u> theorem	
		(C1	(dep M1) for one reason given <u>Opposite angles</u> of a <u>cyclic quadrilateral</u> add up to 180 for angle $SBD = 45$ because <u>alternate segment</u> theorem)	Underlined words need to be shown; reasons need to be linked to their method



Summer 2017 Paper 2H (Calc)

15 A, B, C and D are four points on the circumference of a circle.



AEC and BED are straight lines.

Prove that triangle ABE and triangle DCE are similar.
You must give reasons for each stage of your working.

Geometry & Measures
Angles
Circle Theorems, Proof

 **Video Solutions**

(3 marks)

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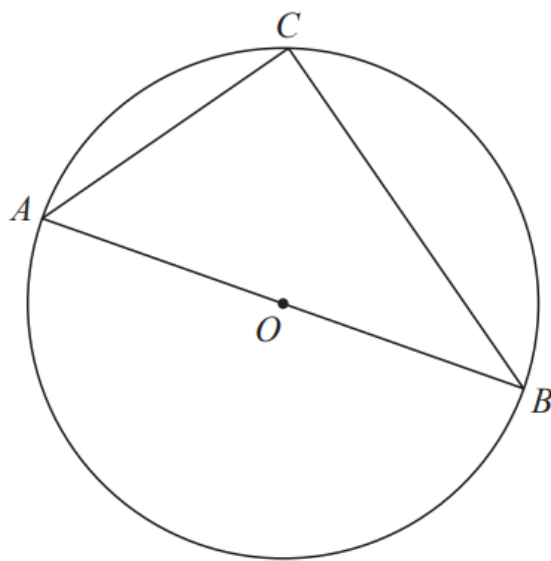
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Geometry & Measures
Angles
Circle Theorems, Proof

15		Proof	C1 for identifying one pair of equal angles with a correct reason, e.g. (angle) $BAE = (\text{angle}) CDE$; <u>angles</u> in the same <u>segment</u> are equal or <u>angles</u> at the circumference <u>subtended</u> on the same <u>arc</u> are equal or for identifying two pairs of equal angles with no correct reasons given (angles must be within the appropriate triangles) C1 for identifying a second pair of equal angles with a correct reason, e.g. (angle) $AEB = (\text{angle}) DEC$; <u>opposite angles</u> or <u>vertically opposite</u> angles are equal or for identifying the three pairs of equal angles with no correct reasons given C1 for stating the three pairs of equal angles of the two triangles e.g. $ABE = DCE$, $BEA = CED$, $EAB = EDC$ with fully correct reasons
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A , B and C are points on the circumference of a circle, centre O .
 AOB is a diameter of the circle.

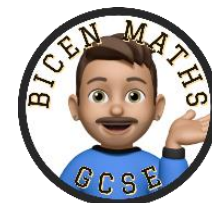
Prove that angle ACB is 90°

You must **not** use any circle theorems in your proof.

 **Video Solutions**

(4 marks)

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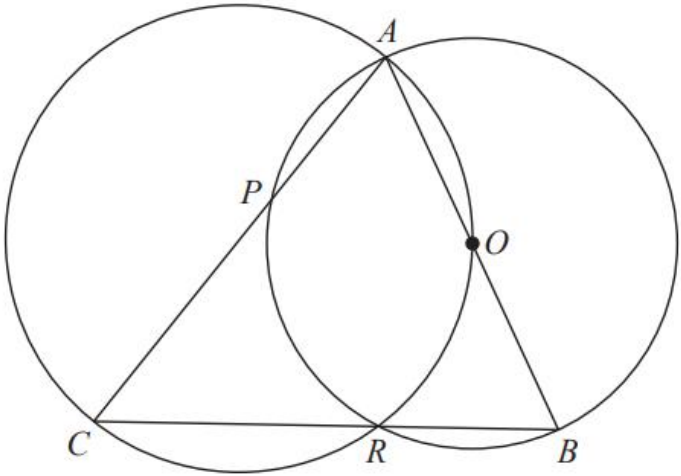


HOME

Geometry & Measures
Angles
Circle Theorems, Proof

20		Proof	C1	draws OC and considers angles in an isosceles triangle (algebraic notation may be used, eg two angles labelled x)
			C1	finds sum of angles in triangle ABC , eg $x + x + y + y = 180$, or sum of angles at O , eg $180 - 2x + 180 - 2y$
			C1	complete method leading to $ACB = 90$
			C1	complete proof with all reasons given, eg base angles of an <u>isosceles triangle</u> are equal, <u>angles</u> in a <u>triangle</u> add up to 180° , <u>angles</u> on a straight <u>line</u> add up to 180°





A, B, R and P are four points on a circle with centre O.
A, O, R and C are four points on a different circle.
The two circles intersect at the points A and R.

CPA, CRB and AOB are straight lines.

Prove that angle CAB = angle ABC.

Geometry & Measures
Angles
Circle Theorems, Proof

 **Video Solutions**

(4 marks)

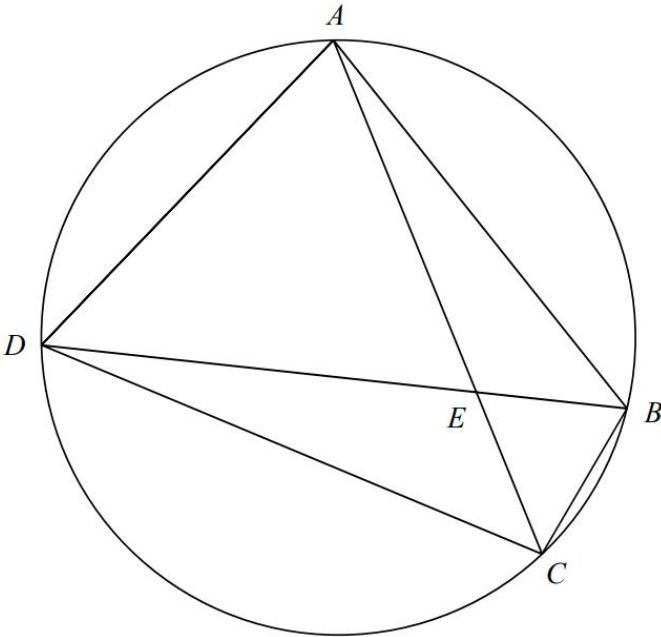


Geometry & Measures
Angles
Circle Theorems, Proof

21	proof	C1	uses cyclic quad eg if $CAB = x$ then $CRO = 180 - x$ (<u>Opposite angles</u> of a <u>cyclic quadrilateral</u> add up to 180° .)	Underlined words need to be shown; reasons need to be linked to their method; any reasons not linked do not credit.
		C1	establishes relationship outside a circle eg $ORB = x$ (<u>Angles</u> on a straight <u>line</u> add up to 180)	Correct method can be implied from angles on the diagram if no ambiguity or contradiction.
		C1	uses properties of a circle eg $RO = OB$ (both radii) so $ABC = x$ (Base angles of an <u>isosceles triangle</u> are equal.)	
		C1	Complete proof and conclusion	Full reasons given without any redundant reasons and correct reasoning throughout.



22 A, B, C and D are four points on a circle.



AEC and DEB are straight lines.

Triangle AED is an equilateral triangle.

Prove that triangle ABC is congruent to triangle DCB .

Geometry & Measures
Angles
Circle Theorems, Congruency

Video Solutions

(4 marks)



22

Proof

C1

for **one** correct pair of equal angles with correct reason from:
angle $ACB = \text{angle } ADB$, (angles in the same segment are equal)
angle $DBC = \text{angle } DAC$, (angles in the same segment are equal)
angle $ABD = \text{angle } ACD$, (angles in the same segment are equal)

or for recognising all angles of 60 in triangle AED **and** in triangle CEB)

C1

for **one** identity, with reason(s), from the following list of alternatives:
Alternatives:
a complete method to show that angle $ACB = \text{angle } DBC (= 60)$,
or
 BC being common to both triangles
or
 $DB = DE + EB = AE + EC = AC$ (sides of an equilateral triangle are equal)
or
angle $ABC = 60 + \text{angle } ABD = 60 + \text{angle } ACD = \text{angle } DCB$
(angles in the same segment are equal)
or
angle $BDC = \text{angle } CAB$ (angles in the same segment are equal)

C1

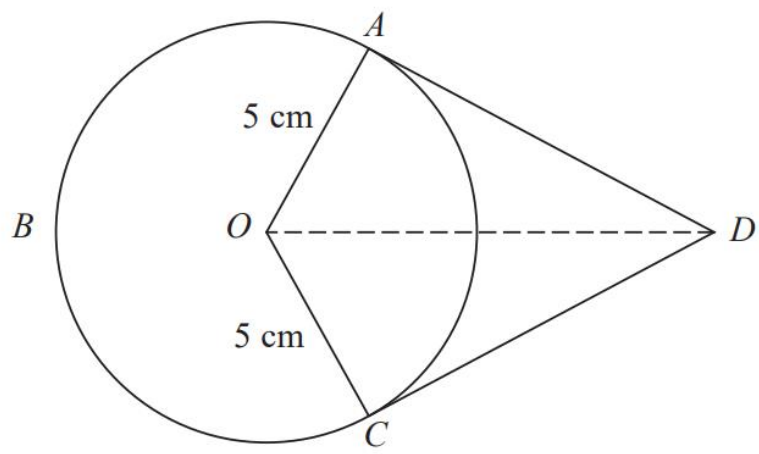
for a **second** identity, with reason(s), from the alternatives above

C1

for concluding the proof with a **third** identity, with reason(s), from the alternatives above, together with the condition for congruency, ASA or SAS or AAS

Underlined words need to be shown; reasons need to be linked to their statement(s)

Pairs of equal angles may be just shown on the diagram



A , B and C are points on a circle of radius 5 cm, centre O .
 DA and DC are tangents to the circle.
 $DO = 9$ cm

Work out the length of arc ABC .
 Give your answer correct to 3 significant figures.

Geometry & Measures
Angles
Circle Theorems, Trigonometry, Arc Length

 **Video Solutions**

(5 marks)



18	Note $DOC=DOA$, $ADO=CDO$	21.6	P1	Recognises that OAD or OCD is 90° or right angle
			P1	for using trigonometry to set up an equation in DOA or ADO eg $\cos DOA = \frac{5}{9}$
			P1	for using inverse trigonometry to find DOA or ADO eg $DOA = \cos^{-1} \frac{5}{9}$ ($= 56.25\dots$)
			P1	for a complete process to find arc length ABC or AC eg $\frac{360 - 2 \times 56.25\dots}{360} \times 2 \times \pi \times 5$ ($= 21.598\dots$) or $\frac{2 \times 56.25\dots}{360} \times 2 \times \pi \times 5$ ($= 9.8174\dots$)
			A1	for answer in the range 21.5 to 21.65



Geometry & Measures

Perimeter and Area

Polygons

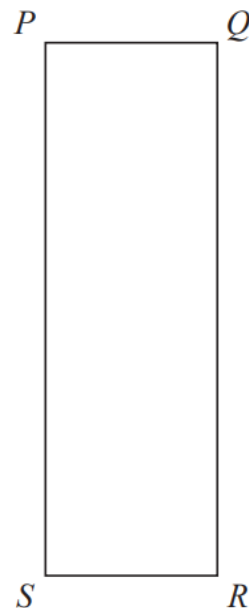
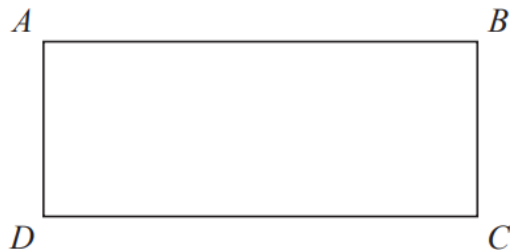
Circles

Sectors



Summer 2019 Paper 1H (Non-Calc)

7 Here are two rectangles.



$$QR = 10 \text{ cm}$$

$$BC = PQ$$

The perimeter of $ABCD$ is 26 cm

The area of $PQRS$ is 45 cm^2

Find the length of AB .

Geometry &
Measures

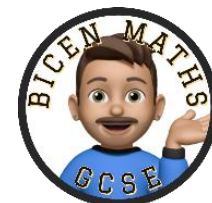
Perimeter and Area

Rectangles

 **Video Solutions**

(4 marks)

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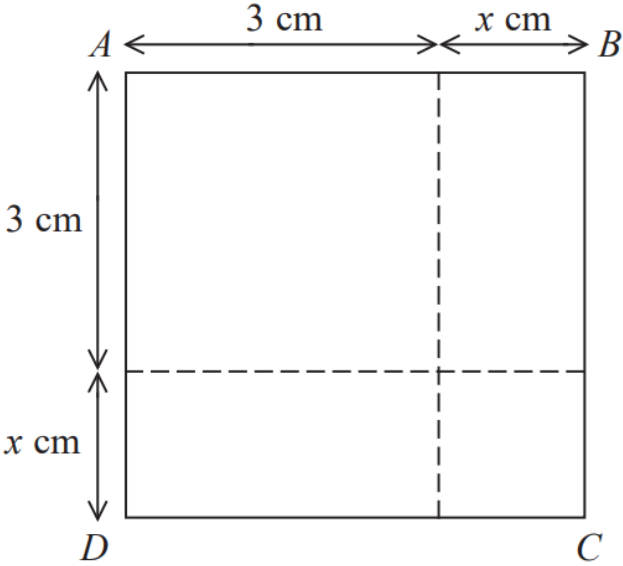
HOME

Geometry & Measures
Perimeter and Area
Rectangles

7	8.5	P1	for process to use the area of $PQRS$ to find the length of PQ , eg $10y = 45$ or $45 \div 10 (= 4.5)$	Sets up equation for area
		P1	for process to use the perimeter of $ABCD$, eg $2x + 2 \times "4.5" = 26$ or $26 - 2 \times "4.5" (= 17)$ or $26 \div 2 (= 13)$	Uses perimeter of $ABCD$
		P1	for process to use length of BC to find length of AB , eg solves $2x + 2 \times "4.5" = 26$ or $(26 - 2 \times "4.5") \div 2$ or $"13" - "4.5"$	
		A1	for 8.5 or $8\frac{1}{2}$	Accept $\frac{17}{2}$



Geometry & Measures
Perimeter and Area
Rectangles and Algebra



The area of square $ABCD$ is 10 cm^2 .

Show that $x^2 + 6x = 1$

 **Video Solutions**

(3 marks)



Geometry & Measures
Perimeter and Area
<i>Rectangles and Algebra</i>

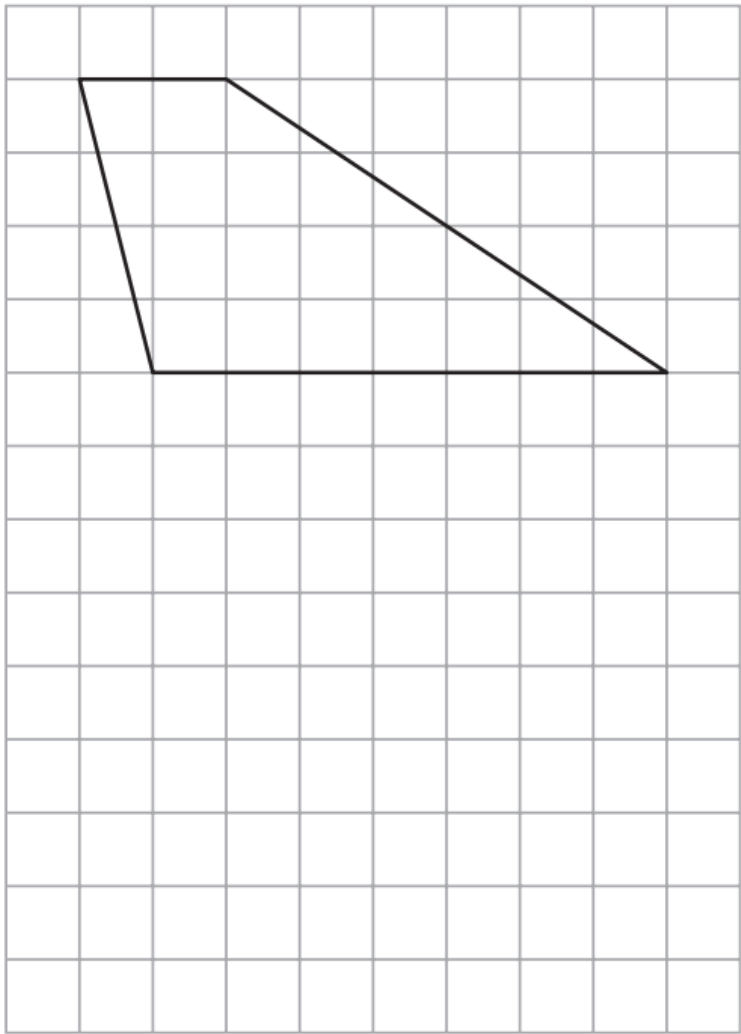
4

$x^2 + 6x = 1$	M1	writes the area using algebraic terms e.g. $(x + 3) \times (x + 3)$ or at least two correct area expressions which may be written on the diagram or x given as $\sqrt{10} - 3$
	M1	expands and includes the given 10 e.g. $x^2 + 3x + 3x + 9 = 10$; condone one error in the four terms when expanding or $10 - 3\sqrt{10} - 3\sqrt{10} + 9 + 6\sqrt{10} - 18 (=1)$ condone 1 error in the 6 terms
	A1	rearranges to give the given equation or shows surd expression simplifies to 1



Summer 2018 Paper 3H (Calc)

3 Here is a trapezium drawn on a centimetre grid.



On the grid, draw a triangle equal in area to this trapezium.

(2 marks)

Geometry & Measures
Perimeter and Area
Trapezium and Triangle

 **Video Solutions**

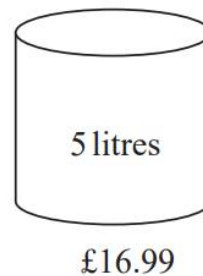
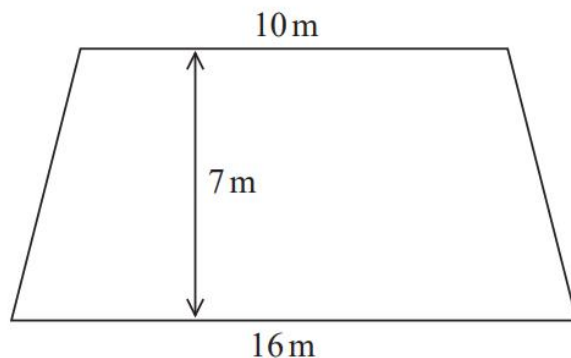


3	Triangle of area 18	M1	for a complete method to find area of trapezium eg $\frac{1}{2}(2 + 7) \times 4 (= 18)$ OR for a triangle drawn of area 36 OR for a triangle that would give an area ft their area of trapezium	The value for the area of the trapezium must be clear for the ft to be checked.
		A1	for a triangle drawn of area 18 eg base = 6, height = 6 or base = 9, height = 4	Accept use of dimensions that are not whole numbers as long as the intention is clear



November 2018 Paper 2H (Calc)

- 5 The diagram shows a floor in the shape of a trapezium.



John is going to paint the floor.

Each 5 litre tin of paint costs £16.99

1 litre of paint covers an area of 2 m^2

John has £160 to spend on paint.

Has John got enough money to buy all the paint he needs?

You must show how you get your answer.

**Geometry &
Measures**

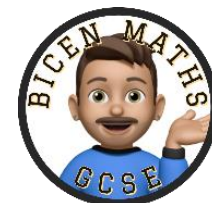
Perimeter and Area

Trapezium

 **Video Solutions**

(5 marks)

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HOME

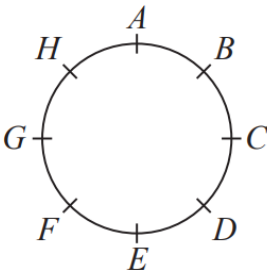
Geometry & Measures
Perimeter and Area
Trapezium

5	No (supported)	P1 P1 P1 P1 C1	calculates area of trapezium eg $\frac{1}{2} \times 7 \times (10+16)$ (= 91) for division by coverage eg $\div 2$ or [area of trapezium] $\div 2$ (= 45.5) or process to find coverage per tin eg 5×2 (= 10) for division to find the number of tins eg $\div 5$ or “45.5” $\div 5$ (= 9.1) or [area of trapezium] $\div$ “10” (= 9.1) (dep on at least P2) for a process to multiply a whole number of tins (rounded up) by 16.99 for ‘No’ supported by correct figures eg 169.9 or 90 and 91	for process to find number of tins bought eg $160 \div 16.99 = 9$ tins for using whole no. of tins to find total litres eg 9×5 (= 45) (dep on at least P2) for a process to find the total coverage eg “45” $\times 2$ (= 90)	[area of trapezium] needs to be clearly stated if the process of finding the area is not clear There must be a conclusion (“No” or equivalent wording) including the figure 169.9 and working showing processes followed.
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November 2017 Paper 2H (Calc)

3 Hasmeet walks once round a circle with diameter 80 metres.

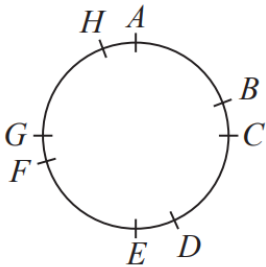


There are 8 points equally spaced on the circumference of the circle.

(a) Find the distance Hasmeet walks between one point and the next point.

(2 marks)

Four of the points are moved, as shown in the diagram below.



Hasmeet walks once round the circle again.

(b) Has the mean distance that Hasmeet walks between one point and the next point changed?
You must give a reason for your answer.

 **Video Solutions**

(1 mark)

Geometry & Measures
Perimeter and Area
Circles

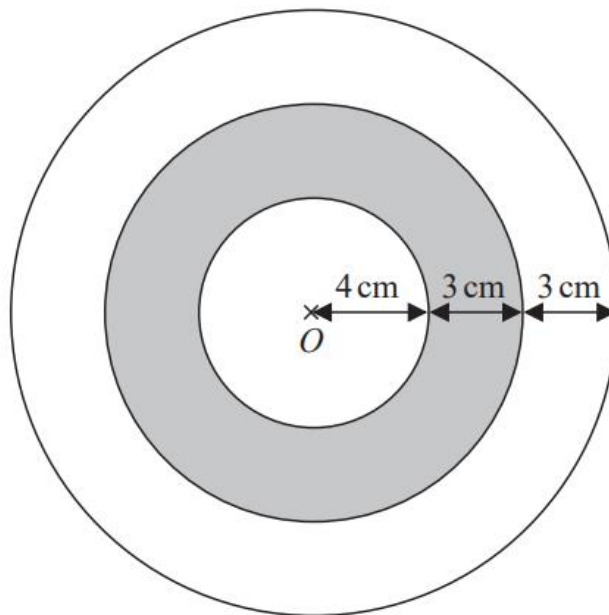


Geometry & Measures
Perimeter and Area
<i>Circles</i>

3 (a)		31.4	P1	for working with circumference formula, eg $\pi \times 80$ (=251. ...) oe
			A1	for answer in the range 31.4 to 31.5 accept 10π
(b)		No (supported)	C1	Mean distance stays the same with reason, eg total distance remains unchanged or same number of points



- 4 The diagram shows a logo made from three circles.



Each circle has centre O .

Daisy says that exactly $\frac{1}{3}$ of the logo is shaded.

Is Daisy correct?

You must show all your working.

 **Video Solutions**

(4 marks)

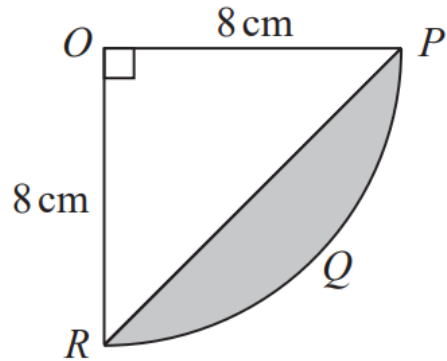


Geometry & Measures
Perimeter and Area
Circles

4		Daisy is wrong (supported)	P1 P1 A1 C1	for process to find area of any relevant circle ie $\pi \times 4^2 (=16\pi)$, $\pi \times 7^2 (=49\pi)$, $\pi \times 10^2 (=100\pi)$ or 7^2 and 4^2 for completed method to find shaded area eg “ $\pi \times 7^2$ ” – “ $\pi \times 4^2$ ” (=33 π) or use of radii eg $7^2 - 4^2 (=33)$ for 2 comparable figures, eg 33 π and 100 π or 33 and 100 or 103 to 103.7 and 314 to 314.2 or 103 to 103.7 and 104.6 to 104.8 statement eg No because it should be $\frac{33}{100}$ and their accurate figures Allow use of $\pi = 3$ or better
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7 The diagram shows a sector $OPQR$ of a circle, centre O and radius 8 cm.



OPR is a triangle.

Work out the area of the shaded segment PQR .
 Give your answer correct to 3 significant figures.

Geometry & Measures
Perimeter and Area
Circles and Triangles

▶ **Video Solutions**

(4 marks)



Geometry & Measures
Perimeter and Area
<i>Circles and Triangles</i>

7	18.3	P1	for finding the area of the triangle eg $0.5 \times 8 \times 8 (= 32)$	Accept rounded or truncated figures
		P1	for finding the area of the circle $\pi \times 8 \times 8 (= 201.06..)$	
		P1	for finding the area of the sector eg $\frac{1}{4} \times \pi \times 8^2$ or “201.06..” $\div 4 (= 50.26...)$	
		A1	for an answer in the range 18.2 to 18.3	
				If the answer is given within the range but then rounded incorrectly award full marks.

 **Video Solutions**

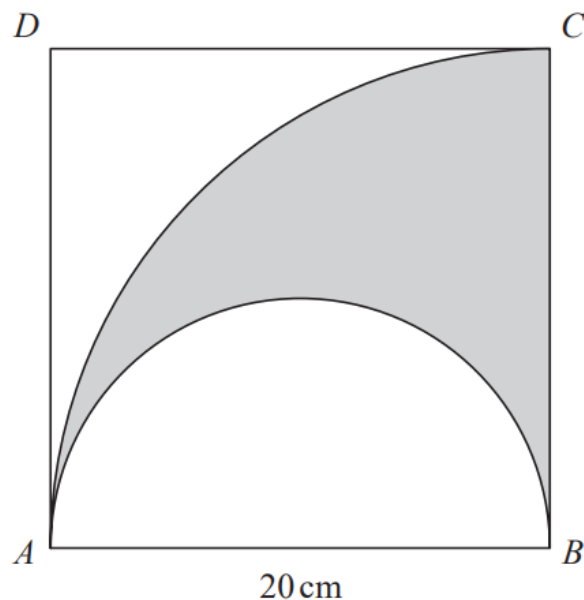
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November 2018 Paper 1H (Non-Calc)

- 7 The diagram shows a square $ABCD$ with sides of length 20 cm. It also shows a semicircle and an arc of a circle.



AB is the diameter of the semicircle.
 AC is an arc of a circle with centre B .

Show that
$$\frac{\text{area of shaded region}}{\text{area of square}} = \frac{\pi}{8}$$

Geometry &
Measures

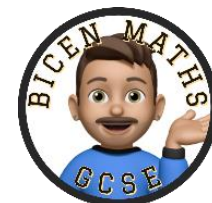
Perimeter and Area

Circles, exact values

 **Video Solutions**

(4 marks)

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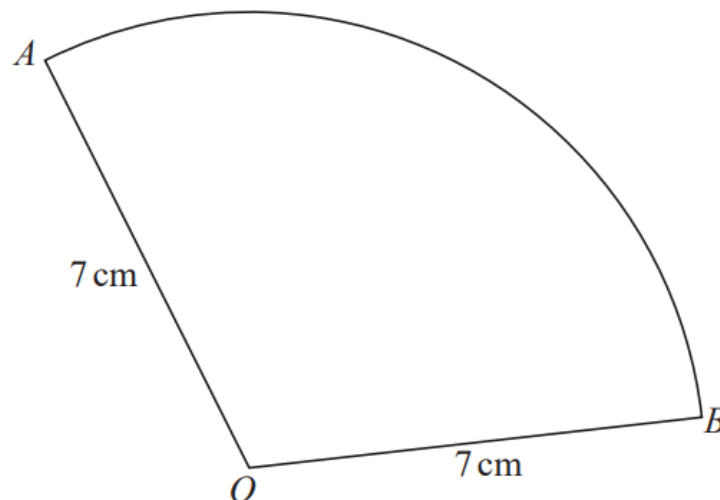
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Geometry & Measures
Perimeter and Area
<i>Circles, exact values</i>

7	shown	C1	for method to find area of semicircle, eg $\pi \times 10^2 \div 2 (= 50\pi)$	Can award first 3 marks if a value for π is used
		C1	for method to find area of quarter circle, for $\pi \times 20^2 \div 4 (= 100\pi)$	
		C1	for a complete method to find area shaded and area of square, eg $\pi \times 20^2 \div 4 - \pi \times 10^2 \div 2$ and 20×20	Working out to find the area of the shaded region must be shown
		C1	fully correct working leading to $\frac{\pi}{8}$	



12 OAB is a sector of a circle with centre O and radius 7 cm.



The area of the sector is 40 cm^2

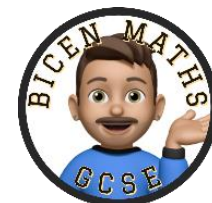
Calculate the perimeter of the sector.

Give your answer correct to 3 significant figures.

 **Video Solutions**

(4 marks)

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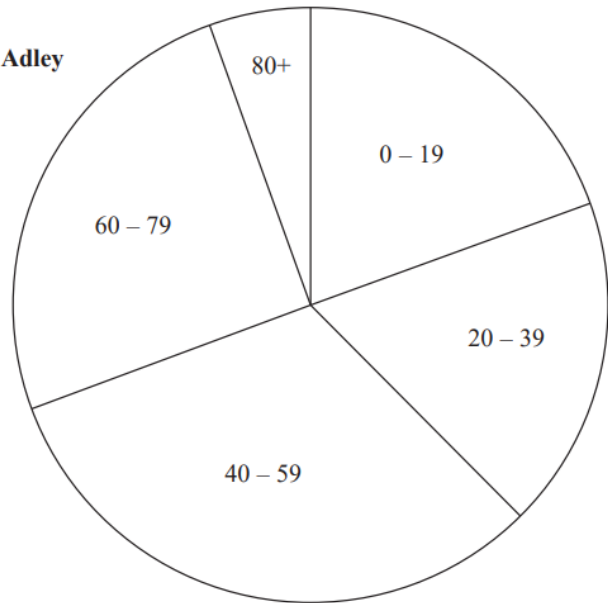
HOME

12	25.4	P2	for finding the size of the angle eg $\frac{40 \times 360}{\pi \times 7^2}$ (=93.5(4..)) or for working with proportion, eg $\frac{40}{49\pi}$ (=0.259(8...) or 0.26) or $\frac{49\pi}{40}$ (=3.84(8...) or 3.85)	
		(P1	for finding the area of the circle eg $\pi \times 7^2$ (=153(.938..) or 154))	May be embedded
		P1	(dep on P2) for a process to find the arc length, eg $\frac{"93.5(4...)" }{360} \times \pi \times 2 \times 7$ (=11.4(28...)) or $\frac{40}{49\pi} \times \pi \times 2 \times 7$ (=11.4(28...)) or $\pi \times 2 \times 7 \div \frac{49\pi}{40}$ (=11.4(28...))	
		A1	for answer in the range 25 to 25.44	If an answer is shown in the range in working and then incorrectly rounded award full marks. Accept $\frac{178}{7}$



Geometry & Measures
Perimeter and Area
Sectors and pie charts

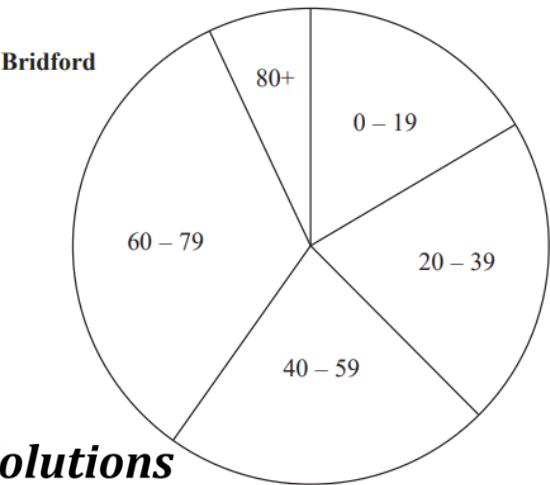
11 The pie charts give information about the ages, in years, of people living in two towns, Adley and Bridford.



Diagrams accurately drawn

The ratio of the number of people living in Adley to the number of people living in Bridford is given by the ratio of the areas of the pie charts.

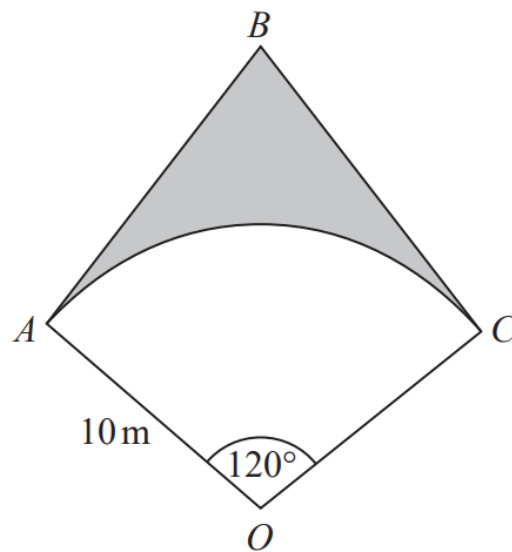
What proportion of the total number of people living in these two towns live in Adley **and** are aged 0 – 19?
Give your answer correct to 3 significant figures.



Geometry & Measures
Perimeter and Area
<i>Sectors and pie charts</i>

11		0.119	P1	for starting the process, eg finds area 25π or 16π oe, or finds angle for town A, $0 - 19$ (70°), may be on diagram
			P1	for a complete process, eg $\frac{70}{360} \times \frac{25\pi}{41\pi}$
			A1	$0.118 - 0.119$ or $11.8\% - 11.9\%$





OAC is a sector of a circle, centre O , radius 10 m.

BA is the tangent to the circle at point A .

BC is the tangent to the circle at point C .

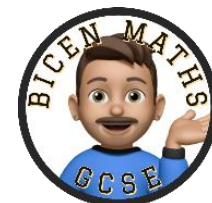
Angle $AOC = 120^\circ$

Calculate the area of the shaded region.

Give your answer correct to 3 significant figures.



Video Solutions



20		68.5	B1	for angle $OAB = 90^\circ$ or angle $OCB = 90^\circ$, may be seen on diagram
			P1	for a process to find the length of AB or the length of CB ($= 10\sqrt{3}$ oe) eg $10 \times \tan 60^\circ$ ($= 17.3\dots$) or the length of OB ($= 20$), eg $10 \div \cos 60^\circ$
			P1	for a process (dep previous P1) to find the area of the triangle OAB ($= 50\sqrt{3}$ oe) or area of triangle OCB ($= 50\sqrt{3}$ oe) or area of kite $OABC$ ($= 100\sqrt{3}$ oe)
			P1	for a process to find the area of the sector OAC e.g. $\frac{1}{3} \times \pi \times 10^2$ ($= 104.7\dots$), accept rounded or truncated to 3 significant figures or more
			A1	for 68.4 – 68.6



Geometry & Measures

Volume and Surface Area

<u>Units</u>	<u>Cuboids</u>	<u>Cylinders</u>	<u>Prisms</u>
<u>Cones, Spheres, etc.</u> <u>(use of formulae)</u>	<u>Cones, Spheres, etc.</u> <u>(problem solving)</u>		



5 Write 37 cm^3 in mm^3

**Geometry &
Measures**

Volume and Surface
Area

Units

 **Video Solutions**

(1 mark)

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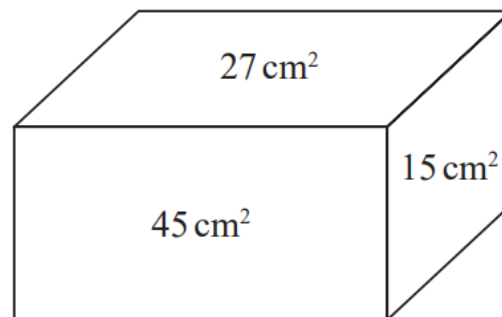


HOME

5	37 000	B1	cao
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- 8 The diagram shows a solid metal cuboid.

The areas of three of the faces are marked on the diagram.
The lengths, in cm, of the edges of the cuboid are whole numbers.



The metal cuboid is melted and made into cubes.
Each of the cubes has sides of length 2.5 cm.

Work out the greatest number of these cubes that can be made.

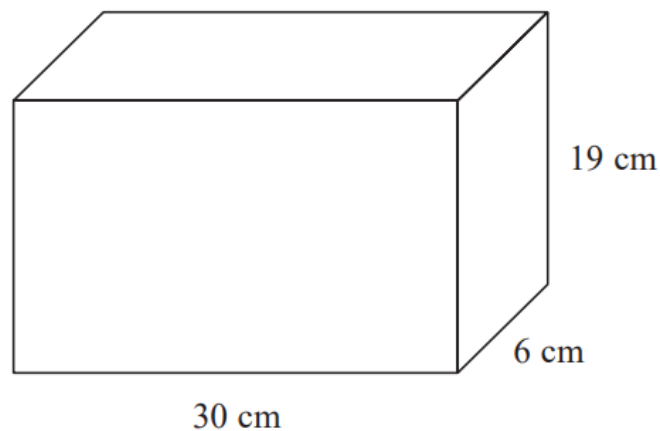
Geometry & Measures
Volume and Surface Area
Cuboids

8	8	P1	process to start the problem eg $xy = 45$ and $xz = 15$ and $yz = 27$ or $5 \times 9 (=45)$ and $3 \times 9 (=27)$ and $3 \times 5 (=15)$ or 3, 5 and 9 stated	Maybe seen on diagram
		P1	for $3 \times 5 \times 9 (=135)$ or 2 of “9” $\div 2.5 (=3.6)$ or “5” $\div 2.5 (=2)$ or “3” $\div 2.5 (=1.2)$	
		P1	for $2.5^3 (=15.625)$ or all of “9” $\div 2.5 (=3.6)$ and “5” $\div 2.5 (=2)$ and “3” $\div 2.5 (=1.2)$	
		P1	for a complete process to find the number of cubes possible eg [volume] $\div$ “15.625” $(=8.64)$ or “3.6” $\times$ “2” $\times$ “1.2” $(=8.64)$	[Volume] must come from multiplying together what they clearly indicate as the 3 dimensions of the cuboid. The three dimensions cannot be 45, 27 and 15
		A1	cao	



Summer 2019 Paper 2H (Calc)

- 4 A container is in the shape of a cuboid.



The container is $\frac{2}{3}$ full of water.

A cup holds 275 ml of water.

What is the greatest number of cups that can be completely filled with water from the container?

**Geometry &
Measures**

Volume and Surface
Area

Cuboids

 **Video Solutions**

(4 marks)

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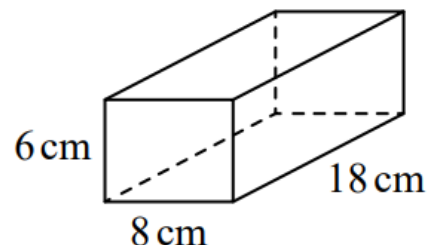
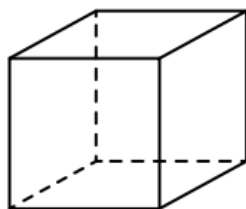
HOME

Geometry & Measures
Volume and Surface Area
<i>Cuboids</i>

4	8	P1	for working with volume of the cuboid, eg $30 \times 6 \times 19 (= 3420)$ OR for using $\frac{2}{3}$ with one dimension, eg. $30 \times 2 \div 3 (= 20)$	For P marks, ignore attempts at unit conversion
		P1	for “3420” $\times 2 \div 3 (= 2280)$ or “3420” $\div 3 (= 1140)$ OR “20” $\times 6 \times 19 (= 2280)$ OR “3420” $\div 275 (= 12.4\dots = 12 \text{ cups})$	
		P1	(dep on P2) for “2280” $\div 275 (= 8(.29\dots))$ or “1140” $\div 275 (= 4(.14\dots))$ OR “12” $\times 2 \div 3$ OR for $275 \times 8 (= 2200)$ or $275 \times 9 (= 2475)$	
		A1	cao	



9 The diagram shows a cube and a cuboid.



The total surface area of the cube is equal to the total surface area of the cuboid.

Janet says,

“The volume of the cube is equal to the volume of the cuboid.”

Is Janet correct?

You must show how you get your answer.

 **Video Solutions**

(5 marks)

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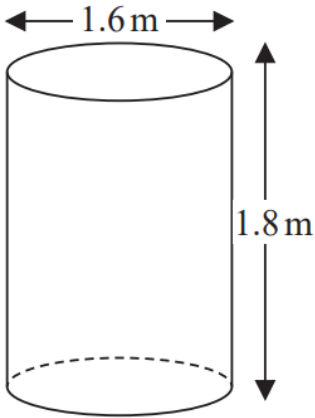
Geometry & Measures
Volume and Surface Area
Cuboids

9	No (supported)	P1	for finding the area of 3 or more faces of the cuboid and adding eg $(6 \times 8) + (8 \times 18) + (6 \times 18) \dots$ or “48” + “144” + “108” ... (= 300)	Could be an addition of <i>any</i> three faces eg $48 + 48 + 144$ etc.
		P1	complete process to find surface area of cuboid, eg $6 \times 8 \times 2 + 6 \times 18 \times 2 + 8 \times 18 \times 2$ (= 600)	
		P1	for process to find side length of cube, eg [surface area] $\div 6$ and square rooting (= 10)	[surface area] must come from the addition of at least three attempts at area, but not from volume.
		P1	(dep on previous P1) for processes to find volume of cube and volume of cuboid, eg [side length] ³ (= 1000) and $6 \times 8 \times 18$ (= 864)	(dep on previous P1) for process to find surface area of cube, eg. $(“9.52\dots”)^2 \times 6$ (= 544.28...)
		A1	No with 1000 and 864 OR No with 600 and 544(.28...)	



Geometry & Measures
Volume and Surface Area
<i>Cylinders, proportion</i>

- 6 Jeremy has to cover 3 tanks completely with paint.
- Each tank is in the shape of a cylinder with a top and a bottom.
The tank has a diameter of 1.6 m and a height of 1.8 m.
- Jeremy has 7 tins of paint.
Each tin of paint covers 5 m^2
- Has Jeremy got enough paint to cover completely the 3 tanks?
You must show how you get your answer.



 **Video Solutions**

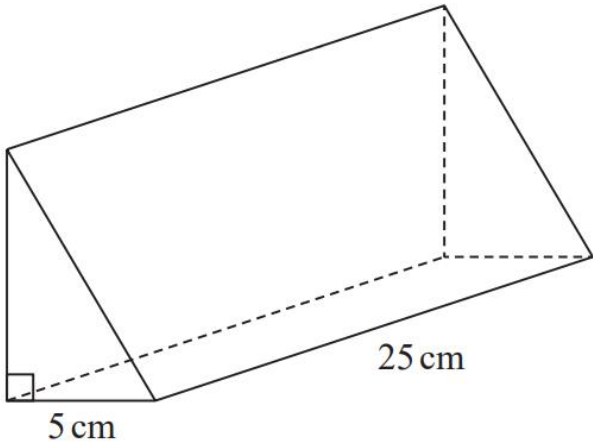
(5 marks)



6	No Supported	P1	for finding the area of a circle eg $\pi \times 0.8^2 (= 2.01\dots)$	Must be area of circle and not part of a volume, eg $\pi r^2 h$ May be seen as $2\pi r^2$
		P1	for finding the curved surface area eg $2\pi \times 0.8 \times 1.8 (= 9.047\dots)$	May be seen from $2\pi rh$ or from πdh
		P1	for use of the coverage information with an area eg “2.01...” $\div 5 (= 0.402\dots)$ or “4.02...” $\div 5 (= 0.804\dots)$ or “9.047...” $\div 5 (= 1.8095\dots)$ or “11.058” $\div 5 (= 2.2116\dots)$ or “13.069...” $\div 5 (= 2.6138\dots)$ OR for process to find total coverage for comparison eg $5 \times 7 (= 35)$	Accept numbers without working written to no less than 2dp Do not award if a volume has been used as part of the calculation. An independent mark for 5×7
		P1	(dep P1) for finding total surface area for 3 tanks eg [total surface area] $\times 3 (= 39.2\dots)$ OR for complete process to find the number of tins needed for total area of 3 tanks eg “13.069”... $\times 3 \div 5 (= 7.84\dots)$ OR for complete process to find coverage needed from each tin eg “13.069”... $\times 3 \div 7 (= 5.6\dots)$	[total surface area] must come from the addition of two attempts at area, but not from volume.
		C1	for conclusion “No” supported by accurate figures eg 8 tins or 7.84 (> 7) or $39.2 > 35$ or $5.6 (> 5)$	Clear statement that there is not enough paint supported by correct figures for comparison. NB: $2.6 \times 3 = 9$ tins needed is inaccurate 8 or 7.84 tins is sufficient without restating the 7, 5.6 m ² is sufficient without restating the 5 but 39.2 and 35 are needed for comparison. A statement of “No, 8 tins” alone gets 0 marks without supporting working.



6 The diagram shows a prism.



The cross section of the prism is a right-angled triangle.
 The base of the triangle has length 5 cm

The prism has length 25 cm
 The prism has volume 750 cm^3

Work out the height of the prism.

Geometry & Measures
Volume and Surface Area
Prisms

[!\[\]\(003082e50e3009141f59bd5df831749f_img.jpg\)
Video Solutions](#)

(3 marks)



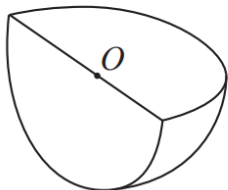
Geometry & Measures
Volume and Surface Area
Prisms

6	12	P1 for a process to find the area of cross section, eg $750 \div 25 (= 30)$ oe or $\frac{1}{2} \times 5 \times h$ oe P1 for a correct equation in h, eg $750 \div 25 = \frac{1}{2} \times 5 \times h$ oe or $\frac{1}{2} \times 5 \times h \times 25 = 750$ oe or for a complete process to find h, eg $\frac{750}{25} \times \frac{2}{5}$ oe or “30” $\times 2 \div 5$ A1 cao SC B1 for answer of 6 if P0 scored	May use any letter for h or may use ?
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Geometry & Measures
Volume and Surface Area
Quarter spheres

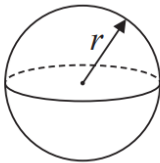
19 Shape S is one quarter of a solid sphere, centre O.



Shape S

Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



The volume of S is $576\pi\text{ cm}^3$

Find the surface area of S.
Give your answer correct to 3 significant figures.
You must show your working.

Video Solutions

(5 marks)



HOME

Geometry & Measures
Volume and Surface Area
Quarter spheres

19

905

- P1 for correct use of formula for the volume of a sphere
eg $\frac{1}{4} \times \frac{4}{3} \times \pi \times r^3$ ($= 576\pi$ or $1809\dots$)
OR $576\pi \times 4$ **or** 2304π **or** $7238\dots$ ($= \frac{4}{3} \times \pi \times r^3$)
- P1 for a complete correct process to find r ,
eg $r = \sqrt[3]{\frac{576 \times 4 \times 3}{4}}$ **or** $r = 12$
- P1 for a process to find the curved surface area
eg $\frac{4 \times \pi \times [\text{radius}]^2}{4}$ ($= 144\pi$ or $452\dots$)
OR the surface area of both flat surfaces
eg $(2 \times \frac{\pi \times [\text{radius}]^2}{2})$
OR complete expression for the total surface area
eg $\frac{4\pi r^2}{4} + \frac{\pi r^2}{2} \times 2$ oe
- P1 for process to find the complete surface area
eg $\frac{4 \times \pi \times [\text{radius}]^2}{4} + (2 \times \frac{\pi \times [\text{radius}]^2}{2})$
- A1 answer in the range $904.7 - 905$ or 288π
(SCB2 for an answer in the range $358.1 - 359.2$)

We do not need to see what is in the brackets to award this mark.
The contents of the bracket alone would score P0

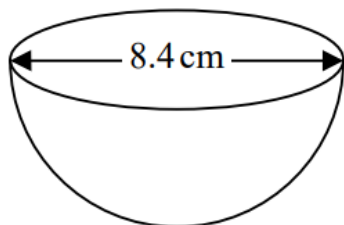
Could be shown in several stages
 $\sqrt[3]{\frac{576 \times 4 \times 3}{4}} = \sqrt[3]{1728}$

Radius used must be clearly identified as their radius of the solid

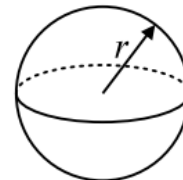
If an answer is given in the range but then incorrectly rounded, award full marks.



- 19 The diagram shows a hemisphere with diameter 8.4 cm.



Volume of sphere = $\frac{4}{3} \pi r^3$



Work out the volume of the hemisphere.
Give your answer correct to 3 significant figures.

 **Video Solutions**

(2 marks)

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Geometry & Measures
Volume and Surface Area
<i>Volume of a hemisphere</i>

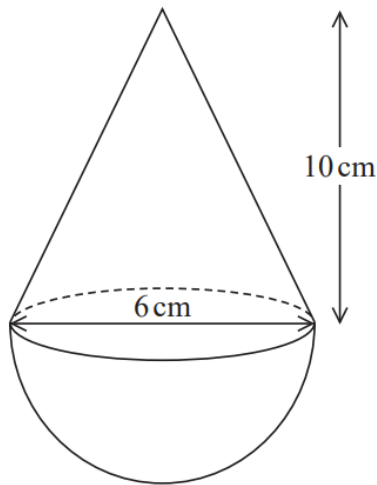
19	155	M1	for a complete method to find the volume of the hemisphere, eg $\frac{1}{2} \times \frac{4}{3} \times \pi \times 4.2^3$ oe	
		A1	answer in range 155 to 155.2	If an answer in the range is seen in working and then incorrectly rounded award full marks

 **Video Solutions**

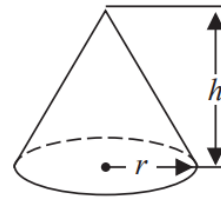


Summer 2019 Paper 1H (Non-Calc)

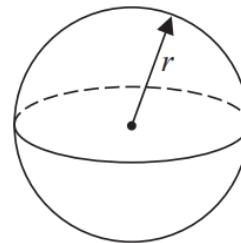
- 15 The diagram shows a solid shape.
The shape is a cone on top of a hemisphere.



Volume of a cone = $\frac{1}{3} \pi r^2 h$



Volume of a sphere = $\frac{4}{3} \pi r^3$



The height of the cone is 10 cm.
The base of the cone has a diameter of 6 cm.
The hemisphere has a diameter of 6 cm.

The total volume of the shape is $k\pi \text{ cm}^3$, where k is an integer.

Work out the value of k .

Geometry &
Measures

Volume and Surface
Area

Cone and hemisphere

 **Video Solutions**

(4 marks)

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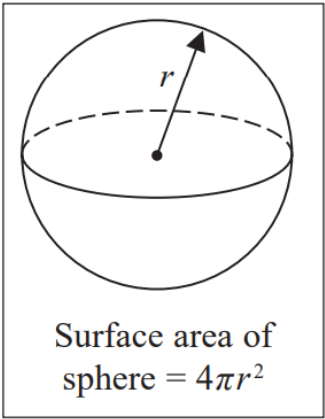
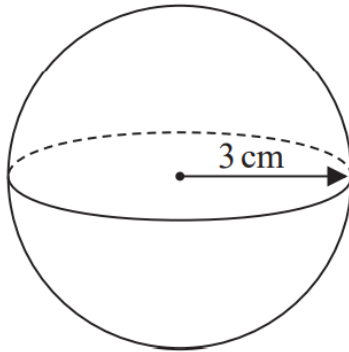
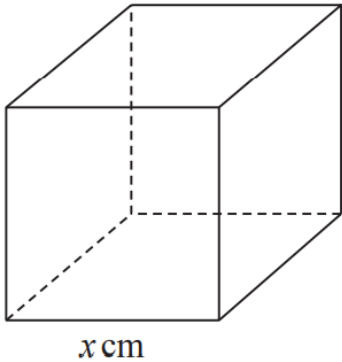
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Geometry & Measures
Volume and Surface Area
Cone and hemisphere

15	48	M1	for method to use a volume formula with correct substitution for the cone, sphere or hemisphere eg $\frac{1}{3} \times \pi \times 3^2 \times 10$ or $\frac{4}{3} \times \pi \times 3^3$ or $\frac{2}{3} \times \pi \times 3^3$ oe	May work without π or with an approximation of π ; must use the correct radius of 3 (and 10) in substitution
		M1	for complete method to find total volume eg $\frac{1}{3} \times \pi \times 3^2 \times 10 + \frac{2}{3} \times \pi \times 3^3$	
		M1	(dep first M1) for correct partial simplification, eg 30π or 18π	Must be cone or hemisphere
		A1	cao	Accept 48π
			SC B2 for answer of 264 or 264π	



7 The diagram shows a cube with edges of length x cm and a sphere of radius 3 cm.



Geometry & Measures
Volume and Surface Area
Cube and Sphere

The surface area of the cube is equal to the surface area of the sphere.

Show that $x = \sqrt{k\pi}$ where k is an integer.

Video Solutions

(4 marks)



Geometry & Measures
Volume and Surface Area
<i>Cube and Sphere</i>

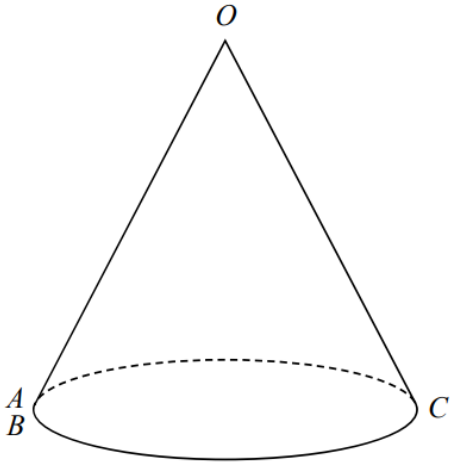
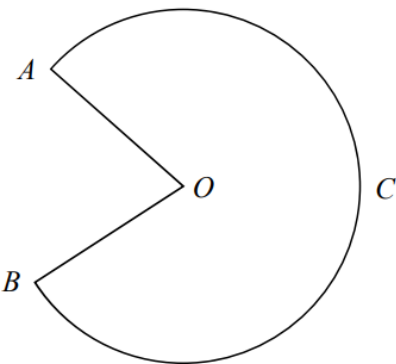
7	Shown	M1	for a correct expression for the area of one face of the cube, eg x^2 or a correct expression for the surface area of the cube, eg $6 \times x^2$	No marks for $x = \sqrt{6\pi}$ without any working.
		M1	for a correct expression for the surface area of the sphere, eg $4 \times \pi \times 3^2 (= 36\pi)$	
		M1	for forming a suitable equation, eg $6 \times x^2 = 4 \times \pi \times 3^2$ or $6x^2 = "36\pi"$	$6 \times x^2 = 4 \times \pi \times 3^2$ $x^2 = 36\pi \div 6$ $x = \sqrt{6\pi}$
		A1	for completing the method to $x = \sqrt{6\pi}$ or $k = 6$	



- 23 The diagram shows a sector $OACB$ of a circle with centre O . The point C is the midpoint of the arc AB .

The diagram also shows a hollow cone with vertex O . The cone is formed by joining OA and OB .

Volume of cone = $\frac{1}{3} \pi r^2 h$
Curved surface area of cone = $\pi r l$



The cone has volume 56.8 cm^3 and height 3.6 cm .
Calculate the size of angle AOB of sector $OACB$.
Give your answer correct to 3 significant figures.
You must show all your working.

Geometry & Measures
Volume and Surface Area
Cone, uses Pythagoras and sectors

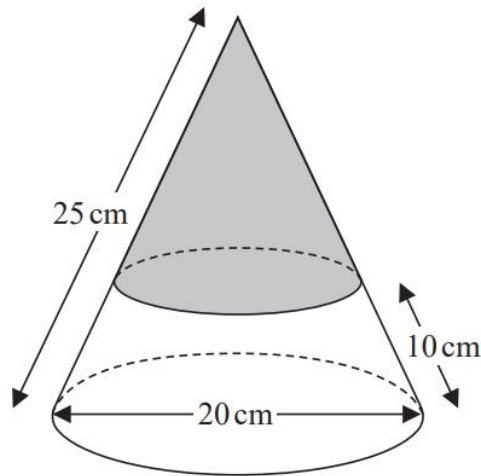
Video Solutions

(5 marks)



23	264	P1	correct substitution into the volume formula, eg $56.8 = \frac{1}{3} \times \pi \times r^2 \times 3.6$	
		P1	completes process to find base radius or the value of r^2 , eg $r = \sqrt{\frac{56.8 \times 3}{\pi \times 3.6}}$ (=3.88158...) or $r^2 = \frac{56.8}{1.2\pi}$ (=15.066)	
		P1	Uses Pythagoras to find the sloping length, eg $\sqrt{3.88^2 + 3.6^2}$ (=5.29....)	
		P1	process to find an equation in <i>AOB</i> , eg $\pi \times "3.88" \times "5.29" = \frac{AOB}{360} \times \pi \times "5.29" ^2$ or $\frac{AOB}{360} \times \pi \times 2 \times "5.29" = 2 \times \pi \times "3.88"$ or $\frac{AOB}{360} \times "5.29" = "3.88"$	<i>AOB</i> does not need to be the subject of the equation
		A1	answer in the range 263.9 to 264.1	

18 The diagram represents a solid cone.



Curved surface
area of cone = $\pi r l$

Geometry & Measures
Volume and Surface Area
Cone, uses Similar Triangles

The cone has a base diameter of 20 cm and a slant height of 25 cm.

A circle is drawn around the surface of the cone at a slant height of 10 cm above the base. The curved surface of the cone above the circle is painted grey.

Work out the area of the curved surface of the cone that is **not** painted grey.

Give your answer as a multiple of π

You must show all your working.

Video Solutions

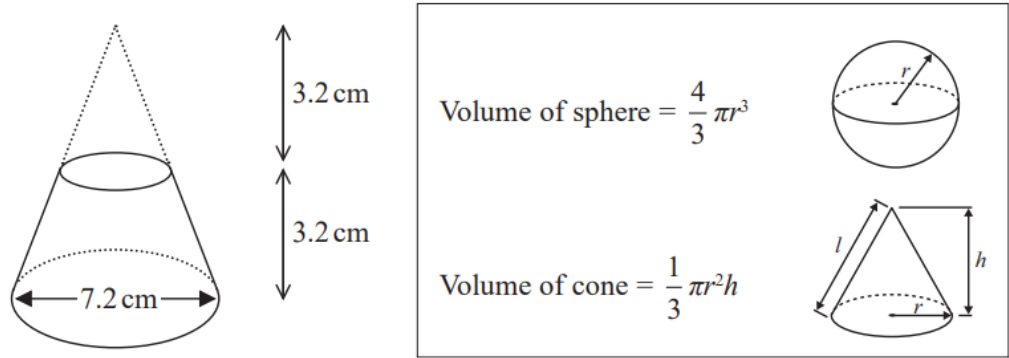
(4 marks)



18	160π	P1	for process to find curved surface area of cone, eg $\pi \times 10 \times 25 (= 250\pi) (= 785.....)$	
		P1	for process to find the radius or diameter of the smaller cone eg $10 \times \frac{15}{25} (= 6)$ or $20 \times \frac{15}{25} (= 12)$ oe OR uses area scale factor, eg “ 250π ” $\times \left(\frac{15}{25}\right)^2 (= 90\pi)$	15 comes from $25 - 10$ $\frac{15}{25}$ may be seen as 0.6
		P1	for a complete process, eg “ 250π ” – $\pi \times “6” \times 15 (= 785... - 282...)$ or answer in range 502 to 503	
		A1	for 160π	Award 0 marks for an answer of 160π or an answer in range 502 to 503 with no supportive working. If 160π seen but answer in range 502 to 503 given on answer line isw and award full marks

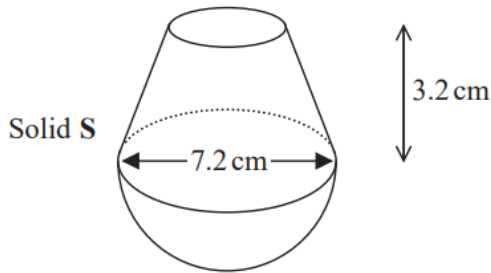


20 Here is a frustum of a cone.



The diagram shows that the frustum is made by removing a cone with height 3.2 cm from a solid cone with height 6.4 cm and base diameter 7.2 cm.

The frustum is joined to a solid hemisphere of diameter 7.2 cm to form the solid S shown below.



The density of the frustum is 2.4 g/cm³
The density of the hemisphere is 4.8 g/cm³

Calculate the average density of solid S.

Geometry & Measures
Volume and Surface Area
Frustum, hemisphere, mass/density/volume

Video Solutions

(5 marks)



Geometry & Measures
Volume and Surface Area
<i>Frustum, hemisphere, mass/density/volume</i>

20	3.75	P1	works to find vol of frustum eg $\frac{1}{3}\pi(3.6)^2 \times 6.4 - \frac{1}{3}\pi(1.8)^2 \times 3.2$ or 86.858.. – 10.857... (=24.192 π or 76.00..)	
		P1	works to find vol of hemisphere eg $\frac{1}{2} \times \frac{4}{3} \pi \times 3.6^3$ (=31.104 π or 97.7....)	781.7... by use of diameter does not get the mark
		P1	mass of frustum as [vol]×density eg “76.00” × 2.4 (=182.4..) or mass of hemisphere as [vol]×density eg “97.7....”×4.8 (=469.037...)	[vol] is their volume which could be ft using the radius, using the diameter, or could be another value as long as it is stated as being the volume, or clearly intended from working.
		P1	mean density as total mass ÷ total volume eg (“182.4..” + “469.037”) ÷ (“76...” + “97.7..”) or “651.4..”. ÷ “173.7....”	All figures must come from correct method shown.
		A1	answer in the range 3.7 to 3.8	

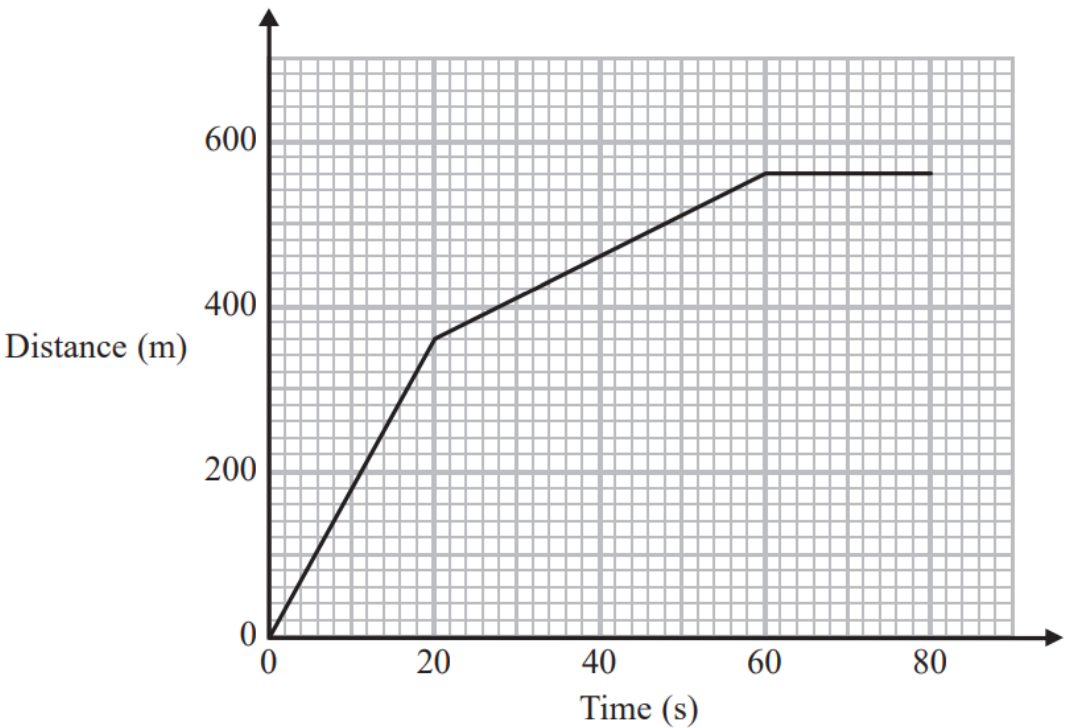


Geometry & Measures

Real-Life Graphs



10 Here is part of a distance-time graph for a car's journey.



(a) Between which two times does the car travel at its greatest speed?
Give a reason for your answer.

(2 marks)

(b) Work out this greatest speed.

Video Solutions

(1 mark)

Geometry & Measures
Real-Life Graphs
Gradient



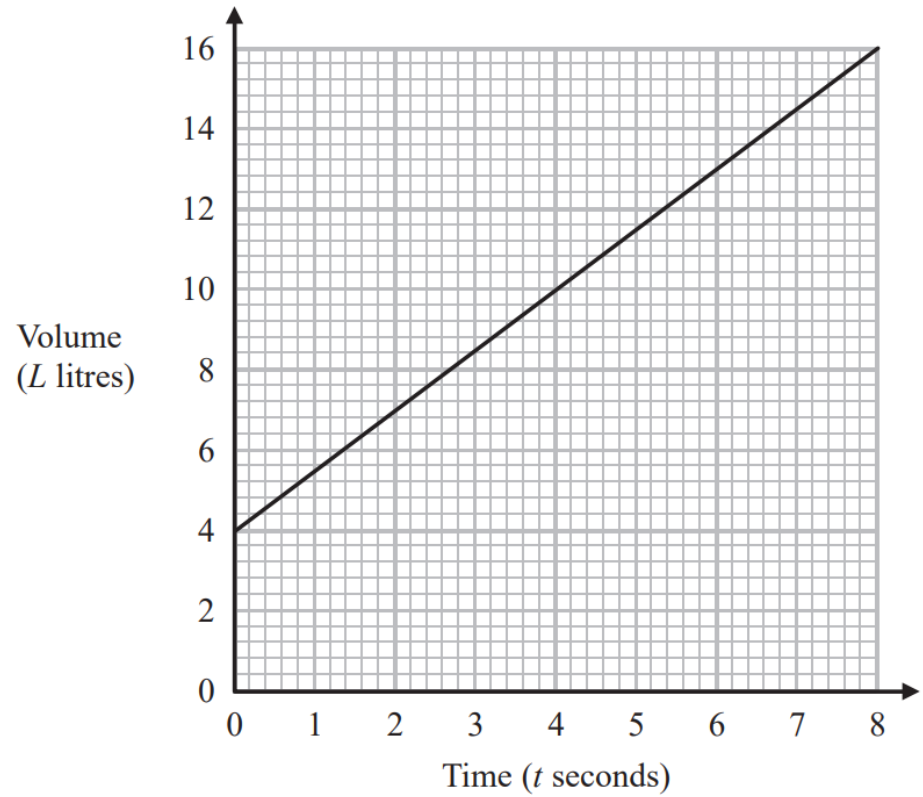
Geometry & Measures
Real-Life Graphs
<i>Gradient</i>

10 (a)		0 to 20 seconds	B1	for between 0 seconds and 20 seconds
		with reason	C1	for reason given eg gradient is greatest oe
(b)		18	B1	ft from (a)



Summer 2018 Paper 3H (Calc)

12 The graph shows the volume of liquid (L litres) in a container at time t seconds.



Geometry & Measures

Real-Life Graphs

Gradient

(2 marks)

(a) Find the gradient of the graph.

(b) Explain what this gradient represents.

(1 mark)

The graph intersects the volume axis at $L = 4$

(c) Explain what this intercept represents.

 **Video Solutions**

(1 mark)



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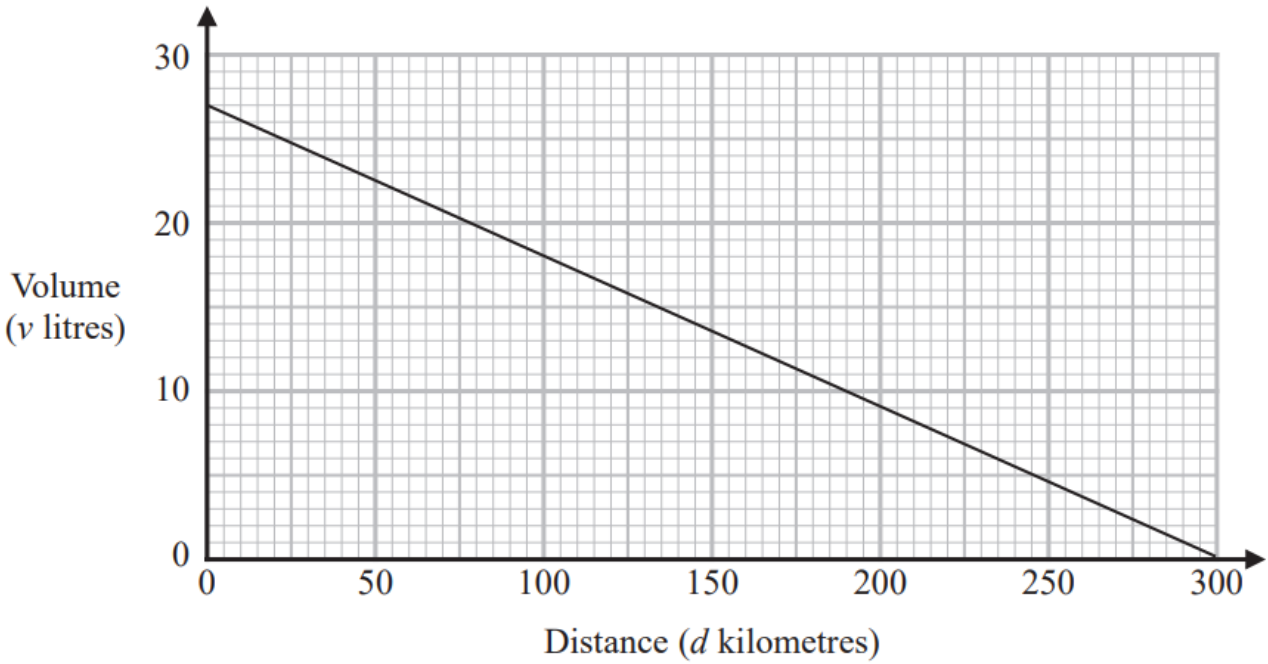
Geometry & Measures
Real-Life Graphs
Gradient

12	(a)	1.5	M1	for method to find the gradient of the line, eg $\frac{12}{8}$	Must see use of scales.
			A1	for 1.5 oe	
	(b)	Explanation	C1	Explanation relating to rate of change of volume with time, eg rate at which the container fills or change in number of litres per second or number of litres added per second	
	(c)	Explanation	C1	Explanation relating to volume (amount) of liquid in the container at the start eg number of litres in the container when $t = 0$, amount of liquid in the container to start with	Ignore any quantities given. Award the mark for an explanation involving rate.



Geometry & Measures
Real-Life Graphs
Gradient

12 The graph gives information about the volume, v litres, of petrol in the tank of Jim's car after it has travelled a distance of d kilometres.



(a) Find the gradient of the graph.

(2 marks)

(b) Interpret what the gradient of the graph represents.

 **Video Solutions**

(1 mark)



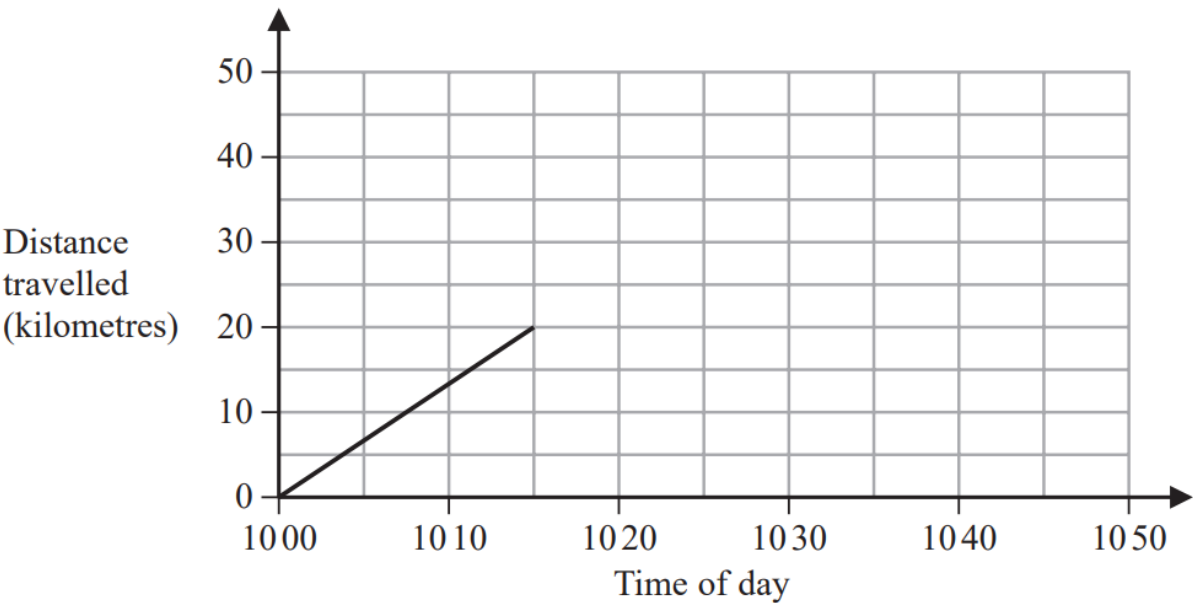
Geometry & Measures
Real-Life Graphs
Gradient

12	(a)	-0.09	M1	for suitable method to find gradient, eg $27 \div 300$	Any readings from the graph must be reasonable. Condone missing negative for M1
			A1	for answer in the range -0.1 to -0.08 oe	
	(b)		C1	for explanation Acceptable examples volume of petrol used each km litres/km Rate of fuel consumption For every 9 litres you can travel 100 km Not acceptable examples volume $\div$ distance volume of petrol used per distance km/litre as distance increases volume decreases	Can ft explanation linked to incorrect gradient in part (a)



November 2021 Paper 2H (Calc)

- 3 Sam drives his car on a journey.
Here is the travel graph for the first 15 minutes of his journey.



(a) Work out Sam’s speed, in km/h, for the first 15 minutes of his journey.

(2 marks)

At 10 15 Sam stops for 10 minutes and then drives for 20 minutes at a speed of 75 km/h.

(b) On the grid, complete the travel graph for Sam’s journey.

 **Video Solutions**

(3 marks)

Geometry & Measures
Real-Life Graphs
Gradient



3	(a)	80	M1	for a complete method eg $\frac{20}{15} \times 60$ or 20×4 or $20 \div \frac{1}{4}$	
			A1	cao	
	(b)	Travel graph	M1	for method to find distance travelled in last 20 minutes, eg $75 \times \frac{20}{60}$ (= 25)	Can be implied by a distance of 25km drawn on the graph
			C2	for a fully correct travel graph	
			(C1	for horizontal straight line from (10 15, 20) to (10 25, 20) or for a line of the correct length and gradient to indicate a speed of 75km/h eg a straight line from (10 25, 20) to (10 45, 45))	



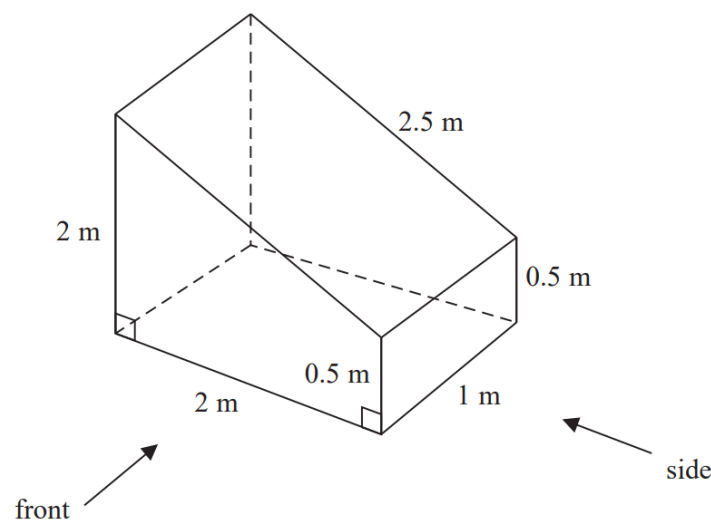
Geometry & Measures

3D Drawings

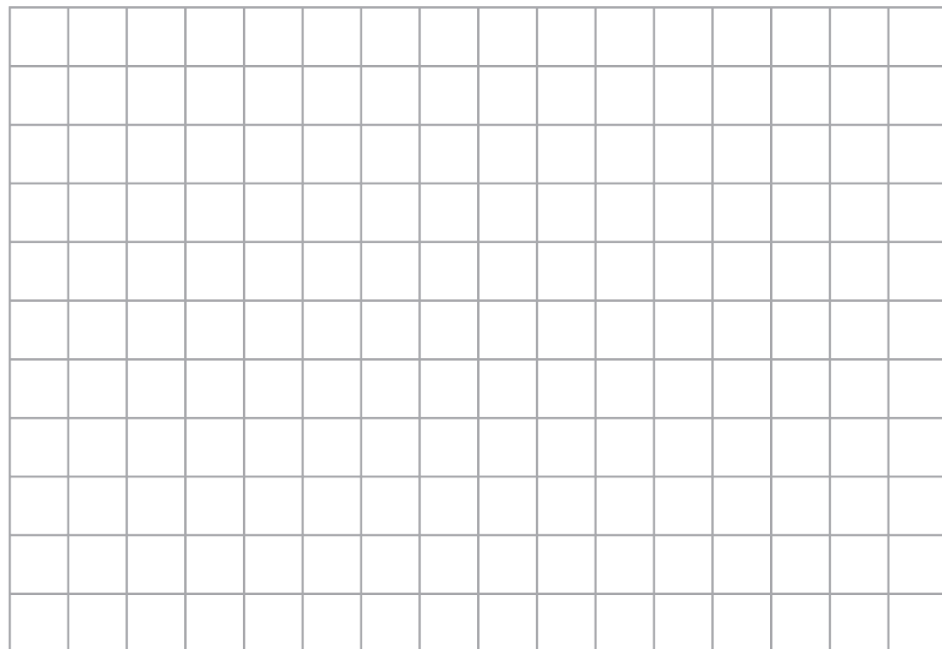


Summer 2017 Paper 2H (Calc)

3 The diagram shows a prism with a cross section in the shape of a trapezium.



On the centimetre grid below, draw the front elevation and the side elevation of the prism.
Use a scale of 2 cm to 1 m.



Geometry & Measures

3D Drawings

Plans and Elevations

 **Video Solutions**

(4 marks)

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Geometry & Measures
3D Drawings
<i>Plans and Elevations</i>

3		Side elevation	C2 [C1]	for the side elevation (4 cm by 2 cm rectangle with a solid line drawn 1 cm from the 2 cm edge, and correct orientation) for the side elevation as a rectangle]
		Front elevation	C2 [C1]	for the front elevation as a trapezium in correct orientation with base 4 cm, parallel sides 1 cm and 4 cm for the front elevation as a trapezium with two right angles] [Ignore incorrect or no labelling]

 **Video Solutions**

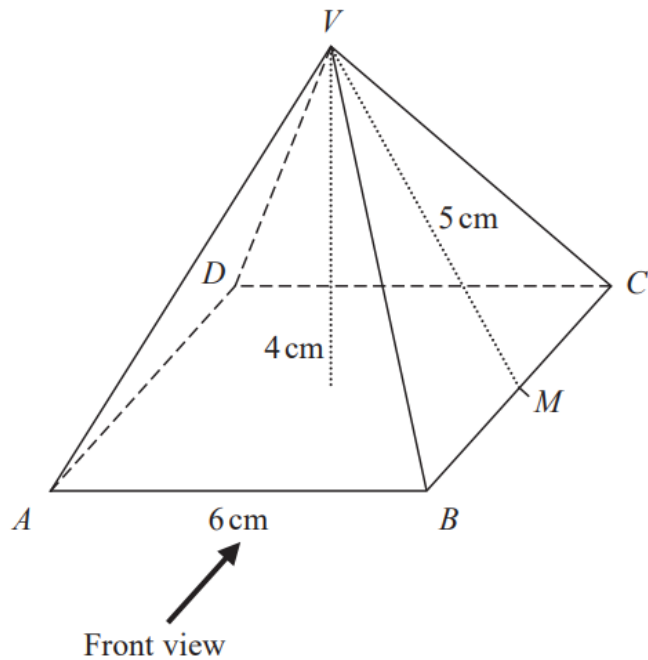
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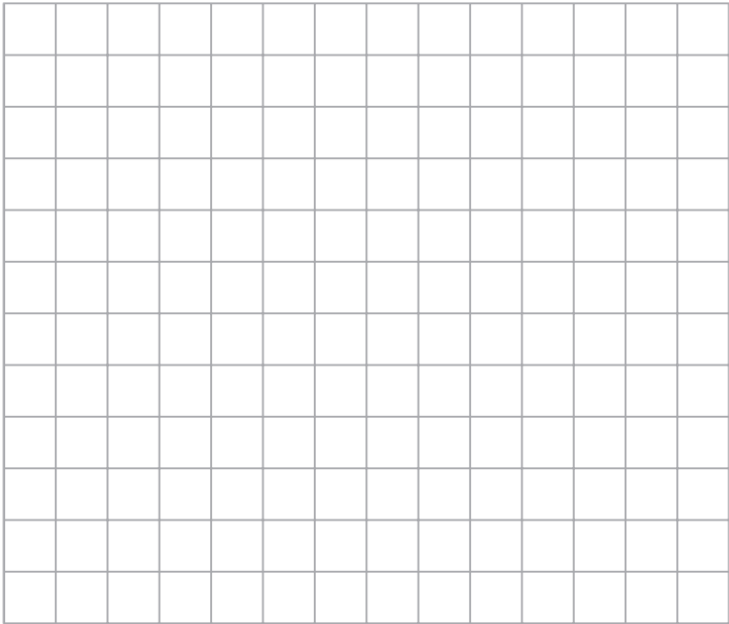
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Summer 2018 Paper 1H (Non-Calc)

5 Here is a solid square-based pyramid, $VABCD$.



The base of the pyramid is a square of side 6 cm .
The height of the pyramid is 4 cm .
 M is the midpoint of BC and $VM = 5\text{ cm}$.



(2)

(a) Draw an accurate front elevation of the pyramid from the direction of the arrow.

(2 marks)

(b) Work out the total surface area of the pyramid.

Video Solutions
(4 marks)

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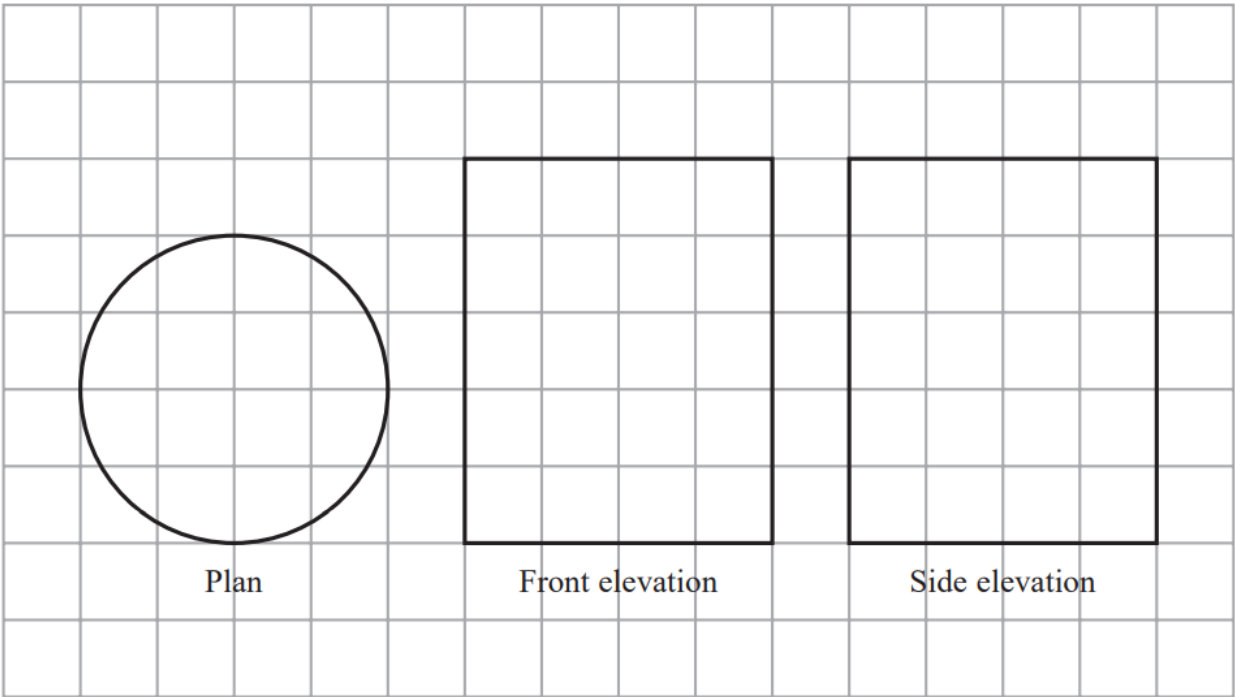
5	(a)	isosceles triangle, base 6 cm, height 4 cm	M1	for drawing an isosceles triangle or for drawing a triangle of base 6cm and height 4cm	Accept a freehand drawing Only a single triangle is acceptable; do not accept any attempted nets or 3-D diagrams Condone a perpendicular drawn from base to vertex Ignore incorrect or absent units for this mark [The SC is from: $4 \times \frac{1}{2} \times 6 \times 4 + 6 \times 6$] Ignore incorrect or absent numerical answer for this mark
			A1	for a fully correct diagram	
	(b)	96 cm ²	M1	for a method to find the area of a triangular face eg $\frac{1}{2} \times 6 \times 5 (= 15)$	
			M1	(dep) for finding the total surface area eg $4 \times "15" + 6 \times 6$	
			A1	for a numerical answer of 96	
			SC B1	for an answer of 84 if M0 scored	
			B1	cm ²	



Summer 2019 Paper 1H (Non-Calc)

Geometry & Measures
3D Drawings
<i>Plans and Elevations</i>

- 4 The diagram shows the plan, front elevation and side elevation of a solid shape, drawn on a centimetre grid.



In the space below, draw a sketch of the solid shape.
Give the dimensions of the solid on your sketch.

 **Video Solutions**

(2 marks)

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  **HOME**

4	sketch	M1	for sketch of a cylinder	Hidden edges may or may not be shown 2 (cm) for radius or 4 (cm) for diameter and 5 (cm) for height
		A1	sketch of cylinder, with dimensions shown	



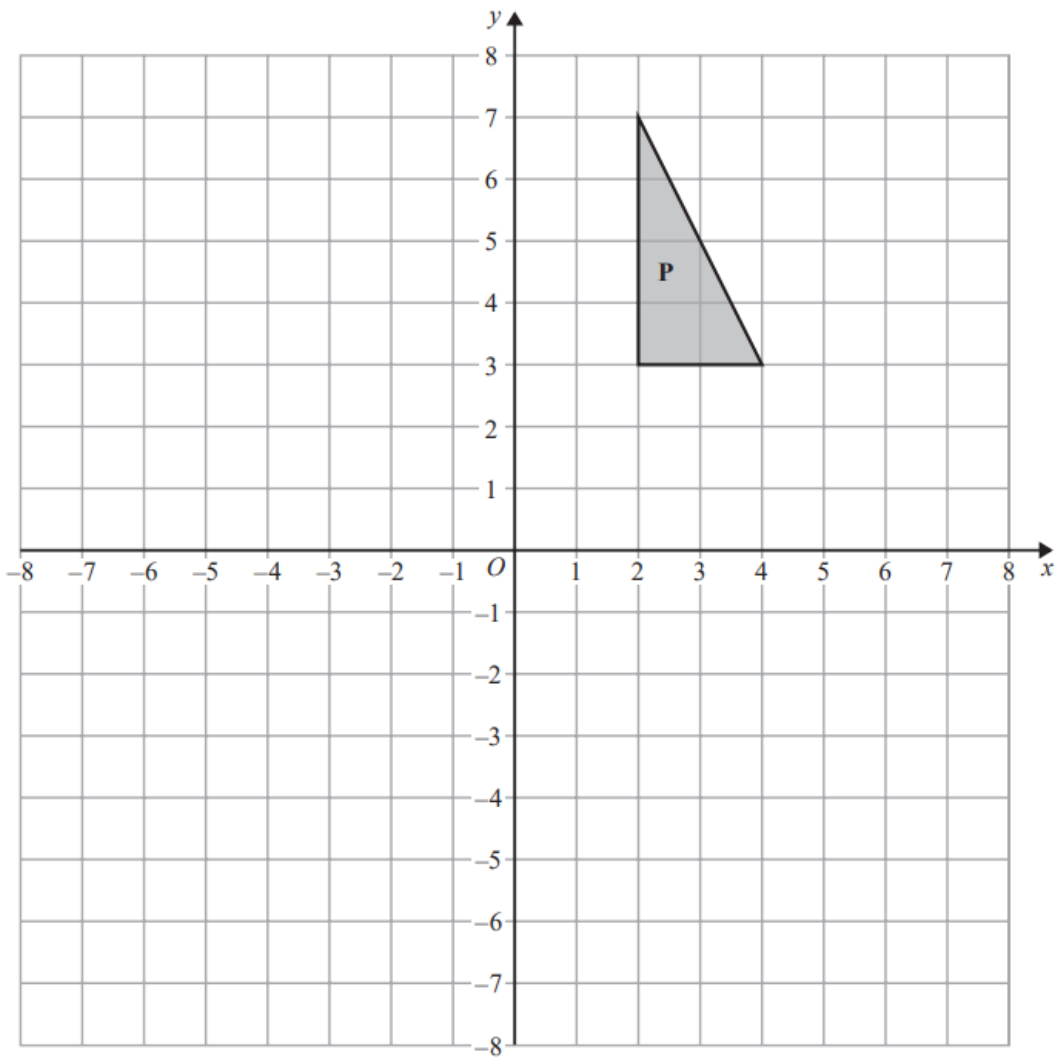
Geometry & Measures

Transformations

Enlargements

Multiple
Transformations





Enlarge shape **P** by scale factor $-\frac{1}{2}$ with centre of enlargement (0, 0).
 Label your image **Q**.

(2 marks)

Geometry & Measures
Transformations
Enlargements

 **Video Solutions**



Geometry & Measures
Transformations
<i>Enlargements</i>

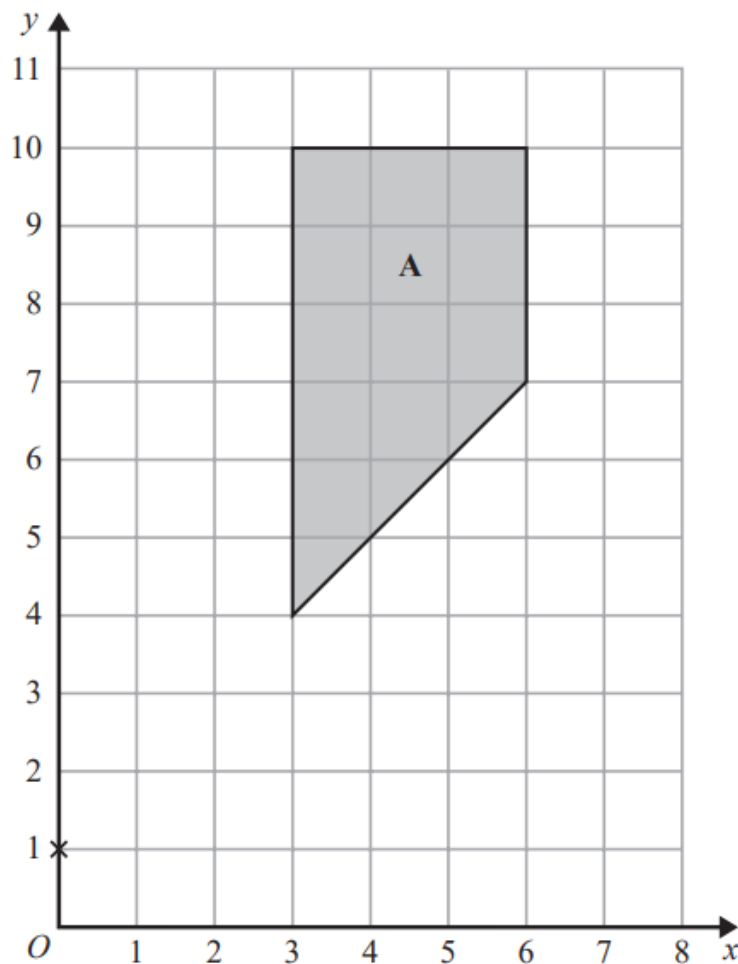
18		Correct enlargement	B2 (B1	Correct enlargement (-1,-1.5), (-1,-3.5) (-2,-1.5) correct size, correct orientation in incorrect position or 2 out of 3 vertices correctly placed)
----	--	---------------------	-----------	---

 **Video Solutions**

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  **HOME**



Enlarge shape A by scale factor $\frac{1}{3}$ centre (0, 1)

 **Video Solutions**

(2 marks)

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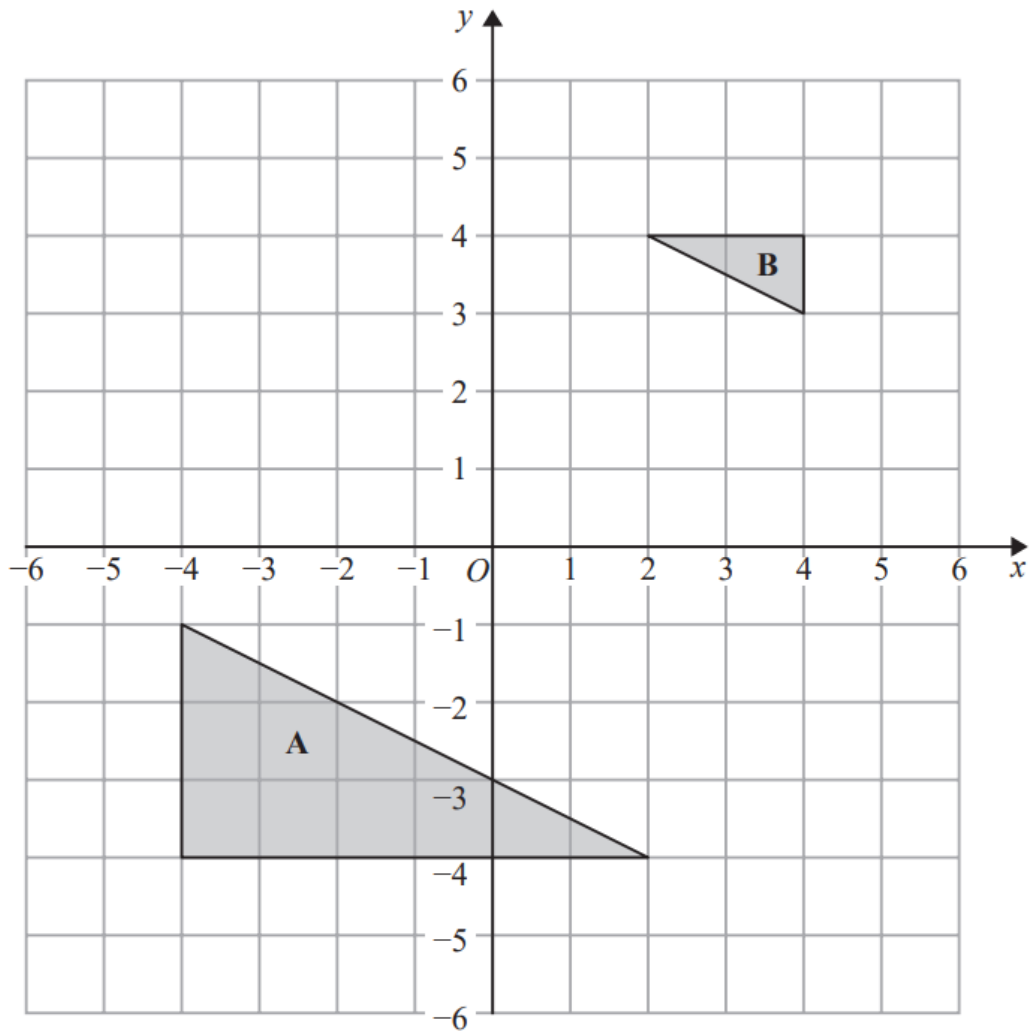
HOME

Geometry & Measures
Transformations
<i>Enlargements</i>

7	Enlargement	B2	for correct enlargement at (1,2) (2,3) (2,4) (1,4)
		(B1	for correct size and orientation in the wrong position OR 3 of 4 vertices correct and joined OR 4 correct vertices not joined)



Geometry & Measures
Transformations
Enlargements



Describe fully the single transformation that maps triangle A onto triangle B.

 **Video Solutions**
(2 marks)

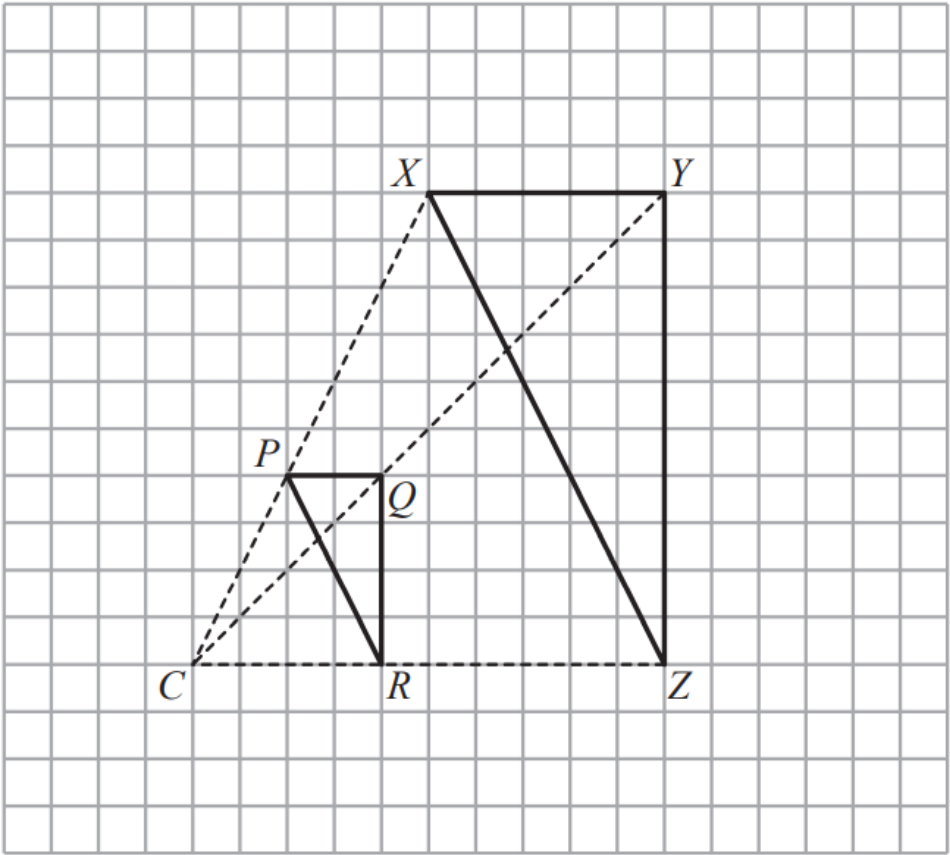
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13	enlargement scale factor $-\frac{1}{3}$ centre (2, 2)	C2	for all of: enlargement, (scale factor =) $-\frac{1}{3}$ oe, (centre =) (2, 2)
		(C1	for two of: enlargement, (scale factor =) $-\frac{1}{3}$ oe, (centre =) (2, 2)) Note: award no marks if more than one transformation is given



Geometry & Measures
Transformations
Enlargements



Roy is going to enlarge triangle PQR with centre C and scale factor $1\frac{1}{2}$

He draws triangle XYZ .

8 (b) Explain why Roy's diagram is **not** correct.

 **Video Solutions**
(1 mark)

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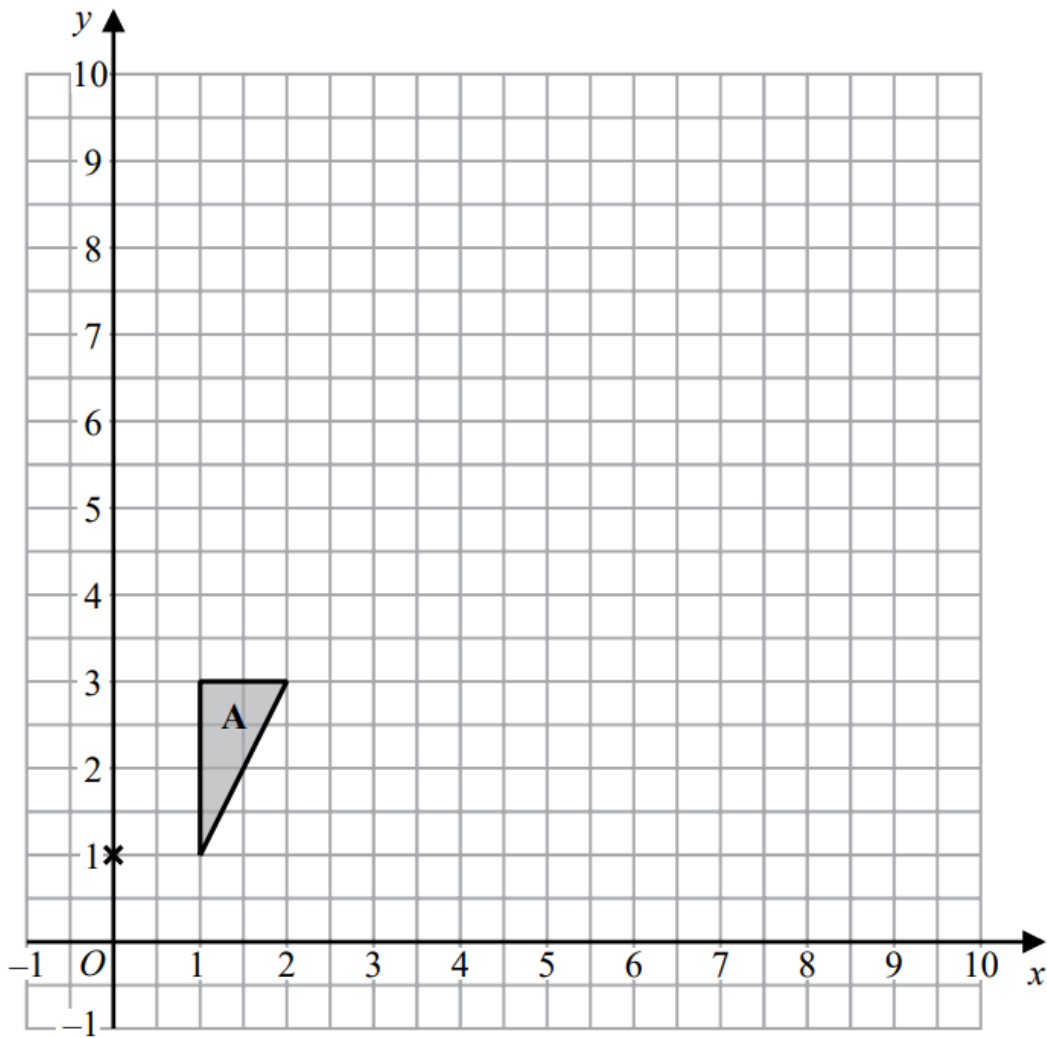


Geometry & Measures
Transformations
<i>Enlargements</i>

(b)	Explanation	C1	for explanation Acceptable examples the scale factor used is 2.5 $5 \div 2$ is not 1.5 $10 \div 4$ is more than 1.5 the scale factor is not 1.5 he has not used the correct scale factor has enlarged it by too much ZY should be 6 Not acceptable examples the grid is not large enough	Note that a diagram alone is insufficient.
-----	-------------	----	---	--



Geometry & Measures
Transformations
Enlargements



Enlarge triangle A by scale factor 2.5 with centre (0, 1)

▶ **Video Solutions**
 (2 marks)

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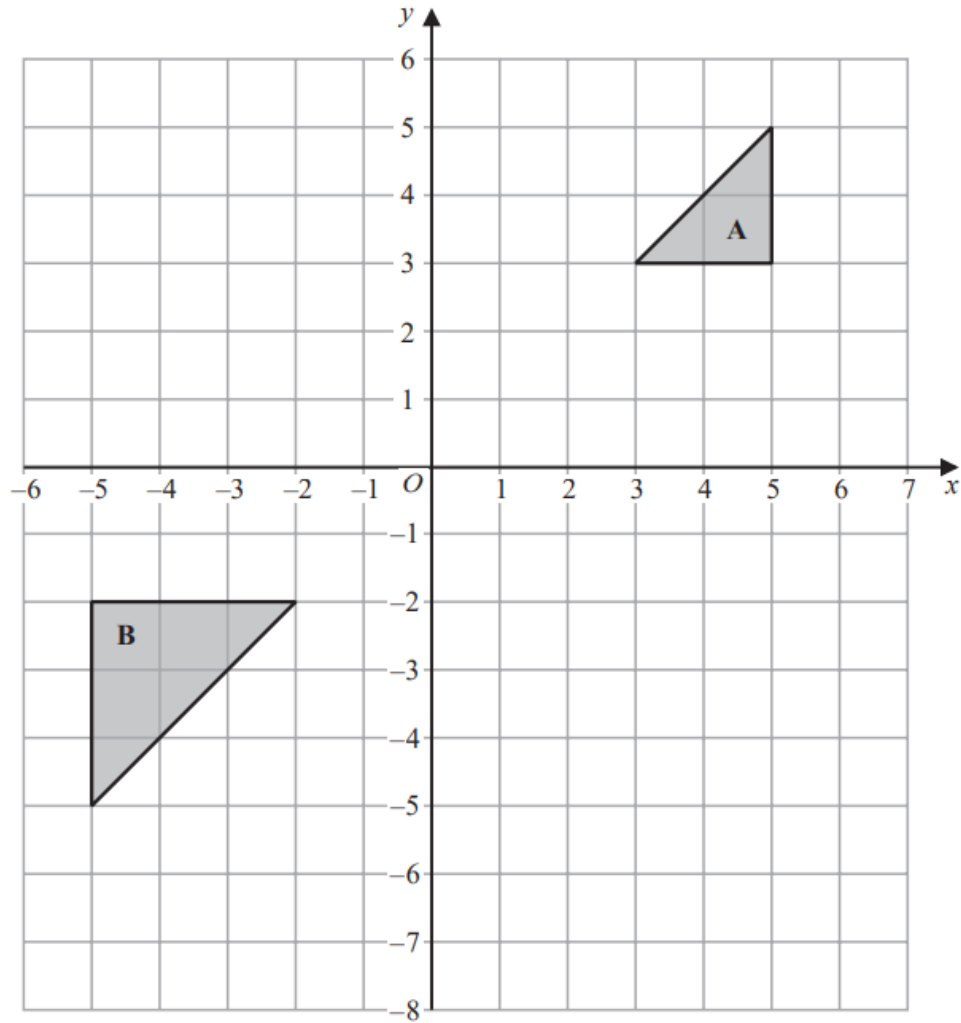
Geometry & Measures
Transformations
<i>Enlargements</i>

9	Enlargement	B2 (B1	vertices at (2.5, 1) (2.5, 6) (5, 6) for triangle of the correct size and orientation in the wrong position or a correct enlargement of a different scale factor centre (0, 1) or correct orientation with 2 of 3 vertices correct)
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 **Video Solutions**



Geometry & Measures
Transformations
<i>Describing</i>



Describe fully the single transformation that maps triangle A onto triangle B.

 **Video Solutions**

(2 marks)

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  **HOME**

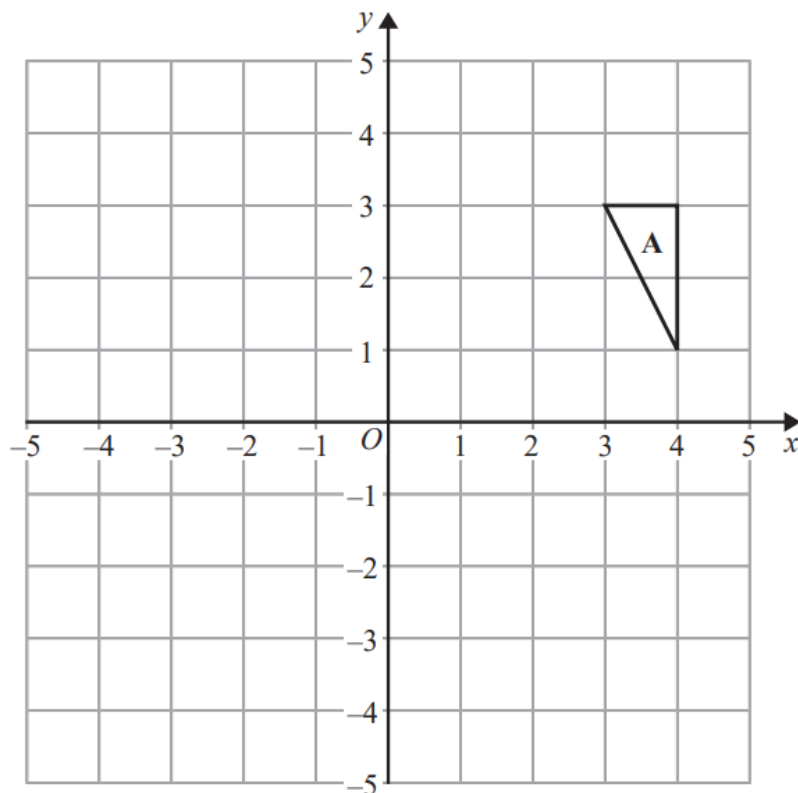
Geometry & Measures
Transformations
<i>Describing</i>

15	Enlargement sf -1.5 centre $(1, 1)$	B2 (B1)	for enlargement scale factor -1.5 and centre $(1, 1)$ for enlargement scale factor -1.5 or enlargement centre $(1, 1)$	Award no marks if more than one transformation is given
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Summer 2017 Paper 2H (Calc)

9 The diagram shows triangle A drawn on a grid.



Kyle reflects triangle A in the x -axis to get triangle B.
He then reflects triangle B in the line $y = x$ to get triangle C.

Amy reflects triangle A in the line $y = x$ to get triangle D.
She is then going to reflect triangle D in the x -axis to get triangle E.

Amy says that triangle E should be in the same position as triangle C.

Is Amy correct?

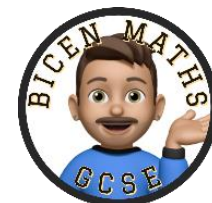
You must show how you get your answer.

Geometry &
Measures

Transformations

Multiple
transformations

 **Video Solutions**



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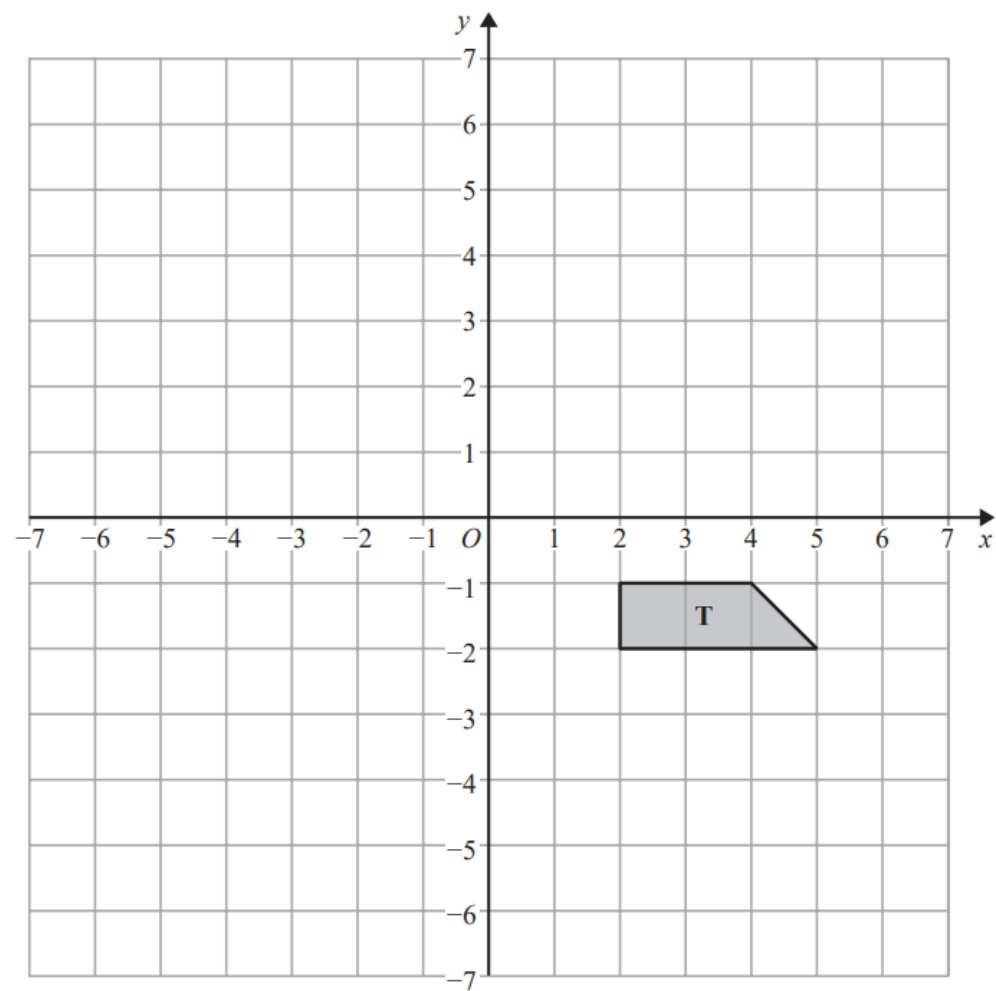
(3 marks)

Geometry & Measures
Transformations
Multiple transformations

9		No (supported)	M2 [M1 C1	for the correct position of C or E for a correct position of B or D] for No with correct supporting evidence, eg. showing C and E in the correct positions OR for C is a rotation of 90° anticlockwise about <i>O</i> or E is a rotation of 90° clockwise about <i>O</i> for No with supporting evidence, eg. C is a rotation of 90° anticlockwise about <i>O</i> and E is a rotation of 90° clockwise about <i>O</i> .
			M2 C1	



Geometry & Measures
Transformations
Multiple transformations



(a) Rotate trapezium T 180° about the origin.
Label the new trapezium A.

(1)

(b) Translate trapezium T by the vector $\begin{pmatrix} -1 \\ -3 \end{pmatrix}$
Label the new trapezium B.

(1)



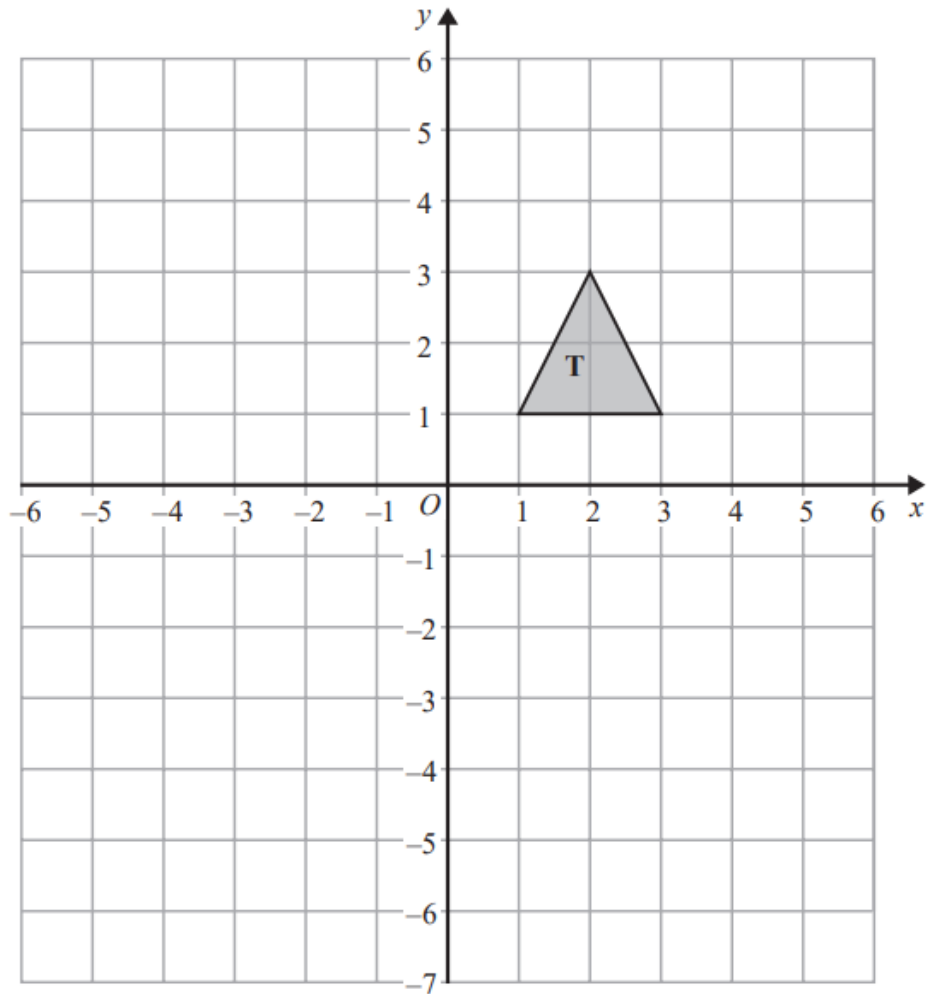
Geometry & Measures
Transformations
<i>Multiple transformations</i>

5 (a)		$(-2, 1) (-4, 1)$ $(-2, 2) (-5, 2)$	B1	Shape labelled A
(b)		$(1, -4) (3, -4)$ $(1, -5) (4, -5)$	B1	Shape labelled B

 **Video Solutions**



Geometry & Measures
Transformations
Multiple transformations



Shape **T** is reflected in the line $x = -1$ to give shape **R**.
Shape **R** is reflected in the line $y = -2$ to give shape **S**.
Describe the **single** transformation that will map shape **T** to shape **S**.



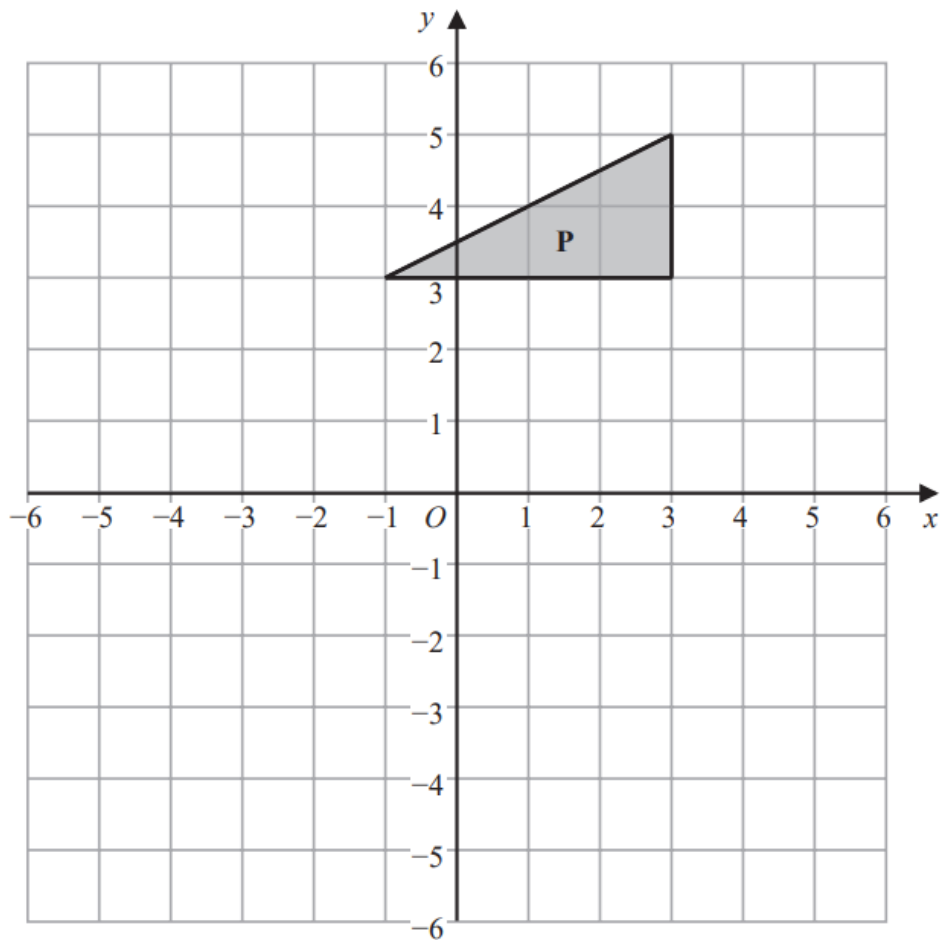
 **Video Solutions**
(2 marks)

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Geometry & Measures
Transformations
Multiple transformations

7	rotation 180° about $(-1, -2)$ or enlargement sf -1 centre $(-1, -2)$	B2 (B1	rotation 180° about $(-1, -2)$ or enlargement sf -1 centre $(-1, -2)$ rotation 180° or rotation about $(-1, -2)$ OR enlargement sf -1 or enlargement centre $(-1, -2)$ Award no marks for the description if more than one transformation is given SC B1 for fully correct diagram if B0 scored	Condone missing brackets but do not accept centre written as a vector Do not accept 'half turn' for 'rotation 180° ' Ignore references to clockwise and anticlockwise Triangles at $(-3, 1)$, $(-5, 1)$, $(-4, 3)$ and $(-3, -5)$, $(-5, -5)$, $(-4, -7)$
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Geometry &
Measures

Transformations

*Multiple
transformations*

Triangle **P** is reflected in the line $y = -x$ to give triangle **Q**.
 Triangle **Q** is reflected in the line $x = -1$ to give triangle **R**.

Describe fully the single transformation that maps triangle **R** to triangle **P**.

 **Video Solutions**



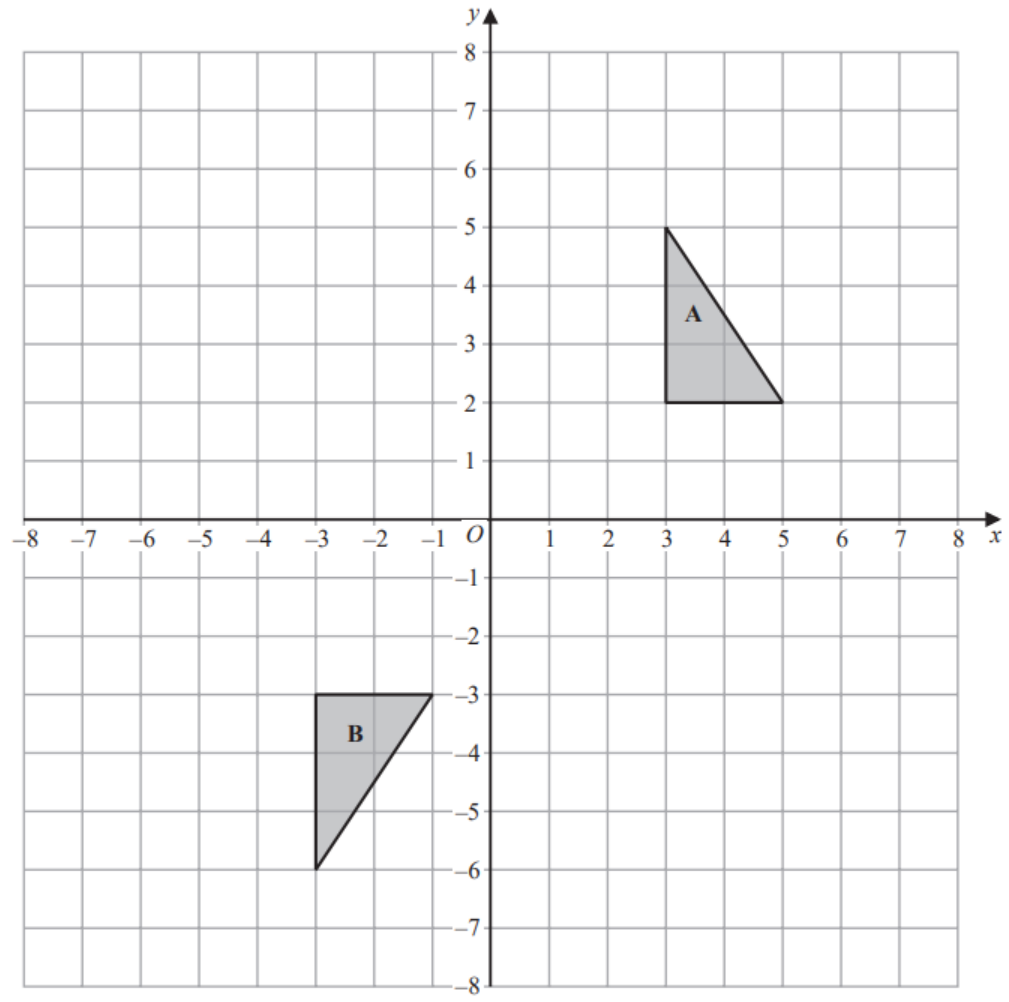
8	Rotation	M1	stating rotation or for showing R [(1,1), (1,−3), (3,−3)]
	90° anticlockwise	A1	for rotation of 90° anticlockwise
	centre (−1,1)	A1	for centre (−1, 1) given as a coordinate.

Award for a triangle in the correct position without the label R as long as this is the only triangle in lower right quadrant.

Accept rotation of 270° clockwise

Can be given as a coordinate alone.
Do not award A marks if there is evidence of other transformations in the description, or other ambiguity in the answer given.





Geometry & Measures
Transformations
Multiple transformations

 **Video Solutions**

Shape **A** can be transformed to shape **B** by a reflection in the x -axis followed by a

translation $\begin{pmatrix} c \\ d \end{pmatrix}$

Find the value of c and the value of d .

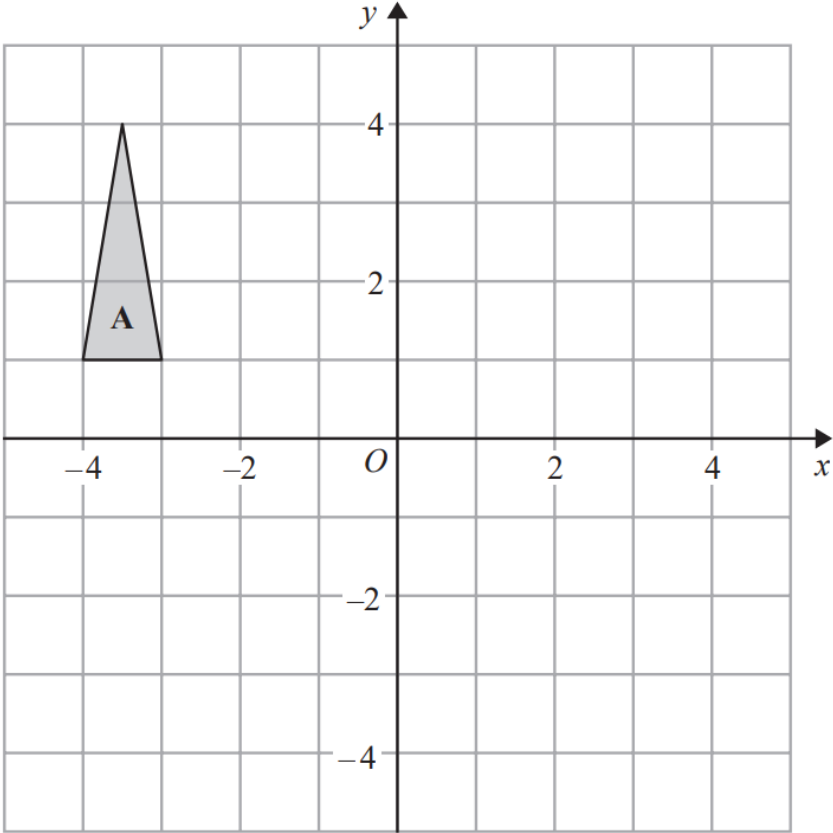
(3 marks)



Geometry & Measures
Transformations
Multiple transformations

5	$c = -6$ $d = -1$	M1	for reflection in x -axis shown on diagram	Vertices $(3, -2), (5, -2), (3, -5)$ One correct value is M1A1 regardless of second value or diagram
		A1	for $c = -6$ or $d = -1$	
		A1	for both $c = -6$ and $d = -1$	
			SCB2 for $c = -1$ and $d = -6$	





Geometry & Measures
Transformations
Multiple transformations, invariant points

Triangle A is transformed by the combined transformation of a rotation of 180° about the point $(-2, 0)$ followed by a translation with vector $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$

One point on triangle A is invariant under the combined transformation.

Find the coordinates of this point.

▶ **Video Solutions**

(2 marks)

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Geometry & Measures
Transformations
<i>Multiple transformations, invariant points</i>

20	$(-3.5, 1)$	M1 A1	for a complete method to show the transformations cao	Image at $(-4, 1)$, $(-3, 1)$ and $(-3.5, -2)$
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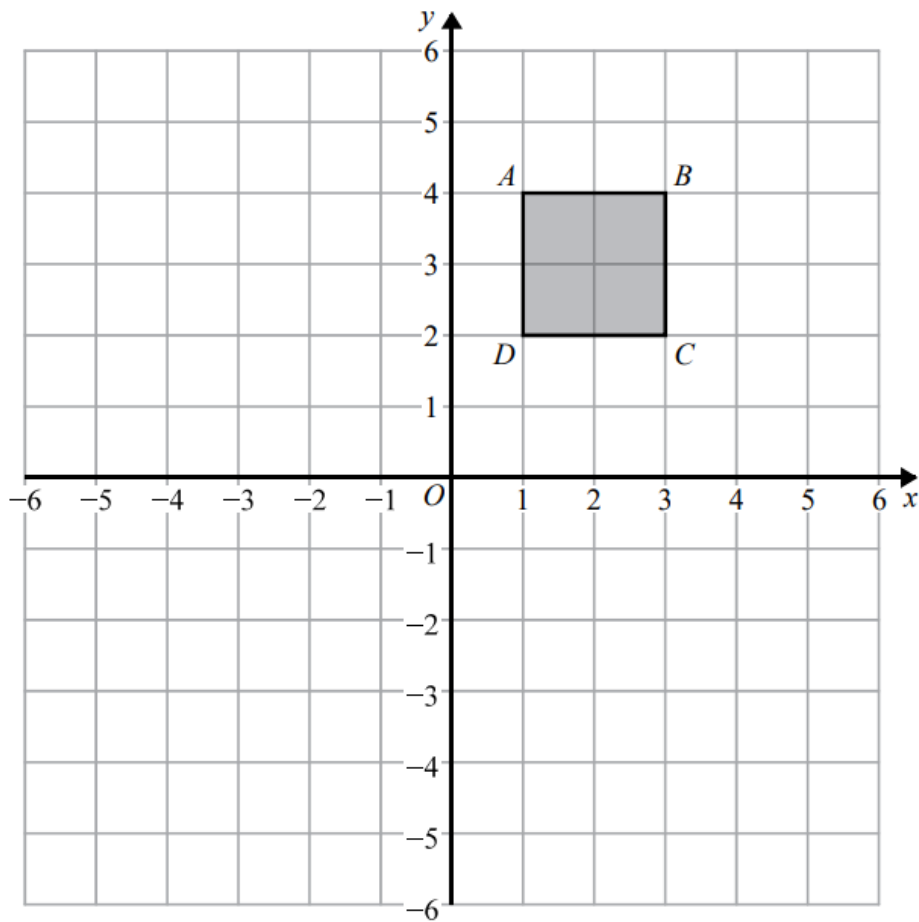
 **Video Solutions**

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Geometry & Measures
Transformations
Multiple transformations, invariant points



Square $ABCD$ is transformed by a combined transformation of a reflection in the line $x = -1$ followed by a rotation.

Under the combined transformation, two vertices of the square $ABCD$ are invariant.

Describe fully one possible rotation.

 **Video Solutions**

(2 marks)

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Geometry & Measures

Transformations

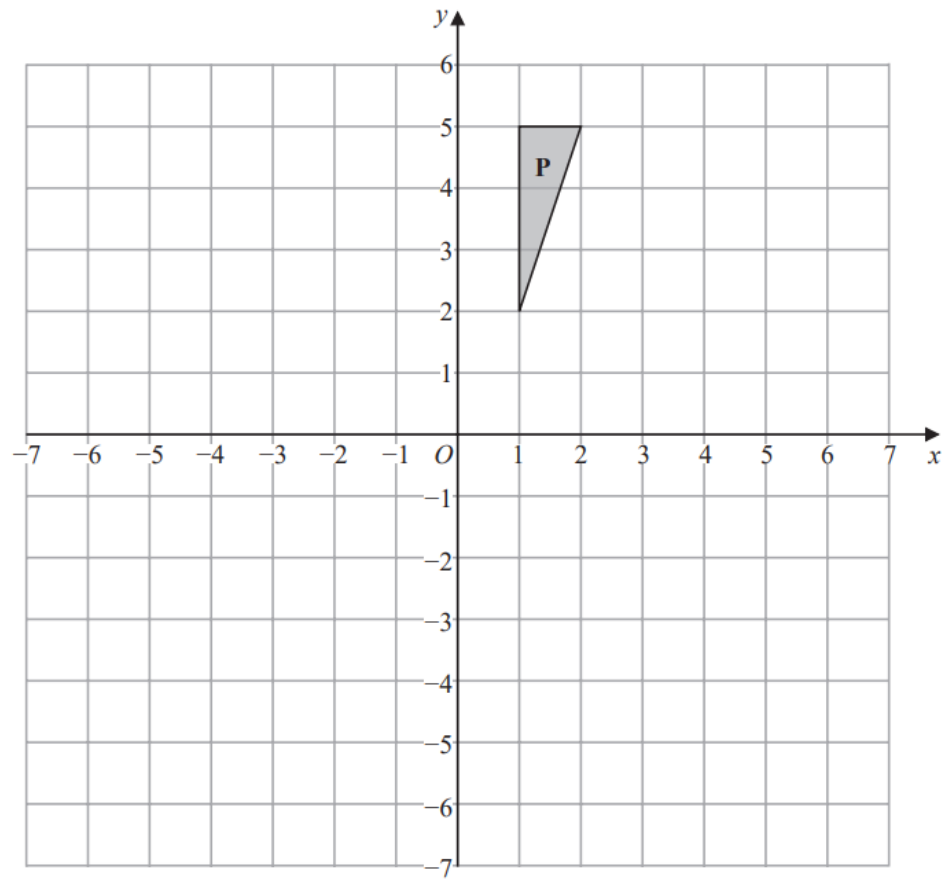
Multiple transformations, invariant points

24	Description	C2	for (rotation) 90° clockwise about (−1, 0) or (rotation) 90° anticlockwise about (−1, 6) or (rotation) 180° about (−1, 2) or (rotation) 180° about (−1, 4)	Award 0 marks if there is reference to other transformations eg coordinates given as vectors (which is a translation)
		(C1	for (−1, 0) or (−1, 6) or (−1, 2) or (−1, 4))	



Summer 2020 Paper 3H (Calc)

11 The diagram shows a triangle **P** on a grid.



Triangle **P** is rotated 180° about $(0, 0)$ to give triangle **Q**.
Triangle **Q** is translated by $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ to give triangle **R**.
(a) Describe fully the single transformation that maps triangle **P** onto triangle **R**.

(3 marks)

Under the transformation that maps triangle **P** onto triangle **R**, the point *A* is invariant.

(b) Write down the coordinates of point *A*.

(1 mark)

Geometry & Measures
Transformations
Multiple transformations, invariant points

 **Video Solutions**



Geometry & Measures
Transformations
Multiple transformations, invariant points

11	(a)	rotation of 180° about $(2.5, -1)$	M1	for method to find position of Q , eg shape drawn at $(-1, -2)$, $(-1, -5)$ and $(-2, -5)$ or for method to find position of R , eg shape drawn at $(4, -4)$, $(4, -7)$ and $(3, -7)$ or for method to translate their Q correctly
			A2	for rotation of 180° about $(2.5, -1)$ or enlargement by scale factor -1 , centre $(2.5, -1)$
			(A1	for any 2 of the 3 aspects)
	(b)	$(2.5, -1)$	B1	for $(2.5, -1)$ ft from rotation or enlargement in (a)

The method mark is awarded if no working is shown but at least 2 of the 3 aspects are correct in the description

Cannot award A marks for a combination of transformations
With no extra incorrect aspects

No follow through from a combined transformation in part (a)



Geometry & Measures

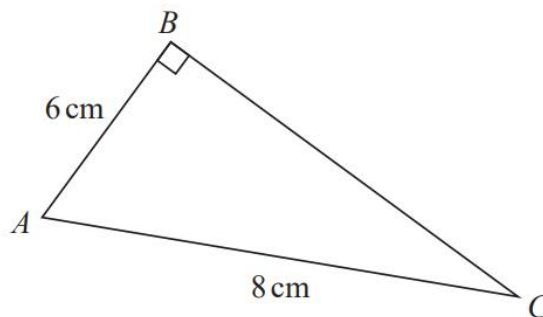
Pythagoras

Simple

... with circles



8 ABC is a right-angled triangle.



Here is Sarah's method to find the length of BC .

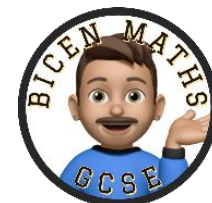
$$\begin{aligned} BC^2 &= AB^2 + AC^2 \\ &= 6^2 + 8^2 \\ &= 100 \\ BC &= 10 \end{aligned}$$

(a) What mistake has Sarah made in her method?

 **Video Solutions**

(1 mark)

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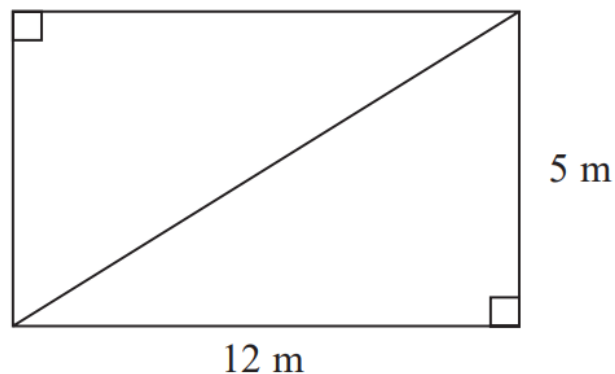
HOME

8	(a)	Mistake described	C1	for statement describing a mistake Acceptable eg should be $AC^2 - AB^2$ she should do $8^2 - 6^2$ she should be subtracting not adding the numbers she thought that BC was the hypoteneuse when it was actually AC should be $BC^2 + AB^2 = AC^2$ should be $8^2 = 6^2 + BC^2$ Not acceptable eg she has not used Pythagoras correctly $6^2 + 8^2$ is 120 the answer should be $\sqrt{28}$ or 5 or 5.3 or 5.2915 $BC + AB = AC$
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Summer 2017 Paper 1H (Non-Calc)

- 5 This rectangular frame is made from 5 straight pieces of metal.



The weight of the metal is 1.5 kg per metre.

Work out the total weight of the metal in the frame.

Geometry &
Measures

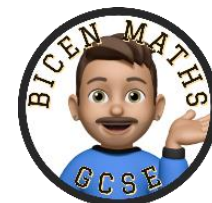
Pythagoras

... with context

 **Video Solutions**

(5 marks)

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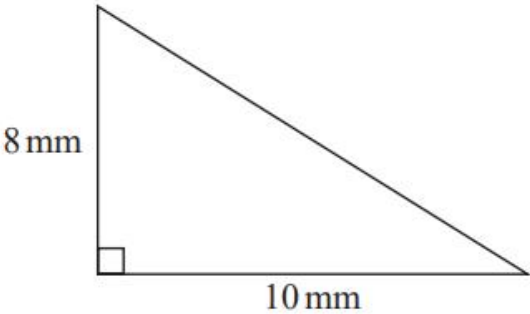
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Geometry & Measures
Pythagoras
... with context

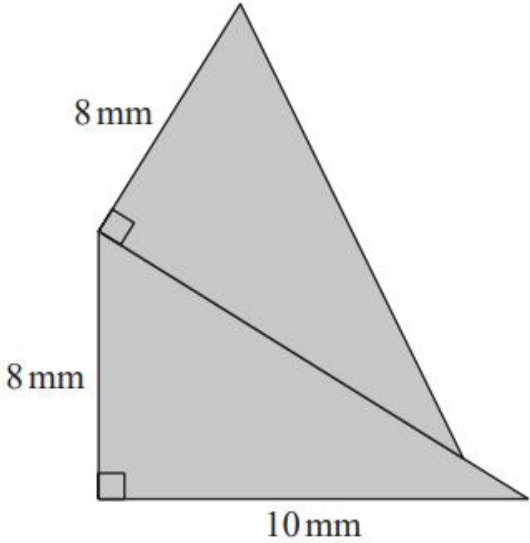
5		70.5	P1 P1 P1 P1 A1	starts process of Pythagoras e.g. $5^2 + 12^2$ complete process for Pythagoras e.g. $\sqrt{5^2 + 12^2}$ or $\sqrt{25 + 144}$ or $\sqrt{169}$ (=13) (dep P1 for Pythagoras) process of adding all the lengths e.g. $5 + 5 + 12 + 12 + "13"$ (=47) (indep) process of multiplying at least 2 lengths by 1.5 cao SC: any evidence of working with Pythagoras award the P1 or P2
---	--	------	----------------------------	---



5 Here is a right-angled triangle.



The shaded shape below is made from two of these triangles.



Work out the perimeter of the shaded shape.
Give your answer correct to 3 significant figures.

Geometry & Measures
Pythagoras
... with context



Geometry & Measures
Pythagoras
... with context

5	41.6	P1	for start of process to find the length of the hypotenuse, eg $(\text{hyp}^2 =) 8^2 + 10^2 (= 164)$	Note lengths may be seen on the diagram
		P1	for complete process to find hypotenuse, eg $\sqrt{8^2 + 10^2}$ or $\sqrt{64 + 100}$ or $\sqrt{164}$ ($= 12.8\dots$)	
		P1	(dep P2) for complete process to find the required perimeter, eg $8 + 8 + 10 + \text{“}12.8\text{”} + \text{“}12.8 - 10\text{”}$ or $16 + 4\sqrt{41}$	$8 + 8 + \text{“}12.8\text{”} + \text{“}12.8\text{”}$ oe is acceptable for this mark
		A1	for answer in the range 41 to 42	If an answer in the range 41 to 42 is given in the working space then incorrectly rounded, award full marks.



Summer 2017 Paper 3H (Calc)

Geometry &
Measures

Pythagoras

... with area of circles

- 8 A square, with sides of length x cm, is inside a circle.
Each vertex of the square is on the circumference of the circle.

The area of the circle is 49 cm^2 .

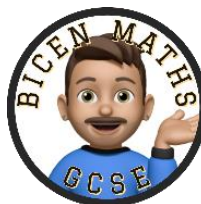
Work out the value of x .

Give your answer correct to 3 significant figures.

 **Video Solutions**

(4 marks)

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Geometry & Measures
Pythagoras
... with area of circles

8

5.59

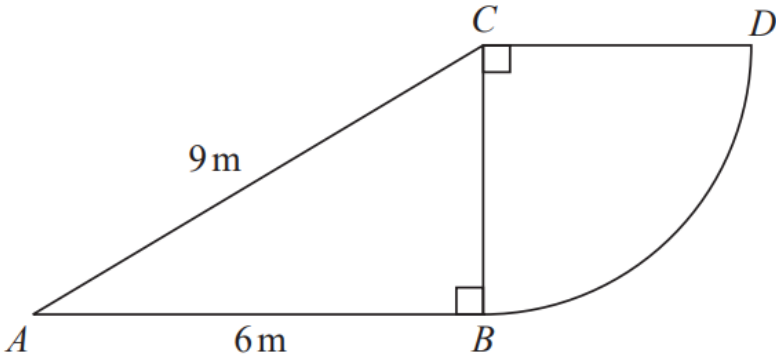
M1	For use of $\pi r^2 = 49$, where r is the radius or $r = 3.9(49\dots)$ or diameter = $7.8(9865\dots)$	
M1	For use of Pythagoras to set up an equation in x^2 e.g. $x^2 + x^2 = (d)^2$ or $x^2 = r^2 + r^2$	For use of trigonometry to set up an equation in x eg $\sin 45 = x \div d$
M1	(dep on M2) Rearrange to $(x^2 =) 2 \times "3.949\dots" ^2$	Rearrange to $(x =) "7.898\dots" \times \sin 45$ oe
A1	5.5 to 5.6	

 **Video Solutions**



Geometry & Measures
Pythagoras
... with area of circles

7 The diagram shows a right-angled triangle and a quarter circle.



The right-angled triangle ABC has angle $ABC = 90^\circ$
 The quarter circle has centre C and radius CB .

Work out the area of the quarter circle.
 Give your answer correct to 3 significant figures.
 You must show all your working.

▶ **Video Solutions**

(4 marks)



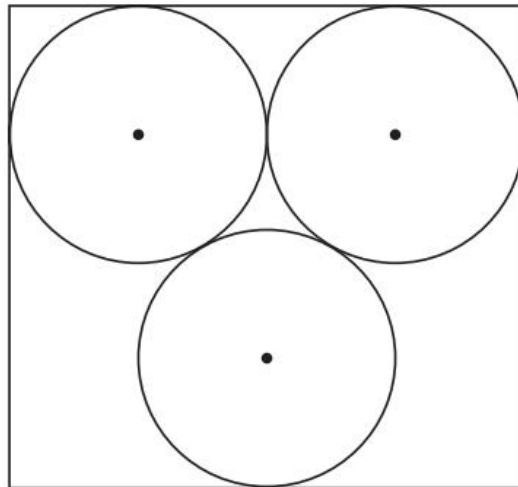
Geometry & Measures
Pythagoras
... with area of circles

7	35.3	P1	for starting the process to find length of third side of triangle, eg $9^2 - 6^2 (= 45)$ or $6^2 + x^2 = 9^2$	
		P1	for $\sqrt{9^2 - 6^2}$ or $\sqrt{81 - 36}$ or $\sqrt{45}$ or $3\sqrt{5}$ ($= 6.7..$) or $r^2 = 45$	
		P1	for stating or using $\pi \times [\text{radius}]^2 \div 4$	[radius] is any value
		A1	for answer in range 35.2 to 35.4	If an answer in the range 35.2 to 35.4 is given in the working space then incorrectly rounded, award full marks No working, answer only, no marks



Summer 2017 Paper 2H (Calc)

- 21 The diagram shows 3 identical circles inside a rectangle. Each circle touches the other two circles and the sides of the rectangle, as shown in the diagram.



The radius of each circle is 24 mm.

Work out the area of the rectangle.

Give your answer correct to 3 significant figures.

Geometry &
Measures

Pythagoras

... with circles
(challenging!)

 **Video Solutions**

(4 marks)

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Geometry & Measures
Pythagoras
... with circles (challenging!)

21		8600	P1 P1 P1 A1	for process to find the length of the rectangle, e.g. $24 \times 4 (= 96)$ for process to find the perpendicular height of an equilateral triangle of side (24×2) cm, e.g. $48\sin 60 (= 41.5(69..))$ or $\sqrt{48^2 - 24^2} (= 24\sqrt{3} \text{ oe})$ for complete process to find the width of rectangle, e.g. “ $41.5(69..)$ ” + $24 + 24 (= 89.5(69..))$ for answer in the range 8592 to 8602
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 **Video Solutions**



Geometry & Measures

Trigonometry

Right Angled Triangles

<u>SOH CAH TOA</u> (simple)	<u>SOH CAH TOA</u> (problem solving)	<u>SOH CAH TOA</u> (3D problem solving)	<u>Exact Values</u>
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Non-Right Angled Triangles

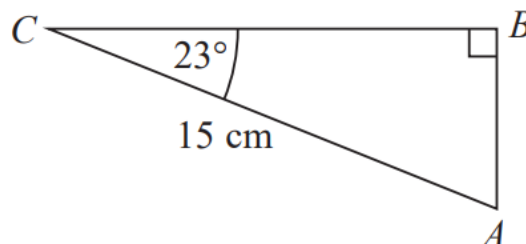
$\frac{1}{2}ab \sin C$	<u>Sine Rule, Cosine Rule</u> (mixed problems)
------------------------	---

Trigonometric Functions

<u>Graphs</u>



7 ABC is a right-angled triangle.



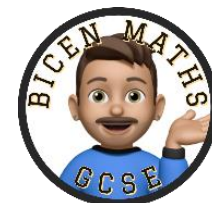
Calculate the length of AB .

Give your answer correct to 3 significant figures.

 **Video Solutions**

(2 marks)

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Geometry & Measures
Trigonometry
SOH CAH TOA

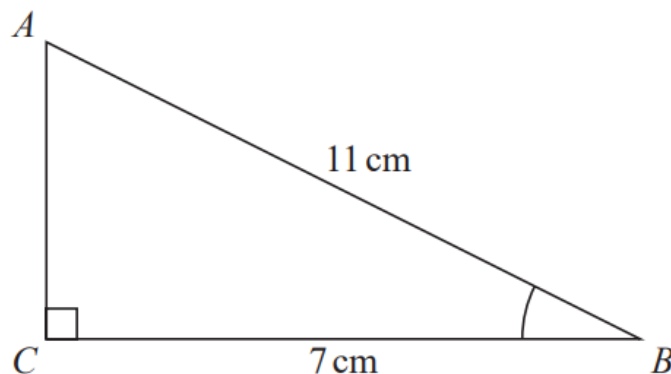
7		5.86	M1 A1	for $\sin 23 = \frac{AB}{15}$ NB Allow any alternative equivalent method to form an equation in AB 5.8 to 5.9
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 **Video Solutions**



Summer 2018 Paper 3H (Calc)

5 ABC is a right-angled triangle.



- (a) Work out the size of angle ABC .
Give your answer correct to 1 decimal place.

(2 marks)

The length of the side AB is reduced by 1 cm.

The length of the side BC is still 7 cm.

Angle ACB is still 90°

- (b) Will the value of $\cos ABC$ increase or decrease?
You must give a reason for your answer.

Geometry &
Measures

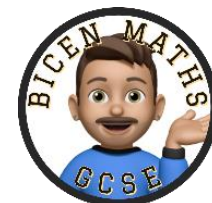
Trigonometry

SOH CAH TOA

 **Video Solutions**

(1 mark)

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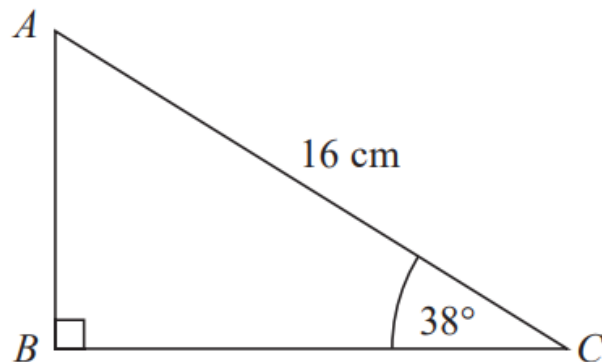
Geometry & Measures
Trigonometry
SOH CAH TOA

5	(a)	50.5	M1	for $\cos ABC = \frac{7}{11}$ (0.63...) oe	Must be a complete statement for cos, sin or tan with all three elements present.
			A1	for answer in the range 50.4 to 50.51	If an answer is in the range 50.4 to 50.51 is given in the working space then incorrectly rounded, award full marks.
	(b)	Increase (supported)	C1	States increase with supporting reason eg “ $\frac{7}{10}$ is greater than $\frac{7}{11}$ ” “ 0.636 is less than 0.7 ” ... “cos increases as angle decreases” “decreasing the denominator increases the value of the fraction” “angle is now 45.6” (accept 45.5 – 45.6)	If figures are given they must be correct (truncated or rounded).



Summer 2019 Paper 2H (Calc)

5 ABC is a right-angled triangle.



Calculate the length of AB .

Give your answer correct to 2 decimal places.

Geometry &
Measures

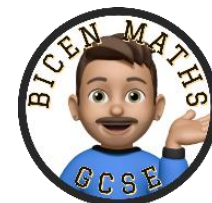
Trigonometry

SOH CAH TOA

 **Video Solutions**

(2 marks)

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HOME

Geometry & Measures
Trigonometry
SOH CAH TOA

5

9.85

M1

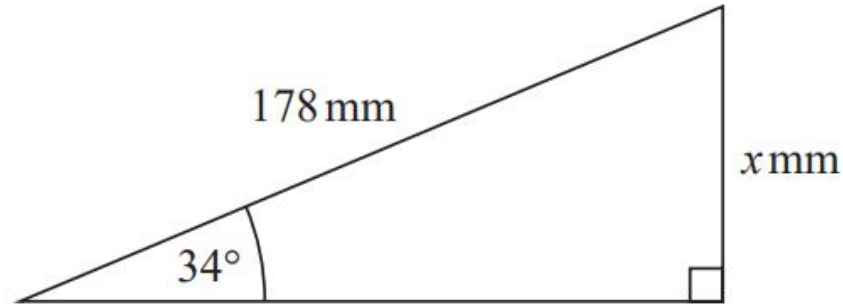
for $\sin (38)=\frac{AB}{16}$ or
or alternative method to find AB

A1

for an answer in the range 9.76 to 9.92



5



Work out the value of x .
Give your answer correct to 1 decimal place.

Geometry &
Measures

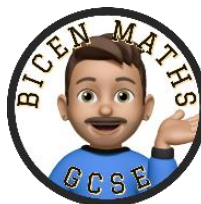
Trigonometry

SOH CAH TOA

 **Video Solutions**

(2 marks)

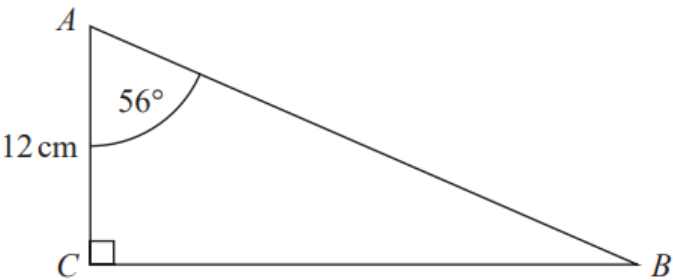
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HOME

5	99.5	M1	for $\sin(34) = \frac{x}{178}$ oe or alternative method to find x	
		A1	for answer in range 99.5 to 99.7	If an answer in the range 99.5 to 99.7 is given in the working space then incorrectly rounded, award full marks

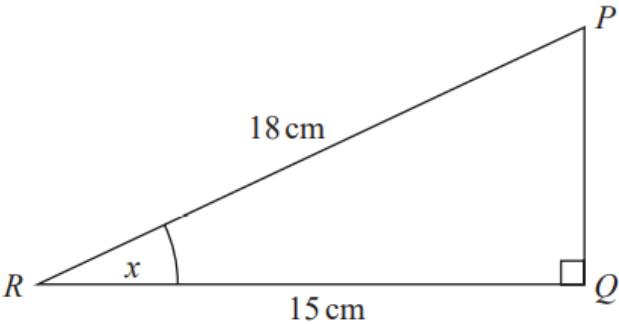
6 ABC is a right-angled triangle.



- (a) Work out the length of BC .
 Give your answer correct to 1 decimal place.

(2 marks)

PQR is a right-angled triangle.



- (b) Work out the size of the angle marked x .
 Give your answer correct to 1 decimal place.

Geometry & Measures
Trigonometry
SOH CAH TOA



6	(a)	17.8	M1	for $\tan 56 = \frac{x}{12}$ or $(BC) = 12 \times \tan 56$ oe or alternative method to find BC
			A1	for an answer in the range 17.7 to 17.8
	(b)	33.6	M1	for $\cos x = \frac{15}{18}$ or $\cos x = 0.83..$ or $x = \cos^{-1} \frac{15}{18}$ or alternative method to find x
			A1	for an answer in the range 33.5 to 33.91

For any alternative method candidates must arrive at an equation with BC as the only unknown

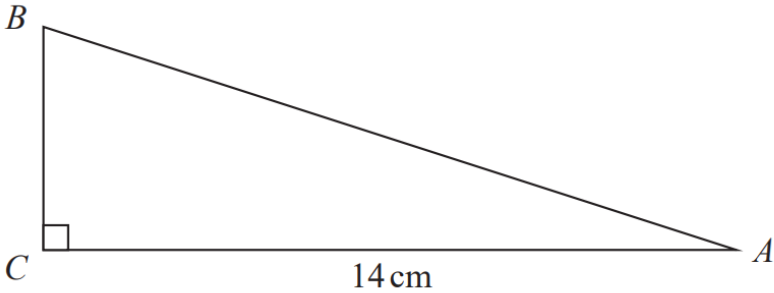
If an answer in the range 17.7 to 17.8 is given in the working space then incorrectly rounded, award full marks.

For any alternative method candidates must arrive at an equation with x as the only unknown

If an answer in the range 33.5 to 33.91 is given in the working space then incorrectly rounded, award full marks.



6 ABC is a right-angled triangle.



$AC = 14\text{ cm}$.
Angle $C = 90^\circ$

size of angle B : size of angle $A = 3 : 2$

Work out the length of AB .
Give your answer correct to 3 significant figures.

Geometry & Measures
Trigonometry
SOH CAH TOA, problem solving

▶ **Video Solutions**

(4 marks)

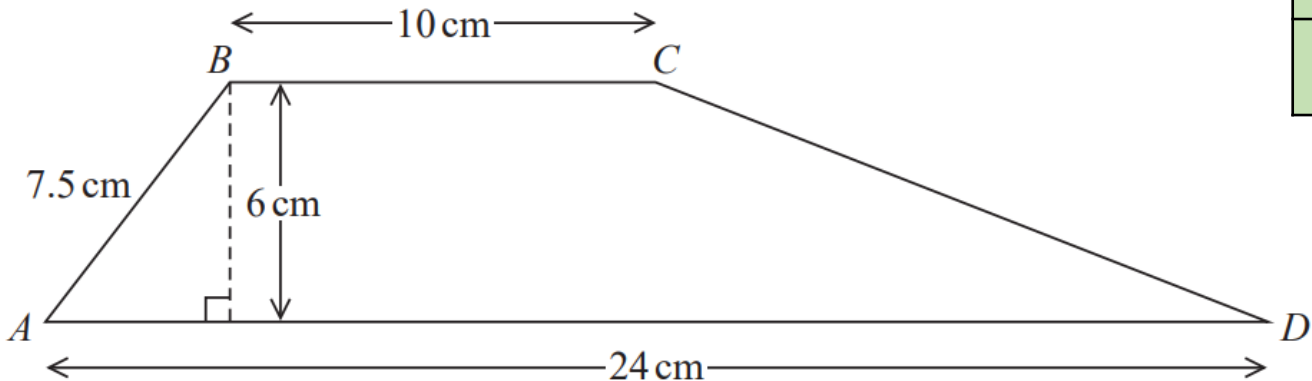


Geometry & Measures
Trigonometry
<i>SOH CAH TOA, problem solving</i>

6	17.3	P1	for full process to find either angle eg $(180 - 90) \div (2+3) \times 2 (=36)$ or for 36 or 54 seen as an angle	May be seen on diagram Condone correct values if incorrectly placed.
		P1	for a correct equation using trigonometry eg $\cos [A] = 14 \div AB$	This must be shown as an equation with all four elements (eg $\cos, [A], 14, AB$) present. [A] could be 36 or any angle clearly and unambiguously identified as A. This also applies to [B] with Sine.
		P1	(dep previous P mark) for rearranging their trigonometry equation to make AB the subject eg $(AB =) "14 \div \cos 36"$	
		A1	for an answer in the range 17.3 to 17.4	If an answer is shown in the range in working and then incorrectly rounded award full marks.



7 $ABCD$ is a trapezium.



Work out the size of angle CDA .
 Give your answer correct to 1 decimal place.

Geometry & Measures
Trigonometry
<i>SOH CAH TOA, problem solving</i>

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Video Solutions](#)

(5 marks)

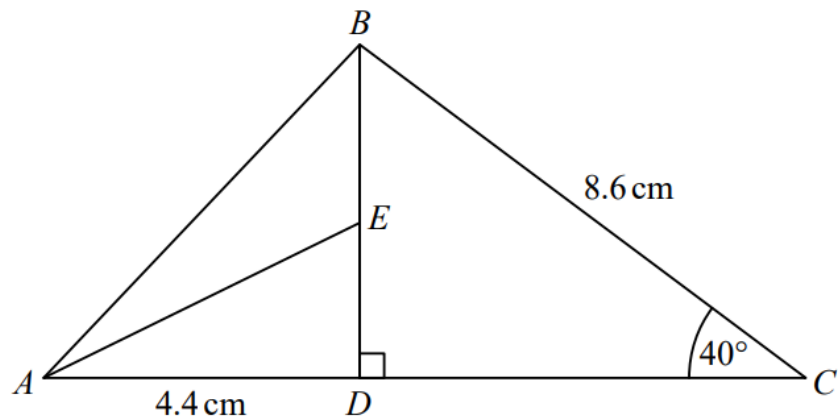


Geometry & Measures
Trigonometry
SOH CAH TOA, problem solving

7		32.3	P1 for using Pythagoras to find length of third side of triangle, eg $7.5^2 - 6^2$ or $6^2 + x^2 = 7.5^2$ or uses trigonometry to find angle in triangle, eg $\sin A = \frac{6}{7.5}$ or $\cos B = \frac{6}{7.5}$ P1 (dep P1) for complete process to find length of third side of triangle eg $\sqrt{7.5^2 - 6^2}$ or $\sqrt{56.25 - 36}$ or $\sqrt{20.25}$ (= 4.5) or uses trigonometry to find base length of triangle, eg $7.5 \times \cos "A"$ or $7.5 \times \sin "B"$ or $\frac{6}{\tan "A"}$ P1 (dep P2) for $24 - 10 - "4.5"$ (= 9.5) P1 (indep) for process to find angle CDA, eg $\tan CDA = \frac{6}{\text{base}}$ from right- angled triangle A1 for answer in the range 32.2 to 32.3
---	--	------	---



12 The diagram shows triangle ABC .



ADC and DEB are straight lines.

$$AD = 4.4 \text{ cm}$$

$$BC = 8.6 \text{ cm}$$

E is the midpoint of DB .

$$\text{Angle } CDB = 90^\circ$$

$$\text{Angle } DCB = 40^\circ$$

Work out the size of angle EAD .

Give your answer correct to 1 decimal place.

You must show all your working.

Geometry &
Measures

Trigonometry

SOH CAH TOA,
problem solving

 **Video Solutions**

(4 marks)

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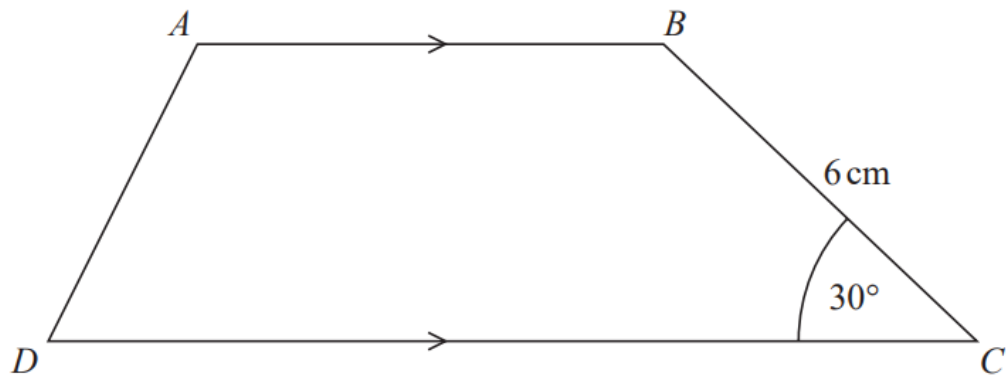
HOME

 **Video Solutions**



November 2021 Paper 1H (Non-Calc)

18 Here is trapezium $ABCD$.



The area of the trapezium is 66 cm^2

the length of AB :the length of $CD = 2:3$

Find the length of AB .

Geometry &
Measures

Trigonometry

*SOH CAH TOA,
problem solving,
exact values*

 **Video Solutions**

(5 marks)

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HOME

18

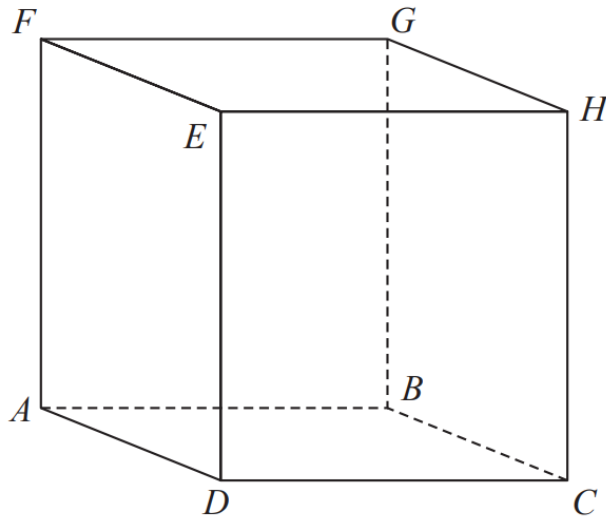
17.6

- P1 for correct trig statement, eg $\sin 30 = \frac{h}{6}$
- P1 for complete process to find h , eg $6 \times \frac{1}{2} (= 3)$
- P1 for correct substitution into the area of a trapezium formula,
eg $\frac{1}{2}(a+b) \times "3" = 66$ **or** $a+b = 44$
or $\frac{1}{2}(2x+3x) \times h = 66$
- P1 for complete correct process to find the length of AB ,
eg $\left[\frac{66 \times 2}{3} \div (2 + "3") \right] \times 2$
- A1 cao

An answer of $\frac{88}{5}$ gets P4 A0

Summer 2018 Paper 2H (Calc)

18 $ABCDEFGH$ is a cuboid.



$AB = 7.3\text{ cm}$
 $CH = 8.1\text{ cm}$
Angle $BCA = 48^\circ$

Find the size of the angle between AH and the plane $ABCD$.
Give your answer correct to 1 decimal place.

Geometry & Measures
Trigonometry
SOH CAH TOA, 3D problem solving



 **Video Solutions**

(4 marks)



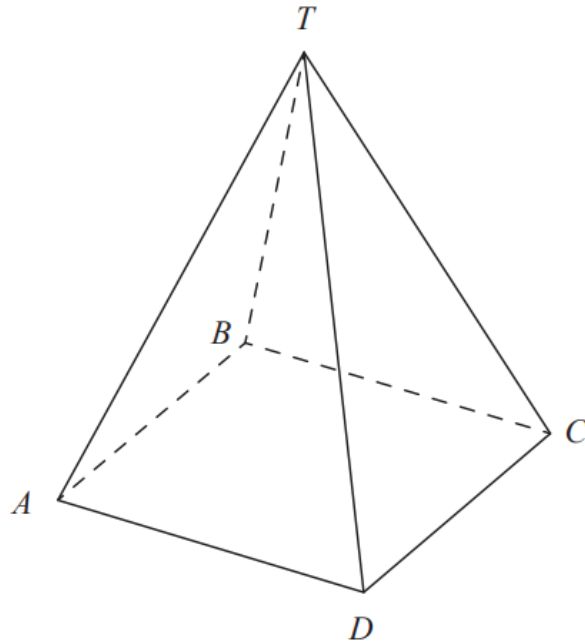
Geometry & Measures
Trigonometry
SOH CAH TOA, 3D problem solving

18	39.5	P1	for a start to a process eg, for a correct trigonometric statement, $\text{eg } \sin 48 = \frac{7.3}{AC} \text{ or } \cos 42 = \frac{7.3}{AC} \text{ or } \frac{AC}{\sin 90} = \frac{7.3}{\sin 48}$ OR angle <i>CAH</i> unambiguously identified on a diagram	Must include correct values
		P1	for a complete correct process to find <i>AC</i> , $\text{eg } (AC =) \frac{7.3}{\sin(48)} (=9.8..) \text{ or } (AC =) \frac{7.3}{\cos(42)} (=9.8..)$ or $(AC =) \sin 90 \times \frac{7.3}{\sin 48} (=9.8..)$	
		P1	for a correct statement using angle <i>CAH</i> , $\text{eg } \tan(CAH) = \frac{8.1}{\text{"9.8..."}}$ OR $\sqrt{8.1^2 + \text{"9.8"}^2} (=12.7...) \text{ and } \frac{\sin CAH}{8.1} = \frac{\sin 90}{\text{"12.7"}}$	
		A1	for answer in the range 39.5 – 39.51	If an answer is given in the range but then incorrectly rounded award full marks.



November 2018 Paper 3H (Calc)

12 Here is a pyramid with a square base $ABCD$.



$$AB = 5 \text{ m}$$

The vertex T is 12 m vertically above the midpoint of AC .

Calculate the size of angle TAC .

Geometry &
Measures

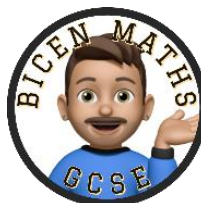
Trigonometry

*SOH CAH TOA,
3D problem solving*

 **Video Solutions**

(4 marks)

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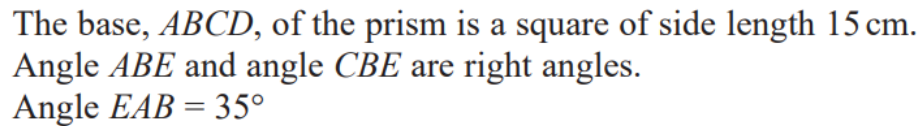


HOME

12	73.6	P1	for correct initial use of Pythagoras eg $5^2 + 5^2 (=50)$ or a trigonometric ratio in the form $\frac{5 \div 2}{0.5AC} = \sin 45$ oe	
		P1	for finding the length of half of the diagonal eg $\sqrt{50} \div 2 (=3.5...)$ or $0.5AC = \frac{5 \div 2}{\sin 45} (=3.5...)$ oe	do not accept $\sqrt{20} \div 2$
		P1	for process to use tan eg $\tan TAC = (12 \div "3.5..") (=3.3..)$ or complete alternative method arriving at an equation with the subject as $\sin TAC$ or $\cos TAC$	
		A1	for an answer in the range 73.58 to 74.1	



Geometry & Measures
Trigonometry
<i>SOH CAH TOA, 3D problem solving</i>


$$DM:MA = 2:3$$

Calculate the size of the angle between EM and the base of the prism.
Give your answer correct to 1 decimal place.

 **Video Solutions**

(4 marks)

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19

31.0

P1

for $\tan 35 = BE \div 15$ or $BE = 10.5(0\dots)$
OR finding the length $DM = \frac{2}{5} \times 15 (= 6)$ or $MA = \frac{3}{5} \times 15 (= 9)$ or 6:9
OR showing the required angle on a diagram eg with an arc

P1

for $MB = \sqrt{15^2 + "9" ^2}$ or $\sqrt{306}$ or 17.4(9....)
OR $ME = \sqrt{"9" ^2 + "18.3(1 \dots)" ^2}$ or $\sqrt{416. (3 \dots)}$ or 20.4(0...)

P1

for using appropriate trigonometry ratio to set up an equation in angle
 EMB eg $\tan \theta = "10.5(0\dots)" \div "17.4(9\dots)"$
or $\cos \theta = "17.4(9\dots)" \div "20.4(0\dots)"$
or $\sin \theta = "10.5(0\dots)" \div "20.4(0\dots)"$

A1

for answer in the range 30.9 to 31

$MB = \sqrt{9^2 + 15^2} = \sqrt{306} (=17.4(9\dots))$ or 17.5
 $BE = 15 \times \tan 35 (=10.5(0\dots))$
 $AE = 15 \div \cos 35 (=18.3(1\dots))$
 $ME = \sqrt{9^2 + 18.31\dots^2} = \sqrt{416. (3 \dots)}$
(=20.4(0...))

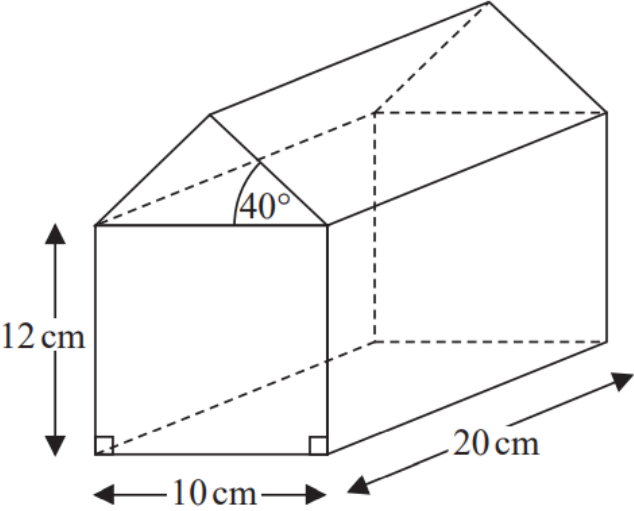
Check diagram for working

If an answer is shown in the range in working
and then incorrectly rounded award full marks.



Summer 2020 Paper 3H (Calc)

9 The diagram shows a prism.



The cross section of the prism has exactly one line of symmetry.

Work out the volume of the prism.
Give your answer correct to 3 significant figures.

Geometry & Measures
Trigonometry
SOH CAH TOA, Volume of a Prism

 **Video Solutions**

(5 marks)



Geometry & Measures
Trigonometry
SOH CAH TOA, Volume of a Prism

9

2820

P1

for start to process to find height of triangle,
eg $\tan(40) = \frac{h}{5}$ oe
or equivalent process to find the height of the triangle
or start to process to find slant height, eg $\frac{10}{\sin 100} = \frac{x}{\sin 40}$

P1

for complete process to find height of triangle, eg $5 \tan 40$ (= 4.19...)
or complete process to find the slant height, eg $\frac{10}{\sin 100} \times \sin 40$ (= 6.5...)

P1

for start of process to find volume of prism,
eg $10 \times 20 \times 12$ (= 2400) or $0.5 \times 10 \times "4.19..." \times 20$ (= 419....)
or $\frac{1}{2} \times 10 \times "6.52..." \times \sin 40 \times 20$ (419....)
or process to find total area of cross section,
eg $0.5 \times 10 \times "4.19..." + 10 \times 12$ (= 140.9...)
or $\frac{1}{2} \times "6.52..." \times "6.52..." \times \sin 100 + 10 \times 12$ (= 140.9...)

P1

for complete process to find total volume,
eg $(0.5 \times 10 \times "4.19..." + 10 \times 12) \times 20$

A1

for an answer in the range 2810 to 2820

Accept 4.2

$10 \times 20 \times 12$ may be seen as part of a calculation to find the volume of the prism

If an answer is given in the range in working and then rounded incorrectly award full marks.



- 14 Find the exact value of $\tan 30^\circ \times \sin 60^\circ$
Give your answer in its simplest form.

 **Video Solutions**

(2 marks)

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Geometry & Measures
Trigonometry
<i>Exact trig values</i>

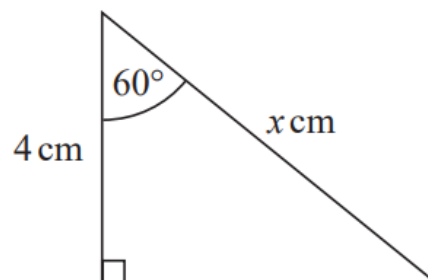
14	$\frac{1}{2}$	M1	for $\frac{1}{\sqrt{3}} \times \frac{\sqrt{3}}{2}$ or $\frac{\sqrt{3}}{3} \times \frac{\sqrt{3}}{2}$ or $(\frac{1}{2} \div \frac{\sqrt{3}}{2}) \times \frac{\sqrt{3}}{2}$ OR $\tan 30 = \frac{1}{\sqrt{3}}$ oe or $\sin 60 = \frac{\sqrt{3}}{2}$
		A1	for $\frac{1}{2}$ or 0.5



8 (a) Write down the exact value of $\tan 45^\circ$

(1 mark)

Here is a right-angled triangle.



$$\cos 60^\circ = 0.5$$

(b) Work out the value of x .

 **Video Solutions**

(2 marks)



Geometry & Measures
Trigonometry
SOH CAH TOA, exact values

8	(a)	1	B1	cao	
	(b)	8	M1	starts process, eg $\cos(60) = \frac{4}{x}$ or $0.5 = \frac{4}{x}$ oe or $\sin 30 = \frac{4}{x}$	All three elements of cos, 4, x must be present in an equation. eg $\cos = 4/x$ is acceptable but $\cos(4/x)$ is insufficient
			A1	or $\frac{\sin 30}{4} = \frac{\sin 90}{x}$ oe cao	



Geometry & Measures
Trigonometry
<i>Exact trig values</i>

20 The table shows some values of x and y that satisfy the equation $y = a \cos x^\circ + b$

x	0	30	60	90	120	150	180
y	3	$1 + \sqrt{3}$	2	1	0	$1 - \sqrt{3}$	-1

Find the value of y when $x = 45$

 **Video Solutions**

(4 marks)



Geometry & Measures
Trigonometry
<i>Exact trig values</i>

20		$1+\sqrt{2}$	B1	for a value for a known trigonometric ratio stated
			P1	for process to form 2 equations in a and b or one correct value stated
			P1	for complete process to solve to reach $a = 2$ and $b = 1$
			A1	for $1+\sqrt{2}$ oe



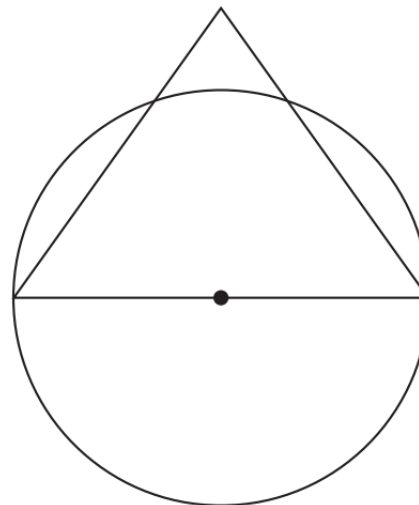
$$\frac{1}{2}ab\sin C$$

- 13 The diagram shows a circle and an equilateral triangle.

One side of the equilateral triangle is a diameter of the circle.
The circle has a circumference of 44 cm.

Work out the area of the triangle.

Give your answer correct to 3 significant figures.



 **Video Solutions**

(3 marks)

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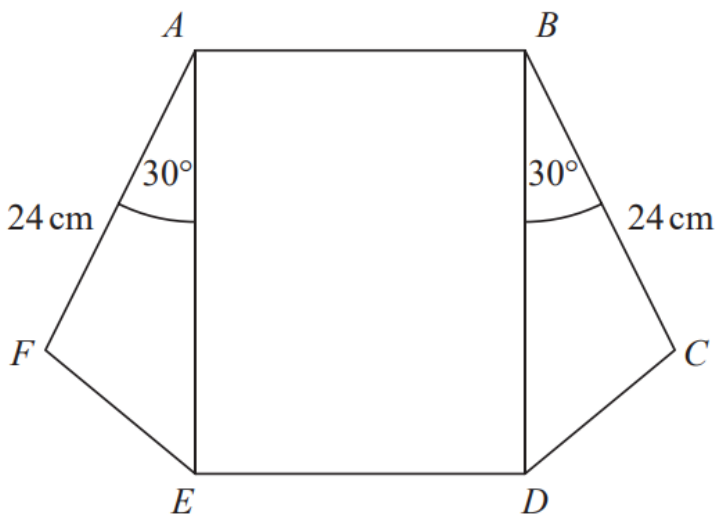


HOME

13	84.9	P1	shows a process to find the radius or diameter eg $44 = 2 \times \pi \times r$ or $r = \frac{22}{\pi}$ or $d = \frac{44}{\pi}$ or $r = 7.0028$ or $d = 14.0056..$	Allow r in the range 7 to 7.1 and d in the range 14 to 14.1 Could be shown on the diagram.
		P1	(dep on P1) complete method to find the area eg $\frac{1}{2} \times "d" \times \sin 60$ oe, $\frac{1}{2} \times 14 \times \tan 60$ oe, $\frac{1}{2} \times 14 \times \sqrt{14^2 - 7^2}$ oe	
		A1	for answer in the range 84.8 to 85	If the correct answer in the range is given in working and then rounded incorrectly award full marks.

Geometry & Measures
Trigonometry
$\frac{1}{2}ab\sin C$

14 The diagram shows a rectangle, $ABDE$, and two congruent triangles, AFE and BCD .



area of rectangle $ABDE$ = area of triangle AFE + area of triangle BCD

$AB : AE = 1 : 3$

Work out the length of AE .

▶ **Video Solutions**

(4 marks)

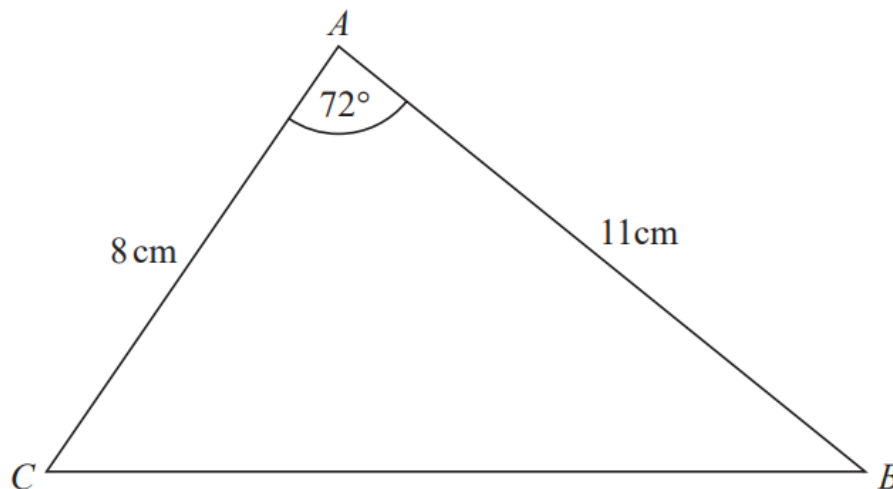


Geometry & Measures
Trigonometry
$\frac{1}{2}ab\sin C$

14	36	P1	for process to find an expression for the area of triangle eg $\frac{1}{2} \times 24 \times AE \times \sin 30 (= 6AE)$	Accept any correct expression, eg $\frac{1}{2} \times 24 \times y \times \sin 30$
		P1	(dep P1) for process to link the area of rectangle with the area of the triangle eg $2 \times \frac{1}{2} \times 24 \times AE \times \sin 30 (= 12AE)$ or for $AB = 12$	
		P1	(indep) for use of given ratio eg $AE = 3AB$ oe, eg area of rectangle = $AE \times AB = 3x \times x$	May be shown on the diagram by labelling AE and AB with, for example, $3x, x$ or $x, \frac{1}{3}x$ or $\frac{3}{4}x, \frac{1}{4}x$ Do not accept $3, 1$ or $1, \frac{1}{3}$ or $\frac{3}{4}, \frac{1}{4}$ for this mark.
		A1	cao	



15 Here is triangle ABC .



(b) Find the area of triangle ABC .

Give your answer correct to 3 significant figures.

 **Video Solutions**

(2 marks)

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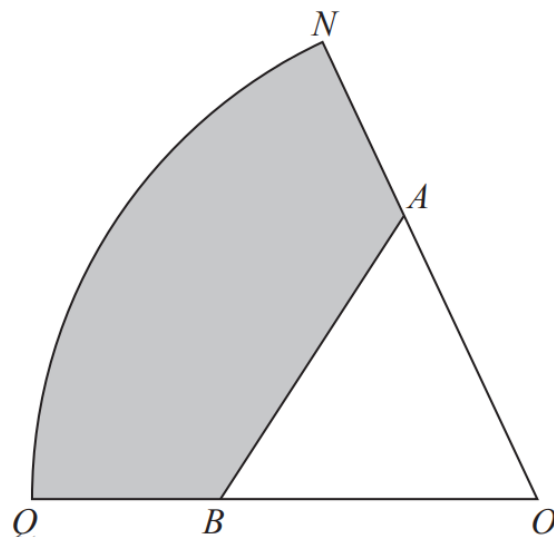
HOME

Geometry & Measures
Trigonometry
$\frac{1}{2}ab\sin C$

(b)	41.8	M1	for $0.5 \times 8 \times 11 \times \sin 72 (= 41.8\dots)$
		A1	for answer in the range 41.5 to 41.9

 **Video Solutions**





ONQ is a sector of a circle with centre O and radius 11 cm.

A is the point on ON and B is the point on OQ such that AOB is an equilateral triangle of side 7 cm.

Calculate the area of the shaded region as a percentage of the area of the sector ONQ .
Give your answer correct to 1 decimal place.

Geometry &
Measures

Trigonometry

$\frac{1}{2}ab\sin C$, Sectors

 **Video Solutions**

(5 marks)

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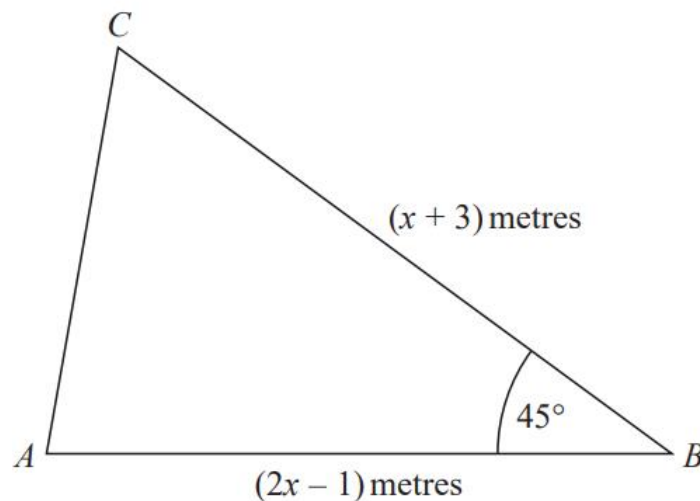


HOME

Geometry & Measures
Trigonometry
$\frac{1}{2}ab\sin C$, Sectors

17		66.5	B1 P1 P1 P1 A1	for recognising an angle of 60 at AOB for a process to find the area of the sector, e.g. $\frac{60}{360} \times \pi \times 11^2$ (= 63.3.. or $\frac{121\pi}{6}$) for a process to find the area of the triangle, e.g. $\frac{1}{2} \times 7^2 \times \sin 60$ (=21.2.. or $\frac{49\sqrt{3}}{4}$) for a process to find the required percentage, eg. $\frac{63.3.. - 21.2..}{63.3..} \times 100$ for answer in the range 66.5 to 66.6
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The area of triangle ABC is $6\sqrt{2} \text{ m}^2$.

Calculate the value of x .

Give your answer correct to 3 significant figures.

Geometry &
Measures

Trigonometry

$\frac{1}{2}ab\sin C$, Quadratic
Equations

 **Video Solutions**

(5 marks)

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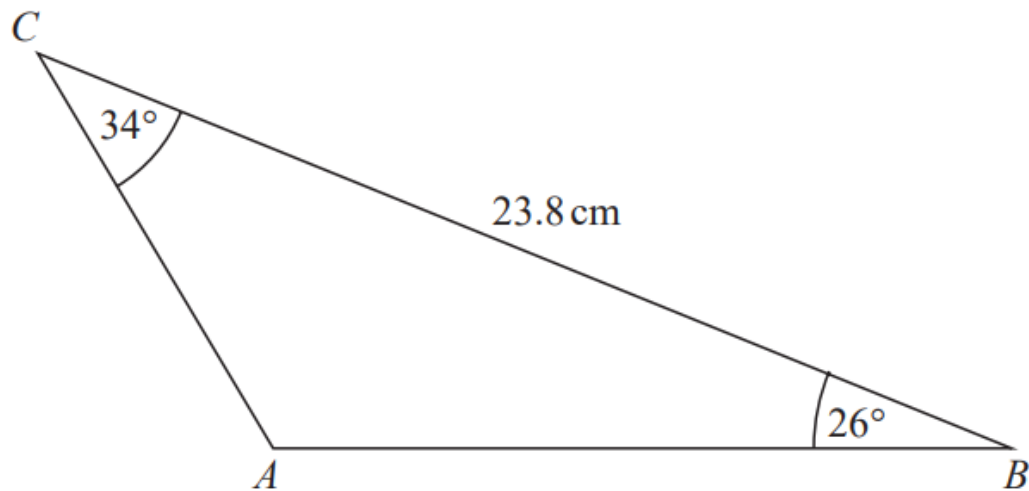
HOME

Geometry & Measures
Trigonometry
$\frac{1}{2}ab\sin C$, Quadratic Equations

15		2.63	P1	for setting up the expression $\frac{1}{2}(x + 3)(2x - 1) \sin 45$ (may be seen in an equation)
			P1	(dep) for expanding the brackets in the expression or for the equation $\frac{1}{2}(x + 3)(2x - 1) \sin 45 = 6\sqrt{2}$ oe
			P1	(dep) for the process to set up the equation and rearrange to the form $ax^2 + bx + c = d$ e.g. to $2x^2 + 5x - 27 = 0$ or $24 = 2x^2 + 5x - 3$
			P1	(dep) for substitution into the quadratic formula e.g. $\frac{-5 \pm \sqrt{5^2 - 4 \times 2 \times -27}}{4}$
			A1	for 2.63(10436...)



13 Here is triangle ABC .



Work out the length of AB .
Give your answer correct to 1 decimal place.

Geometry & Measures
Trigonometry
Sine Rule

 **Video Solutions**

(3 marks)



Geometry & Measures
Trigonometry
<i>Sine Rule</i>

13

15.4

M1

for $\frac{AB}{\sin 34} = \frac{23.8}{\sin 120}$ or $\frac{\sin 34}{AB} = \frac{\sin 120}{23.8}$

M1

for $(AB =) \frac{23.8}{\sin 120} \times \sin 34$

A1

for answer in range 15.36 to 15.4

“120” comes from $180 - 26 - 34$

If an answer in the range 15.36 to 15.4 is given in the working space then incorrectly rounded, award full marks

 **Video Solutions**

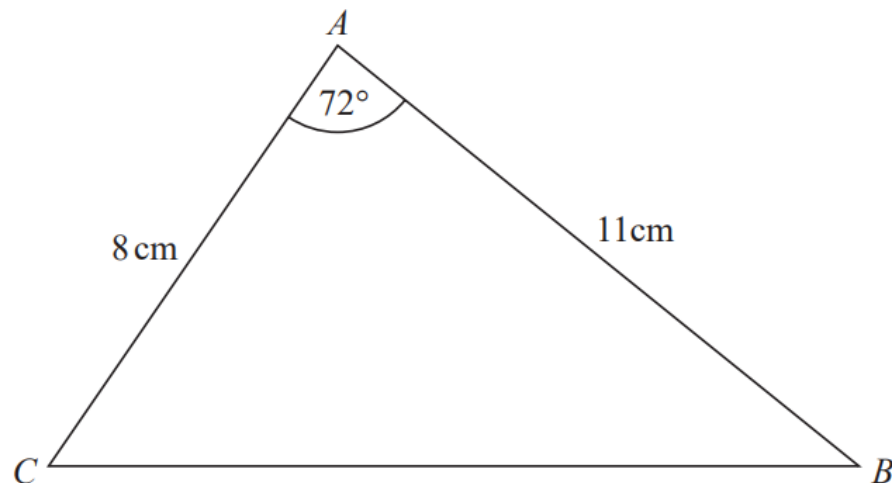
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HOME

November 2021 Paper 2H (Calc)

15 Here is triangle ABC .



- (a) Find the length of BC .
Give your answer correct to 3 significant figures.

Geometry &
Measures

Trigonometry

Cosine Rule

 **Video Solutions**

(3 marks)

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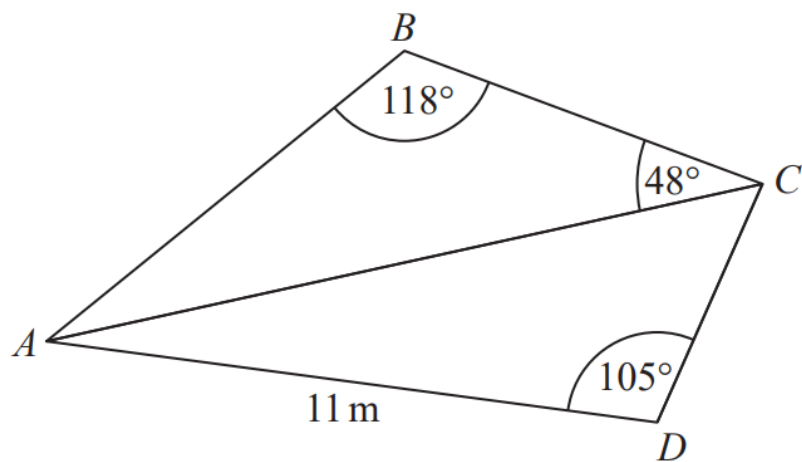
HOME

Geometry & Measures
Trigonometry
<i>Cosine Rule</i>

15	(a)	11.4	M1	for start to method to find the length of BC eg. $8^2 + 11^2 - 2 \times 8 \times 11 \times \cos 72$
			M1	(dep on M1) for method to use correct order of operations, eg. $64 + 121 - 54.38..... (= 130.61...)$
			A1	for answer in the range 11.4 to 11.5



17 ABC and ADC are triangles.



The area of triangle ADC is 56 m^2

Work out the length of AB .
Give your answer correct to 1 decimal place.

Geometry & Measures
Trigonometry
$\frac{1}{2}ab\sin C$, Sine Rule, Cosine Rule

▶ **Video Solutions**

(5 marks)



Geometry & Measures
Trigonometry
$\frac{1}{2}ab\sin C$, Sine Rule, Cosine Rule

17

14.4

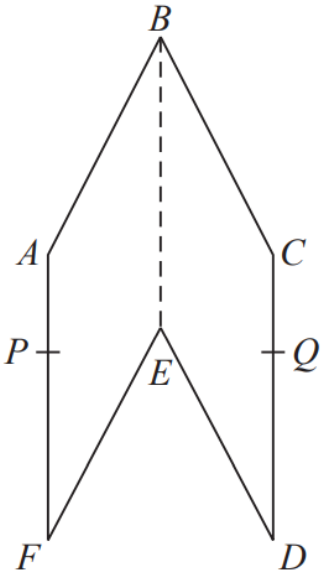
- | | |
|----|---|
| P1 | for start of process, eg $0.5 \times 11 \times CD \times \sin 105 = 56$ |
| P1 | for complete process to find CD , eg $(CD =) \frac{56}{0.5 \times 11 \times \sin 105}$ oe (= 10.54) |
| P1 | for process to find AC , eg $(AC^2 =) 11^2 + [CD]^2 - 2 \times 11 \times [CD] \times \cos 105$ ($AC = 17.09$) |
| P1 | for process to find AB , eg $\frac{AB}{\sin 48} = \frac{[AC]}{\sin 118}$ |
| A1 | answer in range 14.3 to 14.4 |

 **Video Solutions**



22 The diagram shows a hexagon $ABCDEF$.
 $ABEF$ and $CBED$ are congruent parallelograms where $AB = BC = x$ cm.
 P is the point on AF and Q is the point on CD such that $BP = BQ = 10$ cm.
 Given that angle $ABC = 30^\circ$,
 prove that $\cos PBQ = 1 - \frac{(2 - \sqrt{3})}{200}x^2$

Geometry & Measures
Trigonometry
Cosine Rule, exact trig values, problem solving



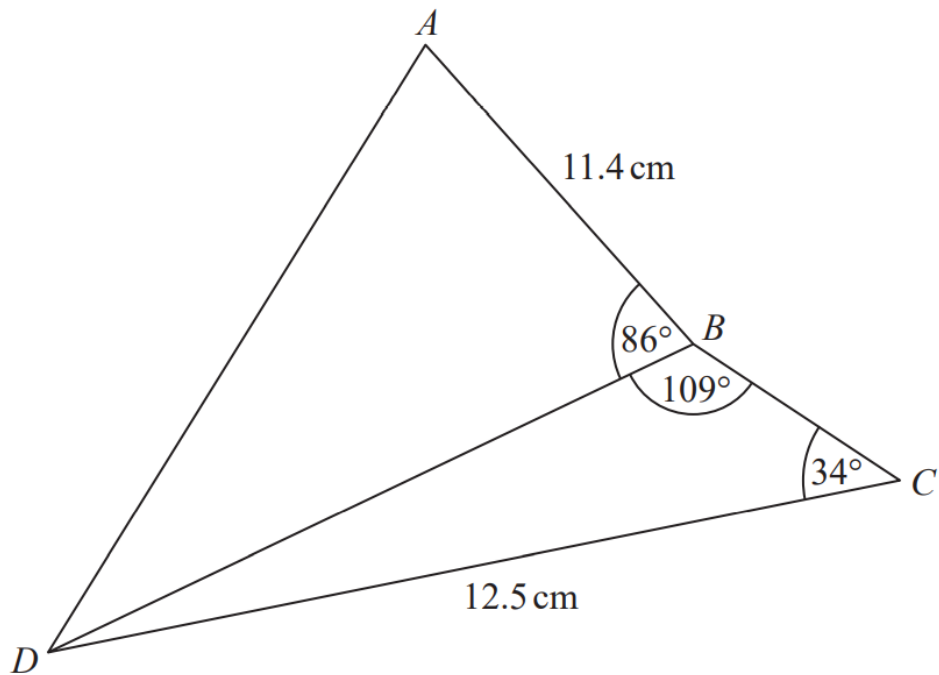
Geometry & Measures
Trigonometry
Cosine Rule, exact trig values, problem solving

22

$\cos PBQ = \frac{10^2 + 10^2 - x^2(2 - \sqrt{3})}{200}$ $= \frac{200 - x^2(2 - \sqrt{3})}{200}$	Proof	B1 (indep) for stating $\cos 30 = \frac{\sqrt{3}}{2}$ M1 for $PQ^2 = 10^2 + 10^2 - 2 \times 10 \times 10 \times \cos PBQ$ or $AC^2 = x^2 + x^2 - 2 \times x \times x \times \cos 30 (=x^2(2-\sqrt{3}))$ oe M1 for $\cos PBQ = \frac{10^2 + 10^2 - PQ^2}{2 \times 10 \times 10}$ (implies previous M1) M1 for $\cos PBQ = \frac{10^2 + 10^2 - (x^2 + x^2 - 2 \times x \times x \times \cos 30)}{2 \times 10 \times 10}$ A1 conclusion of proof with all working seen
--	-------	--



Geometry & Measures
Trigonometry
<i>Cosine Rule & Sine Rule, problem solving</i>



Work out the length of AD .
Give your answer correct to 3 significant figures.

 **Video Solutions**

(5 marks)



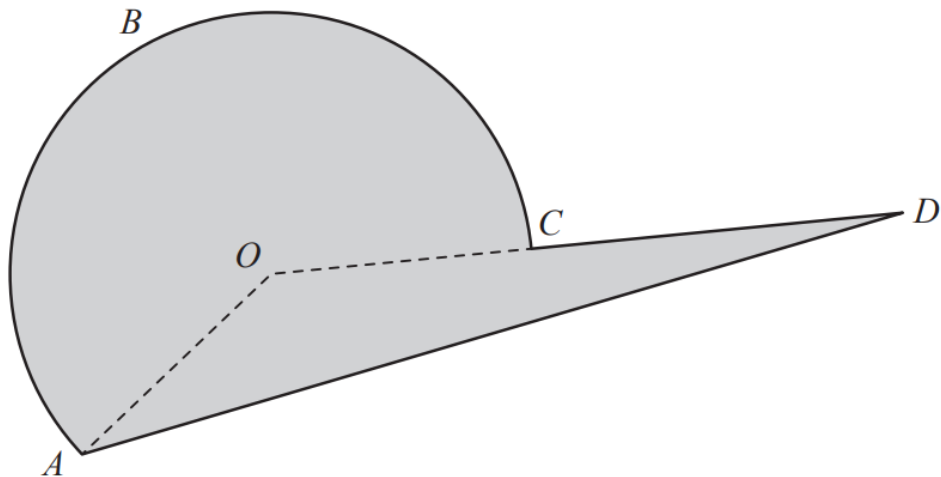
Geometry & Measures
Trigonometry
<i>Cosine Rule & Sine Rule, problem solving</i>

17	13.1	P1	for start of process to find the length of BD , eg $\frac{BD}{\sin 34^\circ} = \frac{12.5}{\sin 109^\circ}$	
		P1	for complete process to find the length of BD , eg $BD = \frac{12.5}{\sin 109^\circ} \times \sin 34^\circ (= 7.39\dots)$	Accept 7.4 for the award of the first two P marks
		P1	for process to find the length of AD , eg $AD^2 = 11.4^2 + "7.39^2" - 2 \times 11.4 \times "7.39" \times \cos 86^\circ$	
		P1	for process to use correct order of operations, eg $129.96 + 54.6(5\dots) - 11.7(5\dots) (= 172.85\dots)$	
		A1	for answer in the range 13.1 to 13.2	If an answer is given within the range and then incorrectly rounded to 3 sig figs award full marks.



November 2018 Paper 3H (Calc)

16 Here is a shaded shape $ABCD$.



The shape is made from a triangle and a sector of a circle, centre O and radius 6 cm.
 OCD is a straight line.

$AD = 14\text{ cm}$

Angle $AOD = 140^\circ$

Angle $OAD = 24^\circ$

Calculate the perimeter of the shape.
Give your answer correct to 3 significant figures.

Geometry &
Measures

Trigonometry

*Cosine Rule &
Sine Rule, problem
solving*



 **Video Solutions**

(5 marks)

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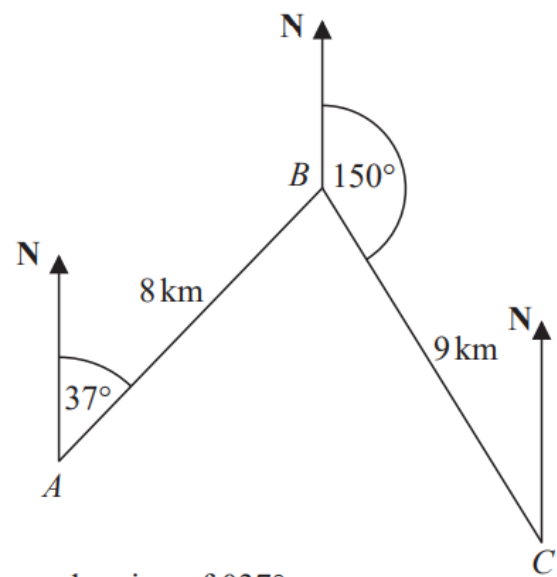
Geometry & Measures
Trigonometry
<i>Cosine Rule & Sine Rule, problem solving</i>

16	39.9	P1	for finding the length of the minor or major arc eg $\frac{220}{360}\pi \times 12$ (= 23(.03834..))	Allow appropriate rounding if calculation seen in parts
		P1	for substituting into the sine or cosine rule to find <i>OD</i> eg $14 \div \sin 140 = OD \div \sin 24$ or ($OD^2 = 6^2 + 14^2 - 2 \times 6 \times 14 \times \cos 24$ (=78.5....))	Must involve <i>OD</i> in the relationship but may be implied
		P1	for a complete process to find the length <i>OD</i> eg $14 \div \sin 140 \times \sin 24$ (=8.8(58778..))	
		P1	for a complete process to find the perimeter eg “23(.03834..)” + 14+ “8.8(58778..)” – 6	May be seen in multiple calculations
		A1	for an answer in the range 39.8 to 40	If an answer in the range is seen in working and then incorrectly rounded award full marks.



Summer 2019 Paper 3H (Calc)

23 The diagram shows the positions of three towns, Acton (A), Barston (B) and Chorlton (C).



Barston is 8 km from Acton on a bearing of 037°
Chorlton is 9 km from Barston on a bearing of 150°

Find the bearing of Chorlton from Acton.
Give your answer correct to 1 decimal place.
You must show all your working.

Geometry & Measures
Trigonometry
<i>Cosine Rule & Sine Rule, problem solving</i>

 **Video Solutions**

(5 marks)

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  **HOME**

23

098.6

P1

for using bearings to determine ABC as 67°

P1

for using the cosine rule to find AC
eg $(AC^2 =) 9^2 + 8^2 - 2 \times 9 \times 8 \times \cos[67]$ oe or $AC = 9.4199\dots$

P1

(dep P1) for using the sine rule to find angle BAC
eg $\frac{9}{\sin BAC} = \frac{9.42}{\sin[67]}$ oe

OR

for using the cosine rule to find angle BAC
eg $9^2 = "9.42" + 8^2 - 2 \times "9.42" \times 8 \times \cos BAC$ oe

P1

for rearranging
eg $\sin BAC = 9 \times \frac{\sin[67]}{9.42}$ oe

OR

eg $\cos BAC = ("9.42" + 8^2 - 9^2) \div (2 \times "9.42" \times 8)$ oe

OR

for angle $BAC = 61.57\dots$

A1

for angle in the range 98.5 to 98.6

Accept 67 written on the diagram.

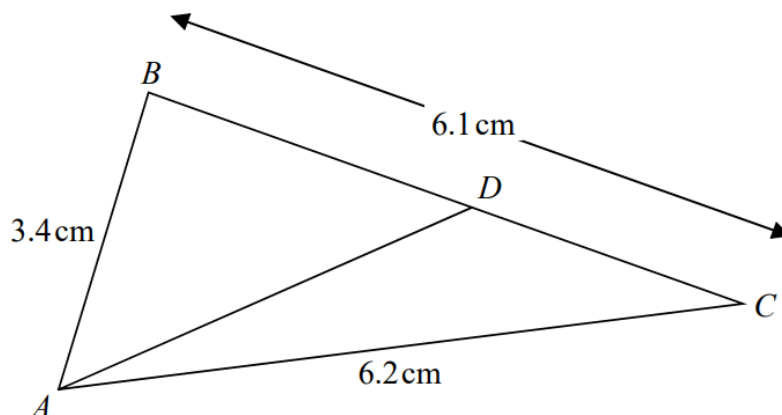
Accept correct substitution into RHS of equation
Accept AC in the range 9.41 to 9.42

Accept any equivalent form with values substituted

If the correct answer is given without supportive evidence award 0 marks.
Condone missing "0" at the front.
If an answer within the range is seen in working and rounded incorrectly award full marks.



18 The diagram shows triangle ABC .



$$AB = 3.4 \text{ cm} \quad AC = 6.2 \text{ cm} \quad BC = 6.1 \text{ cm}$$

D is the point on BC such that

$$\text{size of angle } DAC = \frac{2}{5} \times \text{size of angle } BCA$$

Calculate the length DC .

Give your answer correct to 3 significant figures.

You must show all your working.

 **Video Solutions**

(5 marks)

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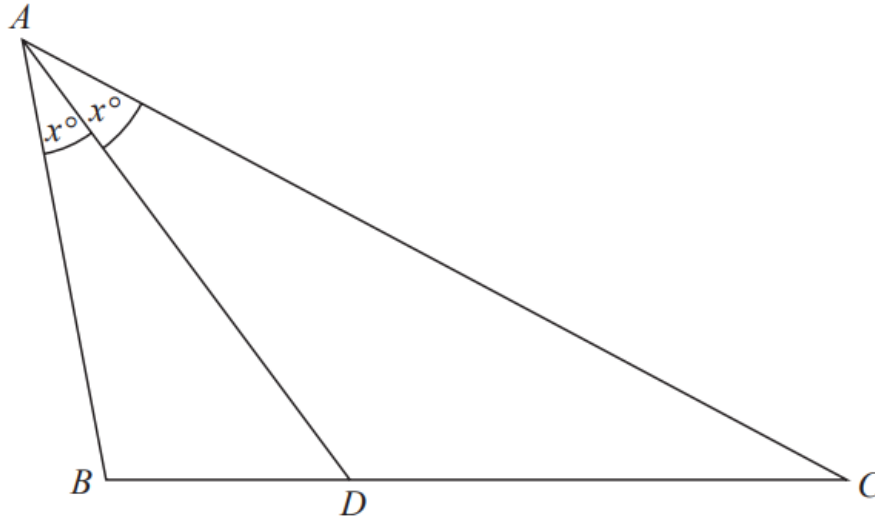
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Geometry & Measures
Trigonometry
Cosine Rule & Sine Rule, problem solving

18	1.95	P1	for correct substitution into the cosine rule, eg $3.4^2 = 6.1^2 + 6.2^2 - 2 \times 6.1 \times 6.2 \times \cos BCA$	Can be any angle within triangle ABC
		P1	for a full process to find BCA eg $(\cos BCA =) \frac{6.1^2 + 6.2^2 - 3.4^2}{2 \times 6.1 \times 6.2}$ or $(BCA =) 32(.08046913...)$	P2 can be awarded for $BCA = 32(.08046913...)$
		P1	correct substitution into the sine rule, eg $\frac{DC}{\sin("32.08..." \times \frac{2}{9})} = \frac{6.2}{\sin(180 - "32.08..." - ("32.08..." \times \frac{2}{9}))}$	
		P1	for complete process to find DC eg $(DC =) \frac{6.2 \times \sin "12.832"}{\sin "135.088"$	
		A1	Answer in the range 1.94 to 1.951	Must not come from incorrect processing



23 ABC is a triangle.



D is the point on BC such that angle $BAD = \text{angle } DAC = x^\circ$

Prove that $\frac{AB}{BD} = \frac{AC}{DC}$

Geometry &
Measures

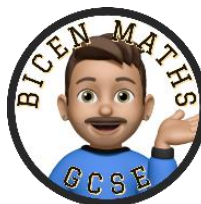
Trigonometry

Sine Rule / $\frac{1}{2}ab\sin C$,
Proof

 **Video Solutions**

(4 marks)

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HOME

23

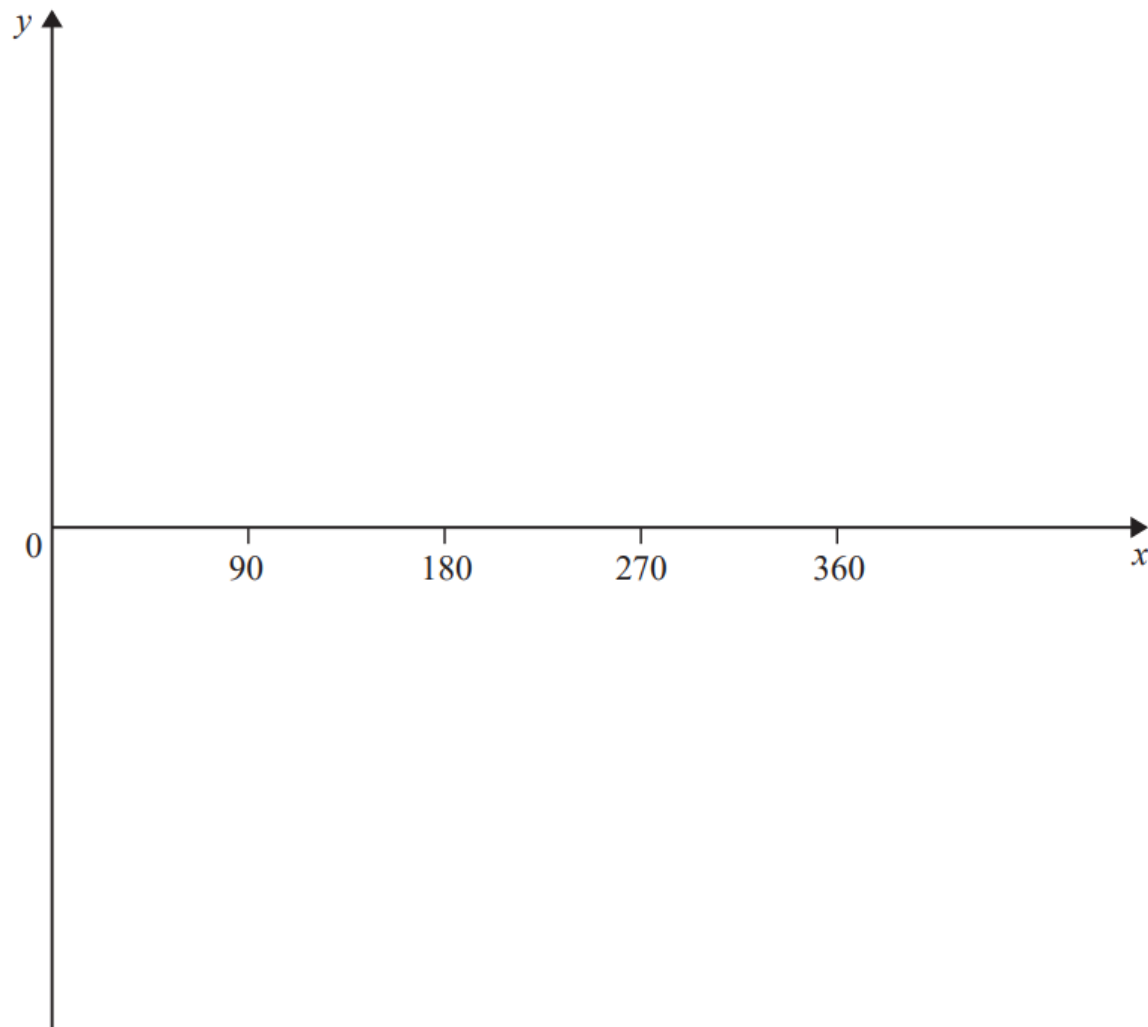
Proof (supported)	M1 for using the sine rule on triangle ABD or on triangle ADC, to involve sides AB, BD, AC, or DC eg $\frac{AB}{\sin ADB} = \frac{BD}{\sin x}$ oe or $\frac{AC}{\sin ADC} = \frac{DC}{\sin x}$ oe OR for an expression for the area of triangle ABD or for the area of triangle ADC eg $\frac{1}{2} AB AD \sin x$ or $\frac{1}{2} AD AC \sin x$ or $\frac{1}{2} h BD$ or $\frac{1}{2} h DC$ M1 for using the sine rule on both triangle ABD and on triangle ADC, to involve sides AB, BD, AC, or DC eg $\frac{AB}{\sin ADB} = \frac{BD}{\sin x}$ oe and $\frac{AC}{\sin ADC} = \frac{DC}{\sin x}$ oe OR for two expressions for the area of either triangle ABD or for triangle ADC eg $\frac{1}{2} AB AD \sin x$ and $\frac{1}{2} h BD$ or $\frac{1}{2} AD AC \sin x$ and $\frac{1}{2} h DC$ M1 for stating or showing $\sin ADB = \sin ADC$, eg $\sin y = \sin (180 - y)$ OR for using two expressions to form an equation eg $\frac{\frac{1}{2} AB AD \sin x}{\frac{1}{2} AD AC \sin x} = \frac{\frac{1}{2} h BD}{\frac{1}{2} h DC}$ oe C1 for a full method to arrive at the given answer
----------------------	---

Accept extra letters eg y shown on diagram for any angle used



November 2018 Paper 3H (Calc)

11 Sketch the graph of $y = \tan x^\circ$ for $0 \leq x \leq 360$



Geometry &
Measures

Trigonometry

*Graphs of trig
functions*

 **Video Solutions**

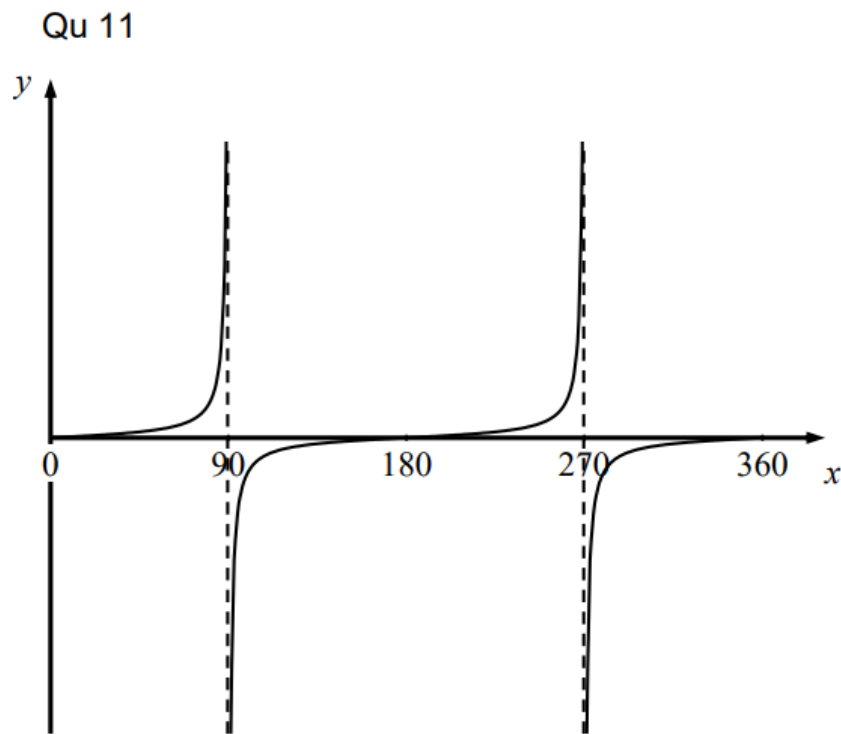
(2 marks)

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Geometry & Measures
Trigonometry
Graphs of trig functions

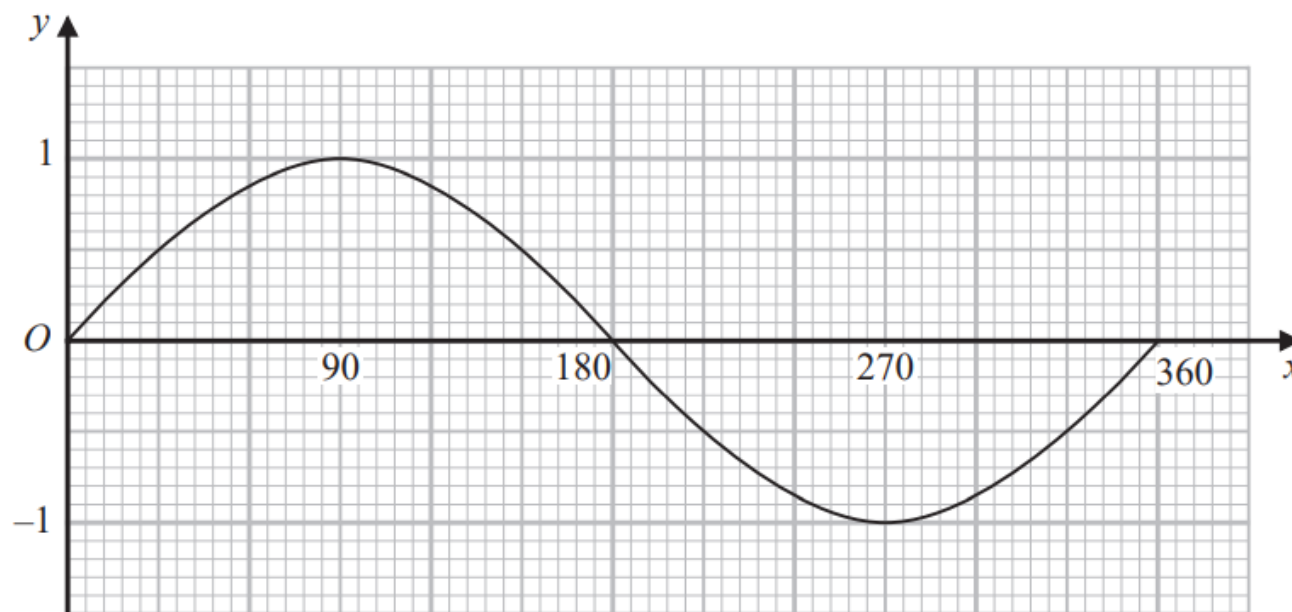


11	Graph drawn	C2	for fully correct sketch between 0° and 360°
		(C1	for a graph with clear asymptotes at 90° and 270° only or the correct graph translated along the x -axis must have a period of 180)

 **Video Solutions**



18 Here is a graph of $y = \sin x^\circ$ for $0 \leq x \leq 360$



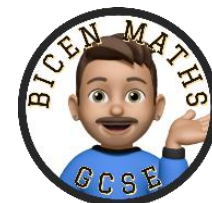
(a) Using this graph, find estimates of all **four** solutions of

$$\sin x^\circ = 0.6 \quad \text{for } 0 \leq x \leq 720$$

 **Video Solutions**

(2 marks)

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HOME

Geometry & Measures
Trigonometry
<i>Graphs of trig functions</i>

18	(a)	37, 143, 397, 503	M1	for any two correct angles within the ranges below or for a correct method to find a solution beyond 360, eg. “angle read from 0 to 360” + 360	Accept given as coordinates for M1 only
			A1	for all 4 angles in the range, 35 to 40, 140 to 145, 395 to 400 and 500 to 505	

 **Video Solutions**

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HOME

Geometry & Measures

Bounds



Geometry & Measures
Bounds
... with proportional reasoning

13 A factory makes 450 pies every day.
The pies are chicken pies or steak pies.

Each day Milo takes a sample of 15 pies to check.

The proportion of the pies in his sample that are chicken is the same as the proportion of the pies made that day that are chicken.

On Monday Milo calculated that he needed exactly 4 chicken pies in his sample.

(a) Work out the total number of chicken pies that were made on Monday.

.....
(2)

On Tuesday, the number of steak pies Milo needs in his sample is 6 correct to the nearest whole number.

Milo takes at random a pie from the 450 pies made on Tuesday.

(b) Work out the lower bound of the probability that the pie is a steak pie.

.....
(2)



Geometry & Measures
Bounds
... with proportional reasoning

13	(a)		120	P1	for $\frac{4 \times 450}{15}$ or $\frac{4}{15} = \frac{x}{450}$ oe
				A1	cao
	(b)		$\frac{165}{450}$	P1	5.5 or 6.5 or 165 or $\frac{5 \times 450}{15}$ (=150) and $\frac{6 \times 450}{15}$ (=180)
				A1	for $\frac{165}{450}$ oe



16 The petrol consumption of a car, in litres per 100 kilometres, is given by the formula

$$\text{Petrol consumption} = \frac{100 \times \text{Number of litres of petrol used}}{\text{Number of kilometres travelled}}$$

Nathan's car travelled 148 kilometres, correct to 3 significant figures.
The car used 11.8 litres of petrol, correct to 3 significant figures.

Nathan says,

“My car used less than 8 litres of petrol per 100 kilometres.”

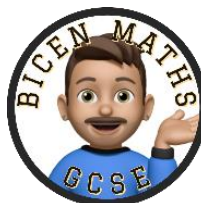
Could Nathan be wrong?

You must show how you get your answer.

 **Video Solutions**

(3 marks)

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HOME

Geometry & Measures
Bounds
... with substitution

16		Yes and correct working	B1 P1 A1	for 147.5 or 148.5 or 148.4999... or 11.75 or 11.85 or 11.84999... substitutes $11.8 < UB \leq 11.85$ and $147.5 \leq LB < 148$ in the formula to work out petrol consumption for 'Yes' and 8.03(3898305...) from correct working
----	--	-------------------------	----------------	---

 **Video Solutions**

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HOME

Geometry & Measures
Bounds
... with substitution

19 $D = \frac{u^2}{2a}$

$u = 26.2$ correct to 3 significant figures

$a = 4.3$ correct to 2 significant figures

- (a) Calculate the upper bound for the value of D .
Give your answer correct to 6 significant figures.
You must show all your working.

(3 marks)

The lower bound for the value of D is 78.6003 correct to 6 significant figures.

- (b) By considering bounds, write down the value of D to a suitable degree of accuracy.
You must give a reason for your answer.

 **Video Solutions**

(2 marks)



Geometry & Measures
Bounds
... with substitution

19	(a)	81.0662	M1	for one of 26.15 or 26.25 or 4.25 or 4.35	Accept 26.249 for 26.25 and 4.349 for 4.35
			M1	for a correct process to find the upper bound for D [UB of u] ² ÷ [2 × LB of a] eg $\frac{26.25^2}{2 \times 4.25}$ where $26.2 < \text{UB of } u \leq 26.25$ and $4.25 \leq \text{LB of } a < 4.3$	
			A1	for answer given in the range 81.0661 to 81.0662 from correct working	
	(b)	80	B1	for 80 ft answer to (a) with 78.6003	Award for $\frac{26.25^2}{4.25}$
			C1	for explanation relating to the upper bound found in (a) Acceptable examples bounds agree when rounded to 80 bounds agree to nearest 10 Not acceptable examples 80 79.83325 rounded to nearest tenth	



20 $d = \frac{1}{8}c^3$

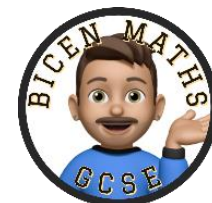
$c = 10.9$ correct to 3 significant figures.

By considering bounds, work out the value of d to a suitable degree of accuracy.
Give a reason for your answer.

 **Video Solutions**

(4 marks)

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HOME

Geometry & Measures
Bounds
... with substitution

20	160 (supported)	B1	stating bound of 10.85 or 10.95	Accept $10.9\dot{4}9$ or 10.9499... for 10.95
		M1	using both UB and LB to work out value of d eg $[\text{UB of } c]^3 \div 8$ and $[\text{LB of } c]^3 \div 8$ or gives a bound of 159.66... from correct working or gives a bound of 164.11... from correct working	$10.9 < \text{UB} \leq 10.98$ $10.85 \leq \text{LB} < 10.9$
		A1	for 159.66... and 164.11... from correct working	Accept bounds rounded or truncated to at least 4 sig fig
		C1	for 160 from 159.66... and 164.11... with a supporting reason eg “since both UB and LB round to 160”	



November 2021 Paper 2H (Calc)

21 The time period, T seconds, of a simple pendulum of length l cm is given by the formula

$$T = 2\pi \sqrt{\frac{l}{g}}$$

Geometry & Measures
Bounds
... with substitution

Katie uses a simple pendulum in an experiment to find an estimate for the value of g .

Here are her results.

$l = 52.0$ correct to 3 significant figures.

$T = 1.45$ correct to 3 significant figures.

Work out the upper bound and the lower bound for the value of g .

Use $\pi = 3.142$

You must show all your working.

upper bound =

lower bound =

 **Video Solutions**

(4 marks)



HOME

Geometry & Measures
Bounds
... with substitution

21	984.(3677853) and 969.(0181643)	B1	stating bound of 51.95 or 52.05 or 1.445 or 1.455	Accept 52.049 or 52.0499... for 52.05 Accept 1.4549 or 1.4549... for 1.455
		P1	for process to rearrange formula to give g as the subject, eg $g = \frac{4\pi^2 l}{T^2}$ oe	Rearrangement may occur after substitution, in this case correct bounds are not needed for this mark
		P1	for process to use LB of l and UB of T in formula for g or T or process to use UB of l and LB of T in formula for g or T eg $\frac{4\pi^2[\text{LB of } l]}{[\text{UB of } T]^2}$ or $\frac{4\pi^2[\text{UB of } l]}{[\text{LB of } T]^2}$	$51.95 \leq [\text{LB of } l] < 52.0$ $1.45 < [\text{UB of } T] \leq 1.455$ $52.0 < [\text{UB of } l] \leq 52.05$ $1.445 \leq [\text{LB of } T] < 1.45$ Rearrangement may not be correct
		A1	for upper bound = 984.(3677853) or 984.(1125639..) and lower bound = 969.(0181643) or 968.(7669227..)	NB: correct answer without supportive working gets 0 marks Accept answers rounded or truncated to 3sf or better



Summer 2018 Paper 2H (Calc)

21 Jackson is trying to find the density, in g/cm^3 , of a block of wood.
The block of wood is in the shape of a cuboid.

He measures
 the length as 13.2 cm, correct to the nearest mm
 the width as 16.0 cm, correct to the nearest mm
 the height as 21.7 cm, correct to the nearest mm

He measures the mass as 1970 g, correct to the nearest 5 g.

By considering bounds, work out the density of the wood.
Give your answer to a suitable degree of accuracy.

You must show all your working and give a reason for your final answer.

Geometry & Measures
Bounds
... with density/mass/volume

 **Video Solutions**

(5 marks)

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  **HOME**

Geometry & Measures
Bounds
... with density/mass/volume

21	0.43	B1 for one correct bound for mass or length eg 1967.5 or 1972.5 or 13.15 or 15.95 or 21.65 or 13.25 or 16.05 or 21.75 P1 for a correct process to find a bound for the volume, eg $13.15 \times 15.95 \times 21.65$ (=454(0.925125)) or $13.25 \times 16.05 \times 21.75$ (=462(5.409375)) P1 for a correct process to find a bound for density, eg [mass LB] $\div$ "462(5.409375)" (=0.425(367755)) where $1965 \leq \text{mass LB} < 1970$ or [mass UB] $\div$ "454(0.925125)" (=0.434(3828506)) where $1970 < \text{mass UB} \leq 1975$ A1 for both correct bounds, 0.425(367755) and 0.434(3828506) C1 (dep on A1) for a correct statement on degree of accuracy e.g. UB and LB both round to 0.43 to 2 decimal places or 2 significant figures	Can work in any units Accept volumes truncated or rounded to at least 3 sig fig Accept densities truncated or rounded to at least 3 sig fig Accept bounds truncated or rounded to at least 3 sig fig At this point correct units must be used Must be 0.43 not 0.4
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Summer 2017 Paper 3H (Calc)

Geometry & Measures
Bounds
... with speed/distance/time

17 A train travelled along a track in 110 minutes, correct to the nearest 5 minutes.

Jake finds out that the track is 270 km long.

He assumes that the track has been measured correct to the nearest 10 km.

(a) Could the average speed of the train have been greater than 160 km/h?

You must show how you get your answer.

(4 marks)

Jake's assumption was wrong.

The track was measured correct to the nearest 5 km.

(b) Explain how this could affect your decision in part (a).

 **Video Solutions**

(1 mark)

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Geometry & Measures
Bounds
... with speed/distance/time

17	(a)	No (supported)	P1 P1 P1 C1	for 265 or 275 or 274.999... or 107.5 or 112.5 or 112.4999... process to find $\frac{d}{t}$ where $270 < d \leq 275$ and $107.5 \leq t < 110$ oe for process to work in consistent units of time eg $\frac{d}{t} \times 60$ or $t \div 60$ where $265 \leq d \leq 275$ and $107.5 \leq t < 110$ oe or $160 \div 60 (= 2.666..)$ Conclusion supported with correct figure(s) given eg No and 153(.488..) or No and 2.66 to 2.7 and 2.5(581..) from correct working
	(b)	Statement	C1	e.g. Less distance in the same time so (max) speed would drop



18 A high speed train travels a distance of 487 km in 3 hours.

The distance is measured correct to the nearest kilometre.

The time is measured correct to the nearest minute.

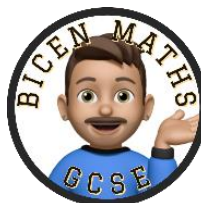
By considering bounds, work out the average speed, in km/minute, of the train to a suitable degree of accuracy.

You must show all your working and give a reason for your answer.

 **Video Solutions**

(5 marks)

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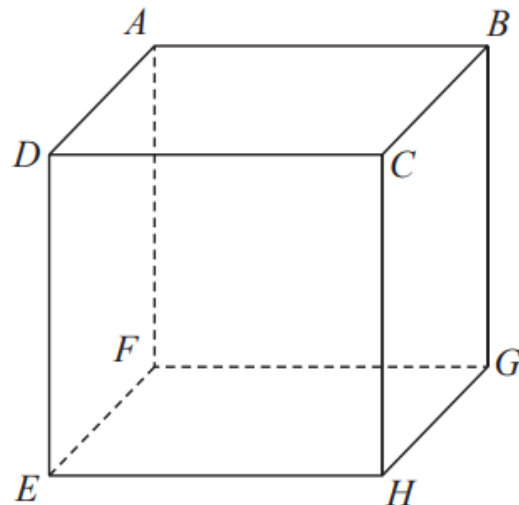
HOME

Geometry & Measures
Bounds
... with speed/distance/time

18	2.7 with statement	B1	for 179.5 or 180.5 or 180.4999...	Accept bounds truncated or rounded to at least 4 sig fig
		B1	for 486.5 or 487.5 or 487.4999...	
		P1	for a correct process to find a bound for average speed, eg [upper bound of distance] ÷ [lower bound of time] where $487 < [\text{UB of distance}] \leq 487.5$ and $179.5 \leq [\text{LB of time}] < 180$ or for [lower bound of distance] ÷ [upper bound of time] where $486.5 \leq [\text{LB of distance}] < 487$ and $180 < [\text{UB of time}] \leq 180.5$	
		A1	(dep on all previous marks) for 2.695(2...) and 2.715(8 ...) with both values clearly coming from working with correct values	
		C1	for 2.7 from 2.695... and 2.715... and statement that both LB and UB round to 2.7	



18 The diagram shows a cube.



$AH = 11.3$ cm correct to the nearest mm.

Calculate the lower bound for the length of an edge of the cube.
You must show all your working.

Geometry & Measures
Bounds
... with 3D Pythagoras

 **Video Solutions**

(4 marks)

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Geometry & Measures
Bounds
... with 3D Pythagoras

18	6.495190528	B1	for 11.25 or 11.35
		M1	use $a^2 + a^2 + a^2$ oe for the square of the length of a diagonal
		M1	for writing an equation to find the length of a side, eg $a^2 + a^2 + a^2 = [\text{LB}]^2$ where $11.25 \leq \text{LB} < 11.3$ oe
		A1	for an answer in the range 6.49 to 6.50

If the answer is given in the range 6.49 to 6.5 without supportive evidence award 0 marks.



Geometry & Measures

Vectors

Column Vectors

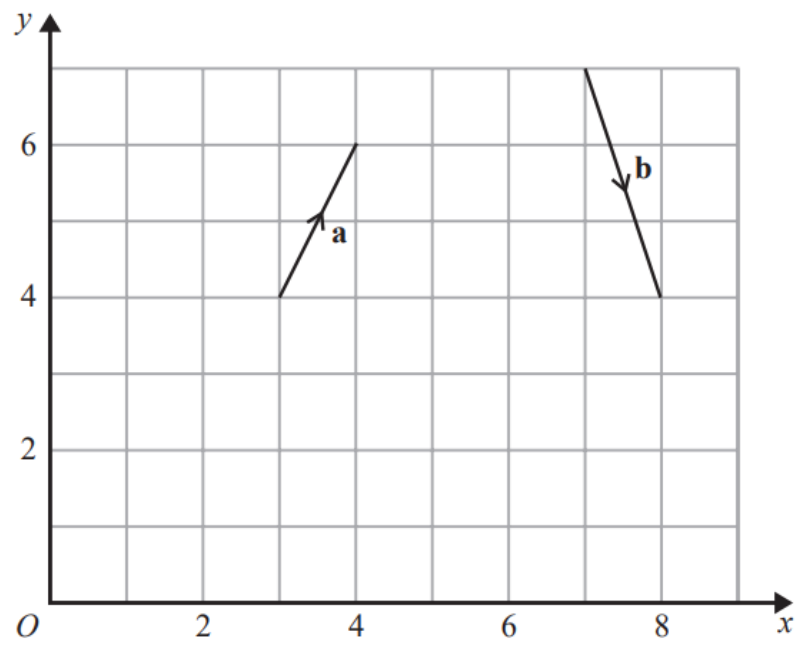
Ratio of Lengths

Problem Solving &
Proof



Summer 2018 Paper 2H (Calc)

10 The vector **a** and the vector **b** are shown on the grid.



Geometry & Measures
Vectors
Column Vectors

(a) On the grid, draw and label vector $-2\mathbf{a}$

(1)

(b) Work out $\mathbf{a} + 2\mathbf{b}$ as a column vector.

$\begin{pmatrix} \\ \\ \end{pmatrix}$
(2)

Video Solutions



Geometry & Measures
Vectors
Column Vectors

10	(a)	Diagram	B1	for correct vector drawn including arrow	May be drawn anywhere on the grid. Condone missing label Accept consistent incorrect notation for M1
	(b)	$\begin{pmatrix} 3 \\ -4 \end{pmatrix}$	M1	for $\mathbf{a} + 2\mathbf{b}$ drawn with resultant vector or for writing $\mathbf{a}$ and $\mathbf{b}$ as column vectors and attempt to add $\mathbf{a} + 2\mathbf{b}$, eg $\begin{pmatrix} 1 \\ 2 \end{pmatrix} + 2 \times \begin{pmatrix} 1 \\ -3 \end{pmatrix}$ or $\begin{pmatrix} 1+2 \\ c \end{pmatrix}$ or $\begin{pmatrix} d \\ 2+-6 \end{pmatrix}$ or $\begin{pmatrix} -4 \\ 3 \end{pmatrix}$	
			A1	cao	



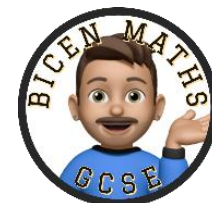
$$6 \quad \mathbf{a} = \begin{pmatrix} 3 \\ 4 \end{pmatrix} \quad \mathbf{b} = \begin{pmatrix} 5 \\ -2 \end{pmatrix}$$

Find $2\mathbf{a} - 3\mathbf{b}$ as a column vector.

 **Video Solutions**

(2 marks)

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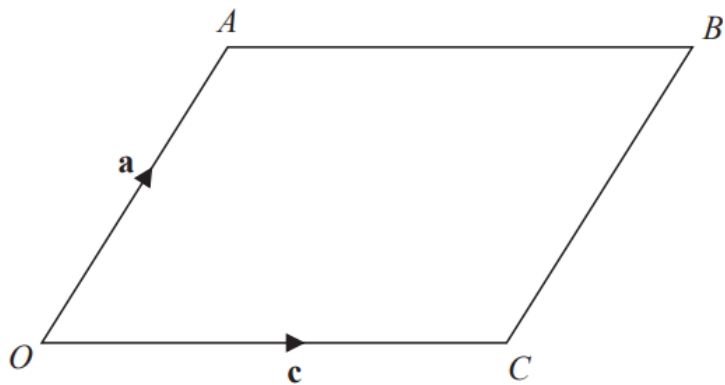
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Geometry & Measures
Vectors
Column Vectors

6	$\begin{pmatrix} -9 \\ 14 \end{pmatrix}$	M1	for $2\begin{pmatrix} 3 \\ 4 \end{pmatrix} - 3\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ or $\begin{pmatrix} 6 \\ 8 \end{pmatrix}$ and $\begin{pmatrix} 15 \\ -6 \end{pmatrix}$ or $\begin{pmatrix} -9 \\ y \end{pmatrix}$ or $\begin{pmatrix} x \\ 14 \end{pmatrix}$	May be seen in two separate calculations eg $2 \times 3 + -3 \times 5$ and $2 \times 4 + -3 \times -2$ Condone incorrect notation if method is clear for this mark only
		A1	cao	



Geometry & Measures
Vectors
Ratio of lengths



$OABC$ is a parallelogram.

$\vec{OA} = \mathbf{a}$ and $\vec{OC} = \mathbf{c}$

X is the midpoint of the line AC .
 OCD is a straight line so that $OC : CD = k : 1$

Given that $\vec{XD} = 3\mathbf{c} - \frac{1}{2}\mathbf{a}$

find the value of k .

 **Video Solutions**

(4 marks)



19

$\frac{2}{5}$

P1

for first step to solve the problem e.g. $\overrightarrow{AC} = -\mathbf{a} + \mathbf{c}$ or $\overrightarrow{OX} = \frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{c}$ or demonstrates the location of D and X on the diagram

P1

for a correct vector statement using $\overrightarrow{CD}$ eg $\overrightarrow{CD} = \overrightarrow{CX} + \overrightarrow{XD}$ or $\overrightarrow{CD} = \overrightarrow{OD} - \overrightarrow{OC}$ or $\overrightarrow{OD} = \frac{7}{2}\mathbf{c}$ or $\overrightarrow{CD} = 2.5\mathbf{c}$ oe

P1

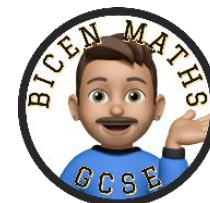
for a correct equation or ratio using k eg equating $\overrightarrow{XD} = 3\mathbf{c} - \frac{1}{2}\mathbf{a} = \frac{1}{2}(-\mathbf{a} + \mathbf{c}) + \frac{1}{k}\mathbf{c}$ or $\frac{\overrightarrow{OD}}{\overrightarrow{OC}} = \frac{k+1}{k}$ or $k = \frac{1}{2.5}$ or using a ratio approach eg $(\overrightarrow{OC} : \overrightarrow{CD}) = k : 1 = 1 : 2.5$

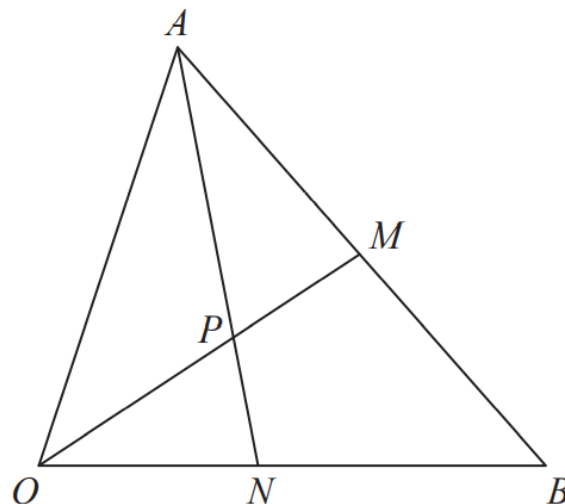
A1

cao



Video Solutions





OAB is a triangle.

OPM and APN are straight lines.

M is the midpoint of AB .

$$\vec{OA} = \mathbf{a} \quad \vec{OB} = \mathbf{b}$$

$$OP:PM = 3:2$$

Work out the ratio $ON:NB$

 **Video Solutions**

(5 marks)

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HOME

21	3 : 4	P1	starts process eg $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$ oe	Formal geometric reasoning relating to congruent and similar triangles is not required
		P1	for process to find $\overrightarrow{OM} = \mathbf{a} + \frac{1}{2} "(\mathbf{b} - \mathbf{a})" \text{ oe } (= \frac{1}{2}(\mathbf{a} + \mathbf{b}))$	
		P1	for process to find $\overrightarrow{AP} = -\mathbf{a} + \frac{3}{5} "(\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b})" \text{ oe }$ or (indep) for $\overrightarrow{AN} = -\mathbf{a} + "k"\mathbf{b}$	
		P1	process to find "k" using $\overrightarrow{AN} = -\mathbf{a} + "k"\mathbf{b}$ as a multiple of $\overrightarrow{AP}$	
		A1	cao	
		P1	ALTERNATIVE for producing OM to C such that AC is parallel to OB	
		P1	for process to show that $MC = OM$, using congruent triangles ACM and BOM	
		P1	for process to find PC as a multiple of $OM/5$ ($= 7OM/5$)	
		P1	for process to find ON as a multiple of $AC(OB)$ ($= 3OB/7$) using similar triangles ACP and NOP	
		A1	cao	



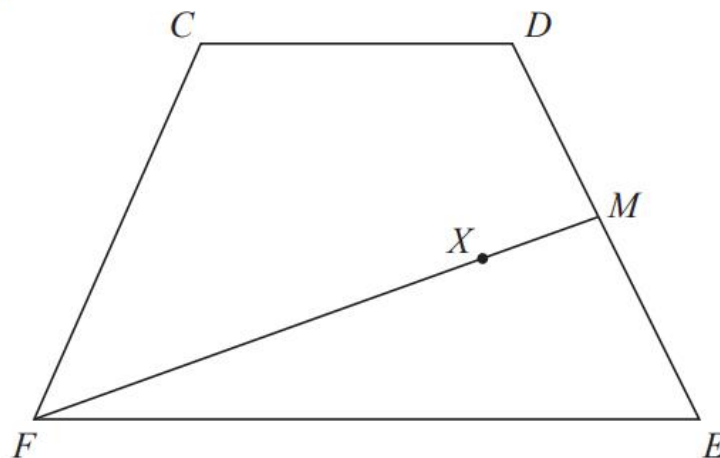
Summer 2019 Paper 2H (Calc)

Geometry &
Measures

Vectors

Ratio of lengths

20 $CDEF$ is a quadrilateral.



$$\vec{CD} = \mathbf{a}, \vec{DE} = \mathbf{b} \text{ and } \vec{FC} = \mathbf{a} - \mathbf{b}.$$

- (a) Express $\vec{FE}$ in terms of $\mathbf{a}$ and/or $\mathbf{b}$.
Give your answer in its simplest form.

(2 marks)

M is the midpoint of DE .

X is the point on FM such that $FX:XM = n:1$

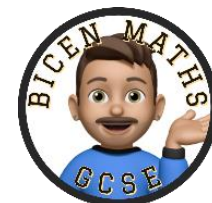
CXE is a straight line.

- (b) Work out the value of n .

 **Video Solutions**

(4 marks)

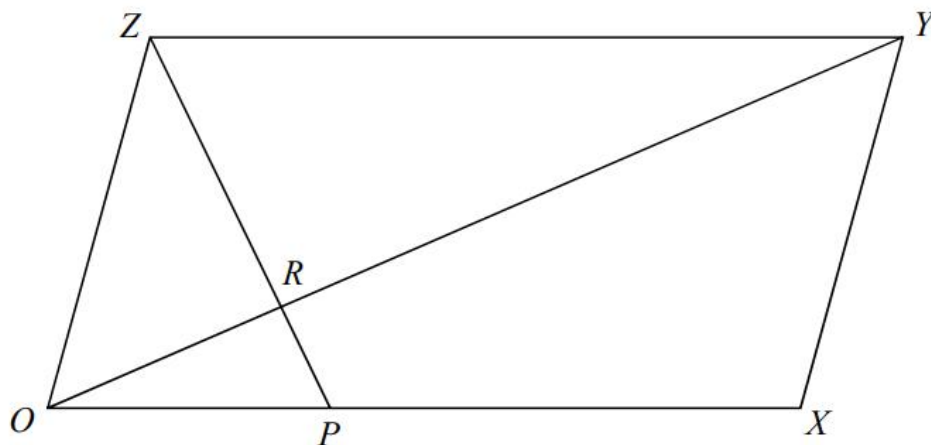
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HOME

20	(a)	2a	M1	for $\mathbf{a} - \mathbf{b} + \mathbf{a} + \mathbf{b} (=2\mathbf{a})$	Accept ft from (a) providing vectors are clearly stated
			A1	cao	
	(b)	4	P1	for a process to find $\overrightarrow{MF} = -0.5\mathbf{b} - \mathbf{a} - (\mathbf{a} - \mathbf{b}) (=0.5\mathbf{b} - 2\mathbf{a})$ or $\overrightarrow{CE} = \mathbf{a} + \mathbf{b}$ or $\overrightarrow{FM} = \mathbf{a} - \mathbf{b} + \mathbf{a} + 0.5\mathbf{b} (=2\mathbf{a} - 0.5\mathbf{b})$	$\overrightarrow{CX} = \frac{n-1}{n+1}\mathbf{a} + \frac{n+2}{2(n+1)}\mathbf{b} \quad \overrightarrow{XE} = \frac{2}{n+1}\mathbf{a} + \frac{n}{2(n+1)}\mathbf{b}$ $\overrightarrow{XC} = \frac{1-n}{n+1}\mathbf{a} + \frac{-n-2}{2(n+1)}\mathbf{b} \quad \overrightarrow{EX} = \frac{-2}{n+1}\mathbf{a} - \frac{n}{2(n+1)}\mathbf{b}$
			P1	For finding a suitable vector expression for two of $(\overrightarrow{CE}$ or $\overrightarrow{EC})$, ($\overrightarrow{CX}$ or $\overrightarrow{XC}$) or $(\overrightarrow{EX}$ or $\overrightarrow{XE})$ eg, $\overrightarrow{CX} = \mathbf{a} + 0.5\mathbf{b} + \frac{1}{n+1}(0.5\mathbf{b} - 2\mathbf{a})$ or $\overrightarrow{CX} = -\mathbf{a} + \mathbf{b} + \frac{n}{n+1}(2\mathbf{a} - 0.5\mathbf{b})$ $\overrightarrow{XE} = \frac{1}{n+1}(2\mathbf{a} - 0.5\mathbf{b}) + 0.5\mathbf{b}$ or $\overrightarrow{XE} = \frac{n}{n+1}(0.5\mathbf{b} - 2\mathbf{a}) + 2\mathbf{a}$ or $\overrightarrow{XC} = \frac{n}{n+1}(0.5\mathbf{b} - 2\mathbf{a}) + \mathbf{a} - \mathbf{b}$ or $\overrightarrow{XC} = \frac{1}{n+1}(2\mathbf{a} - 0.5\mathbf{b}) - 0.5\mathbf{b} - \mathbf{a}$ or $\overrightarrow{EX} = -0.5\mathbf{b} + \frac{1}{n+1}(0.5\mathbf{b} - 2\mathbf{a})$ or $\overrightarrow{EX} = -2\mathbf{a} + \frac{n}{n+1}(2\mathbf{a} - 0.5\mathbf{b})$	
			P1	for complete process to equate the coefficients of $\mathbf{a}$ and $\mathbf{b}$ eg $\frac{n-1}{n+1} = \frac{n+2}{2(n+1)}$	
			A1	cao	

24 $OXYZ$ is a parallelogram.



$$\vec{OX} = \mathbf{a}$$

$$\vec{OY} = \mathbf{b}$$

P is the point on OX such that $OP:PX = 1:2$

R is the point on OY such that $OR:RY = 1:3$

Work out, in its simplest form, the ratio $ZP:ZR$

You must show all your working.

Geometry &
Measures

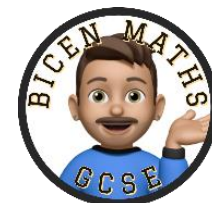
Vectors

Ratio of lengths

 **Video Solutions**

(5 marks)

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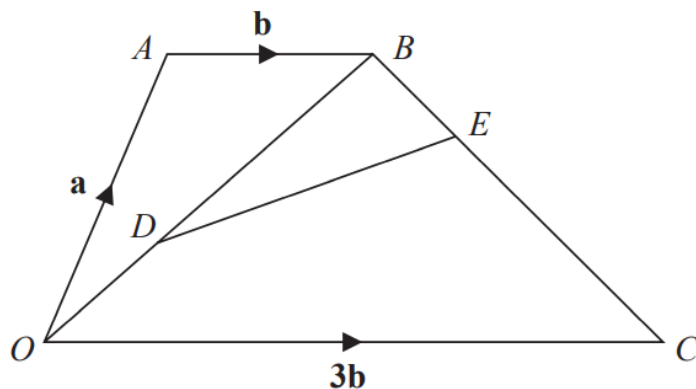
Geometry & Measures
Vectors
Ratio of lengths

24	4 : 3	P1	Process to find a missing vector using the given ratios as fractions, eg. $\frac{1}{3}$ of $\overrightarrow{OX}$ ($=\frac{1}{3}\mathbf{a}$) or. $\frac{1}{4}$ of $\overrightarrow{OY}$ ($=\frac{1}{4}\mathbf{b}$)	Might be embedded in their answer for ZP The award of this mark implies the first two process marks.
		P1	for a process to use $\overrightarrow{ZO} = \overrightarrow{YX} = \mathbf{a} - \mathbf{b}$ oe	
		P1	for a process to find either $\overrightarrow{ZP}$ or $\overrightarrow{ZR}$ in terms of $\mathbf{a}$ and $\mathbf{b}$, eg. either $\overrightarrow{ZP} = \mathbf{a} - \mathbf{b} + \frac{1}{3}\mathbf{a}$ or $\overrightarrow{ZR} = \mathbf{a} - \mathbf{b} + \frac{1}{4}\mathbf{b}$	
		P1	for a process to write $\overrightarrow{ZP}$ and $\overrightarrow{ZR}$ as multiples of the same vector, eg. multiplying both by 12 to get the ratio, $\frac{4}{3}(\mathbf{a} - 0.75\mathbf{b})$ and $\mathbf{a} - 0.75\mathbf{b}$ respectively	
		A1	oe	



November 2021 Paper 3H (Calc)

18 $OABC$ is a trapezium.



$$\begin{aligned}\vec{OA} &= \mathbf{a} \\ \vec{AB} &= \mathbf{b} \\ \vec{OC} &= 3\mathbf{b}\end{aligned}$$

D is the point on OB such that $OD:DB = 2:3$

E is the point on BC such that $BE:EC = 1:4$

Work out the vector $\vec{DE}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.
Give your answer in its simplest form.

Geometry &
Measures

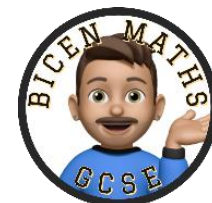
Vectors

Ratio of lengths

 **Video Solutions**

(4 marks)

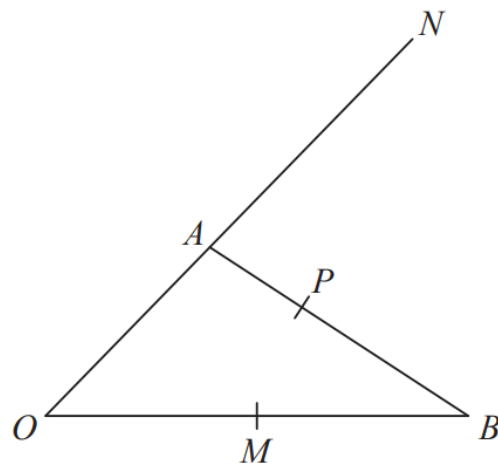
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HOME

18	$\frac{2}{5}\mathbf{a} + \mathbf{b}$	P1	for relationship involving D eg $\overrightarrow{OD} = \frac{2}{5}\overrightarrow{OB}$ or $\overrightarrow{DB} = \frac{3}{5}\overrightarrow{OB}$ or for relationship involving E eg $\overrightarrow{BE} = \frac{1}{5}\overrightarrow{BC}$ or $\overrightarrow{EC} = \frac{4}{5}\overrightarrow{BC}$
		P1	for relationship involving D in terms of $\mathbf{a}$ and $\mathbf{b}$ eg $\overrightarrow{OD} = \frac{2}{5}(\mathbf{a} + \mathbf{b})$ or $\overrightarrow{DB} = \frac{3}{5}(\mathbf{a} + \mathbf{b})$ or for relationship involving E in terms of $\mathbf{a}$ and $\mathbf{b}$ eg $\overrightarrow{BE} = \frac{1}{5}(-\mathbf{b} - \mathbf{a} + 3\mathbf{b})$ oe or $\overrightarrow{EC} = \frac{4}{5}(-\mathbf{b} - \mathbf{a} + 3\mathbf{b})$ oe or $\overrightarrow{BC} = 2\mathbf{b} - \mathbf{a}$ oe or $\overrightarrow{CB} = \mathbf{a} - 2\mathbf{b}$ oe
		P1	(dep P2) for expression for $\overrightarrow{DE}$ in terms of $\mathbf{a}$ and $\mathbf{b}$ eg $\overrightarrow{DE} = \frac{3}{5}(\mathbf{a} + \mathbf{b}) + \frac{1}{5}(-\mathbf{b} - \mathbf{a} + 3\mathbf{b})$
		A1	for $\frac{2}{5}\mathbf{a} + (1)\mathbf{b}$ or $\frac{1}{5}(2\mathbf{a} + 5\mathbf{b})$





OAN , OMB and APB are straight lines.

$AN = 2OA$.

M is the midpoint of OB .

$\vec{OA} = \mathbf{a}$ $\vec{OB} = \mathbf{b}$

$\vec{AP} = k\vec{AB}$ where k is a scalar quantity.

Given that MPN is a straight line, find the value of k .

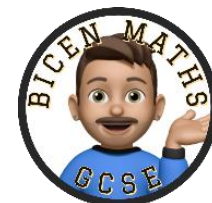
Geometry &
Measures

Vectors

Problem Solving

 **Video Solutions**

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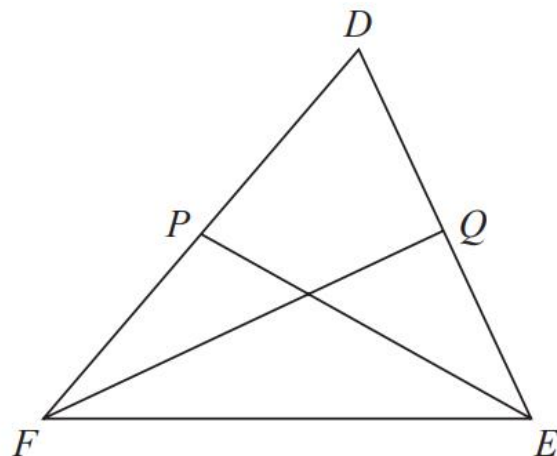
HOME

21		$\frac{2}{5}$	P1	for process to find $\overrightarrow{AB} (= \mathbf{b} - \mathbf{a})$ or $\overrightarrow{BA} (= \mathbf{a} - \mathbf{b})$
			P1	for process to find $\overrightarrow{MN} (= -\frac{1}{2}\mathbf{b} + \mathbf{a} + 2\mathbf{a})$ or $\overrightarrow{PN} (= -k(\mathbf{b} - \mathbf{a}) + 2\mathbf{a})$ or $\overrightarrow{MP} (= -\frac{1}{2}\mathbf{b} + \mathbf{a} + k(\mathbf{b} - \mathbf{a})$ or $\frac{1}{2}\mathbf{b} + (1 - k)(\mathbf{a} - \mathbf{b}))$
			P1	for process to find two of $\overrightarrow{MN}$, $\overrightarrow{PN}$ and $\overrightarrow{MP}$
			P1	for process to find k , using $\overrightarrow{MN}$ as a multiple of $\overrightarrow{PN}$ or using $\overrightarrow{MN}$ as a multiple of $\overrightarrow{MP}$ or using $\overrightarrow{PN}$ as a multiple of $\overrightarrow{MP}$
			A1	for $\frac{2}{5}$ oe



Summer 2020 Paper 1H (Non-Calc)

21 DEF is a triangle.



P is the midpoint of FD .

Q is the midpoint of DE .

$$\vec{FD} = \mathbf{a} \text{ and } \vec{FE} = \mathbf{b}$$

Use a vector method to prove that PQ is parallel to FE .

Geometry &
Measures

Vectors

Proof

 **Video Solutions**

(4 marks)

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HOME

Geometry & Measures
Vectors
<i>Proof</i>

21	Proof	M1	for $\overrightarrow{DQ} = \frac{1}{2}(\mathbf{b} - \mathbf{a})$ oe or $\overrightarrow{EQ} = \frac{1}{2}(\mathbf{a} - \mathbf{b})$ oe	Vectors could be written on the diagram
		M1	for $\overrightarrow{PQ} = \frac{1}{2}\mathbf{a} + \overrightarrow{DQ}$ or $\frac{1}{2}\mathbf{a} + \frac{1}{2}(\mathbf{b} - \mathbf{a})$ oe or $\overrightarrow{PQ} = -\frac{1}{2}\mathbf{a} + \mathbf{b} + \overrightarrow{EQ}$ or $-\frac{1}{2}\mathbf{a} + \mathbf{b} + \frac{1}{2}(\mathbf{a} - \mathbf{b})$ oe	
		B1	for $\overrightarrow{PQ} = \frac{1}{2}\mathbf{b}$	
		C1	for complete proof with statement, eg $FE = 2PQ$ or FE is a multiple of PQ or $\mathbf{b} = 2(\frac{1}{2}\mathbf{b})$	



Geometry & Measures

Area & Gradient, Graphs

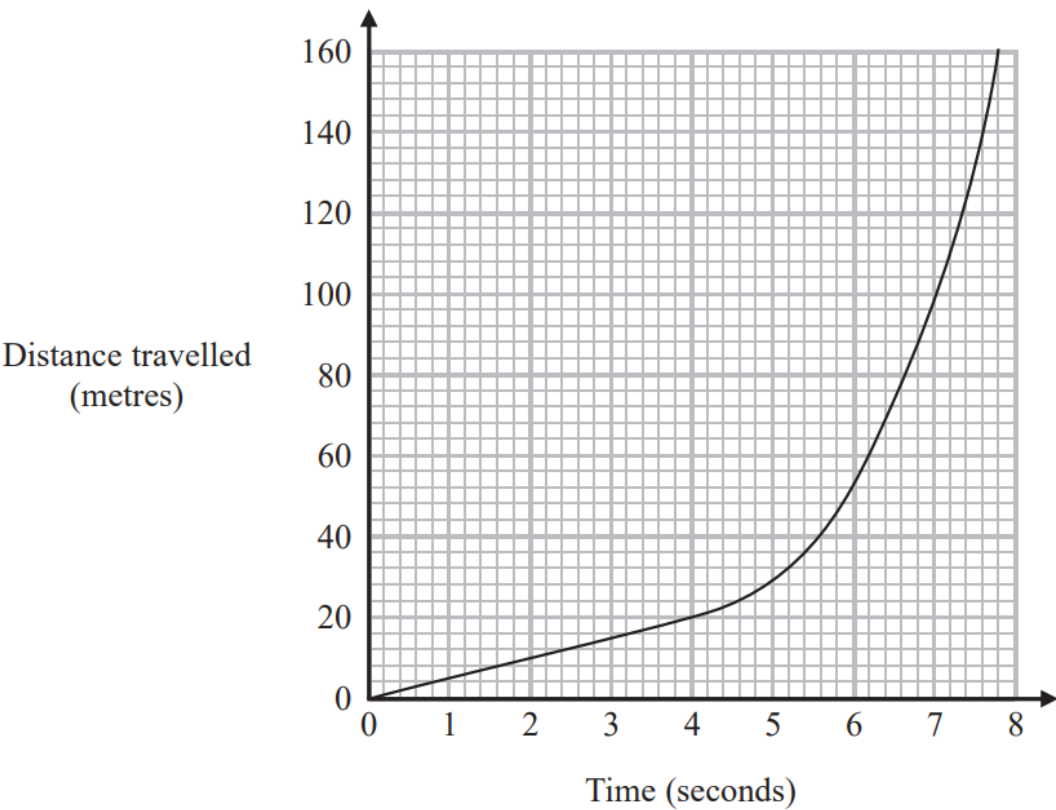
[Distance-Time Graphs](#)

[Speed-Time Graphs](#)

[Other Graphs](#)



14 The distance-time graph shows information about part of a car journey.



Use the graph to estimate the speed of the car at time 5 seconds.

Geometry & Measures
Area & Gradient, Graphs
<i>Distance-time graph</i>

 **Video Solutions**

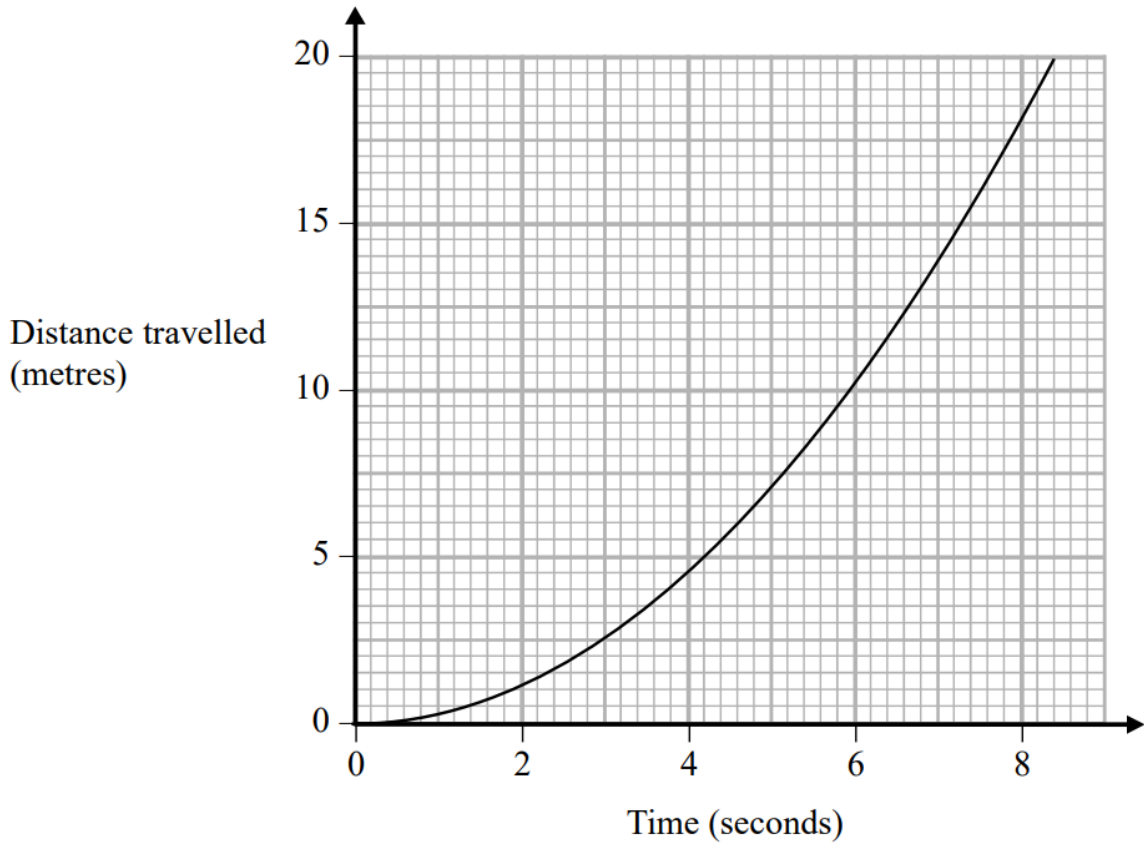
(3 marks)



14	11 – 19	P1	for drawing a tangent to the curve at time = 5	Using their drawn tangent, eg change in $y \div$ change in x Must come from gradient of a tangent.
		P1	for process to find the gradient, eg $70 \div 5$	
		A1	(dep on 1 st P1) for answer in the range 11 - 19 m/s	



19 The graph shows information about part of a cyclist's journey.



Work out an estimate of the speed, in m/s, of the cyclist at time 6 seconds.

Geometry & Measures
Area & Gradient, Graphs
<i>Distance-time graph</i>

Video Solutions

(3 marks)



Geometry & Measures
Area & Gradient, Graphs
<i>Distance-time graph</i>

19	3.4	M1	for drawing a suitable tangent at $t = 6$	
		M1	for a full method to find the gradient of the tangent at $t=6$, eg $20 \div 5.8$	Use of change in y over change in x
		A1	answer in the range 3.05 to 3.7	Answers of $\frac{10}{6}$ oe scores no marks

 **Video Solutions**

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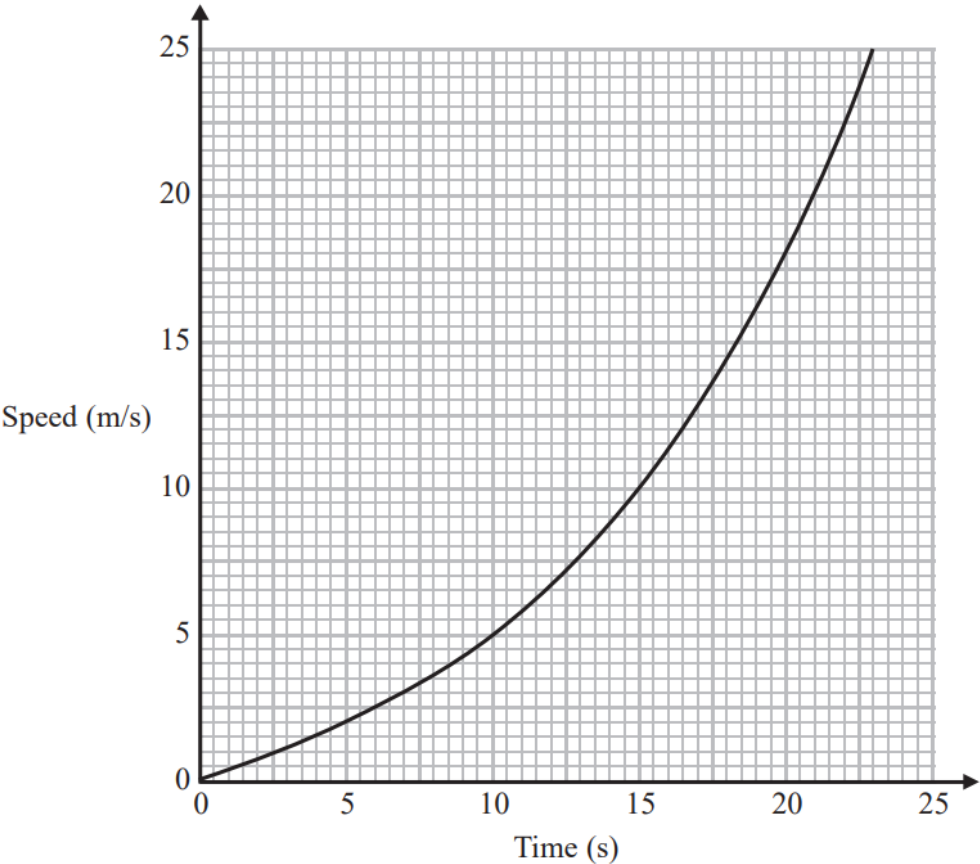
HOME

November 2017 Paper 3H (Calc)

18 Here is a speed-time graph for a train.

Geometry & Measures
Area & Gradient, Graphs
Speed-time graph

 **Video Solutions**



- (a) Work out an estimate for the distance the train travelled in the first 20 seconds.
Use 4 strips of equal width.

(3 marks)

- (b) Is your answer to (a) an underestimate or an overestimate of the actual distance the train travelled?
Give a reason for your answer.

(1 mark)



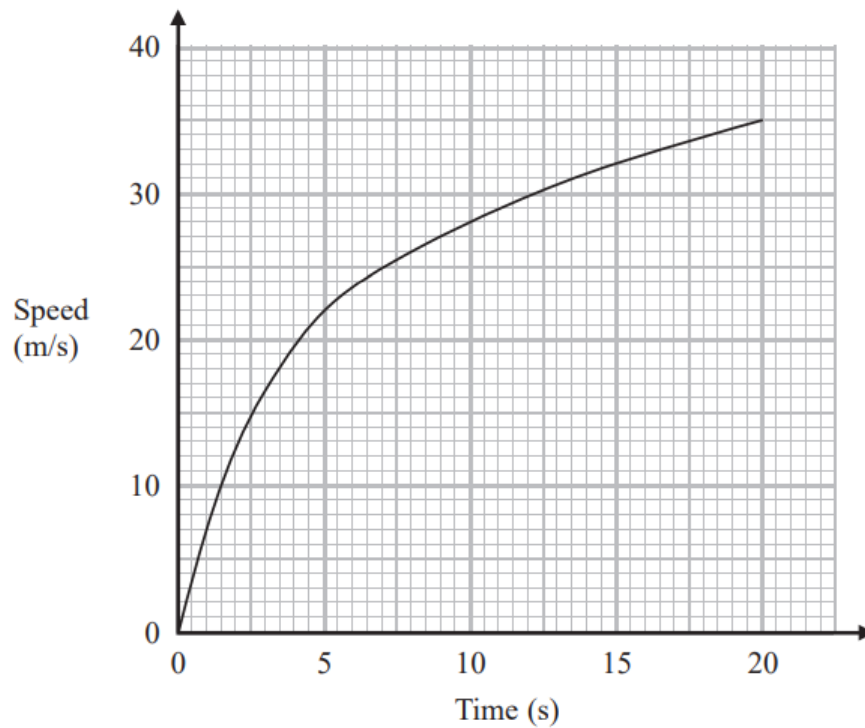
Geometry & Measures
Area & Gradient, Graphs
<i>Speed-time graph</i>

18	(a)	values 0, 2, 5, 10, 18	130	M1	for starting to find area under the curve, eg $0.5 \times 5 \times 2 (= 5)$
				M1	for a complete method to find the area under the curve using 4 strips of equal width, eg “5” + $0.5 \times 5 \times (2+5) (= 17.5)$ + $0.5 \times 5 \times (5+10) (= 37.5)$ + $0.5 \times 5 \times (10+18) (= 70)$
				A1	for 130 or answer in range 130.1 to 132 supported by accurate working
	(b)		overestimate with reason	C1	for “overestimate” and appropriate reason linked to method eg area between trapeziums and curve also included



Summer 2018 Paper 3H (Calc)

15 The graph shows the speed of a car, in metres per second, during the first 20 seconds of a journey.



- (a) Work out an estimate for the distance the car travelled in the first 20 seconds.
Use 4 strips of equal width.

(3 marks)

- (b) Is your answer to part (a) an underestimate or an overestimate of the actual distance the car travelled in the first 20 seconds?
Give a reason for your answer.

(1 mark)

Geometry & Measures
Area & Gradient, Graphs
Speed-time graph

 **Video Solutions**



Geometry & Measures
Area & Gradient, Graphs
Speed-time graph

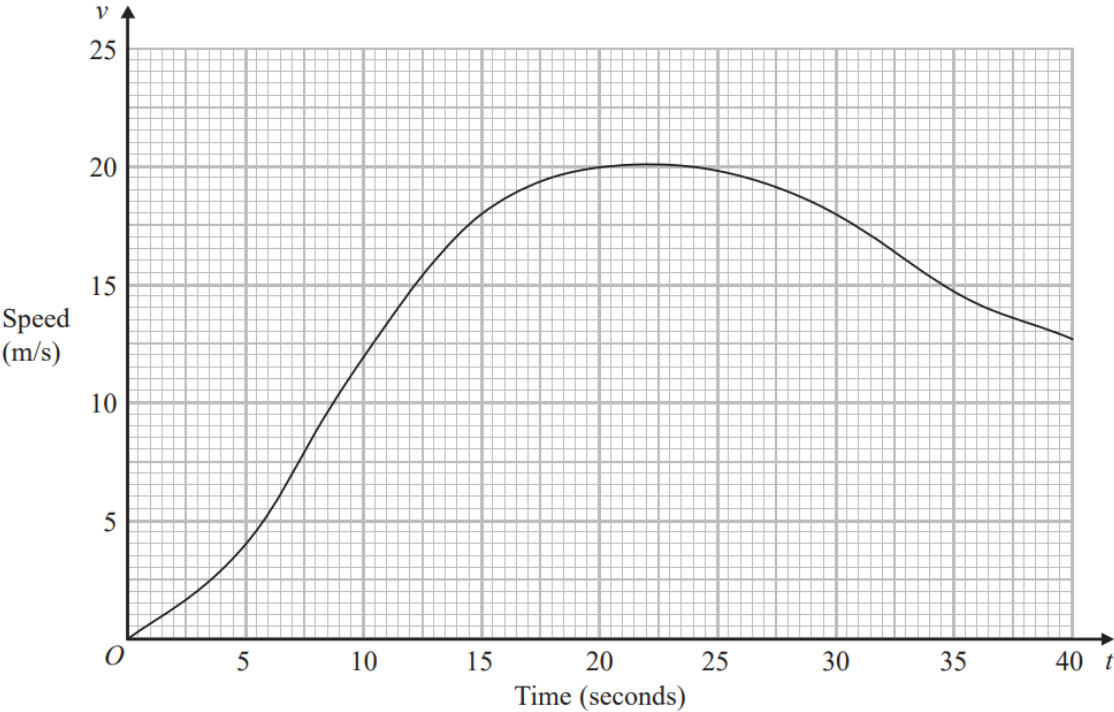
15	(a)	488 to 507	M1	for method to find area of one strip using trapezia, eg $\frac{1}{2} \times 5 \times 22 (= 55)$ or $\frac{1}{2} \times 5 \times (22 + 28) (= 125)$ or $\frac{1}{2} \times 5 \times (28 + 32) (= 150)$ or $\frac{1}{2} \times 5 \times (32 + 35) (= 167.5)$ OR for a method to find an estimate for the area using rectangles eg 5×22 or 5×28 or 5×32 or 5×35	May use area of triangle + area of rectangle for the second, third and fourth strips – lengths must be correct. May use triangle for first strip, $\frac{1}{2} \times 5 \times 22$
			M1	for complete and correct method to find the area using four strips, eg $\frac{1}{2} \times 5 \times 22 + \frac{1}{2} \times 5 \times (22 + 28) + \frac{1}{2} \times 5 \times (28 + 32)$ $+ \frac{1}{2} \times 5 \times (32 + 35)$ or $5 \times 22 + 5 \times 28 + 5 \times 32 + 5 \times 35$	
			A1	for answer in the range 488 to 507 (SC B1 for using area under the curve)	May use triangle for first strip, $\frac{1}{2} \times 5 \times 22$
	(b)	Underestimate (supported)	C1	(dep M1) for underestimate since parts not included below the graph OR fit their method	



Summer 2019 Paper 2H (Calc)

14 A car moves from rest.

The graph gives information about the speed, v metres per second, of the car t seconds after it starts to move.



(a) (i) Calculate an estimate of the gradient of the graph at $t = 15$

(3 marks)

(ii) Describe what your answer to part (i) represents.

(1 mark)

(b) Work out an estimate for the distance the car travels in the first 20 seconds of its journey.
Use 4 strips of equal width.

(3 marks)

Geometry & Measures
Area & Gradient, Graphs
Speed-time graph

 **Video Solutions**

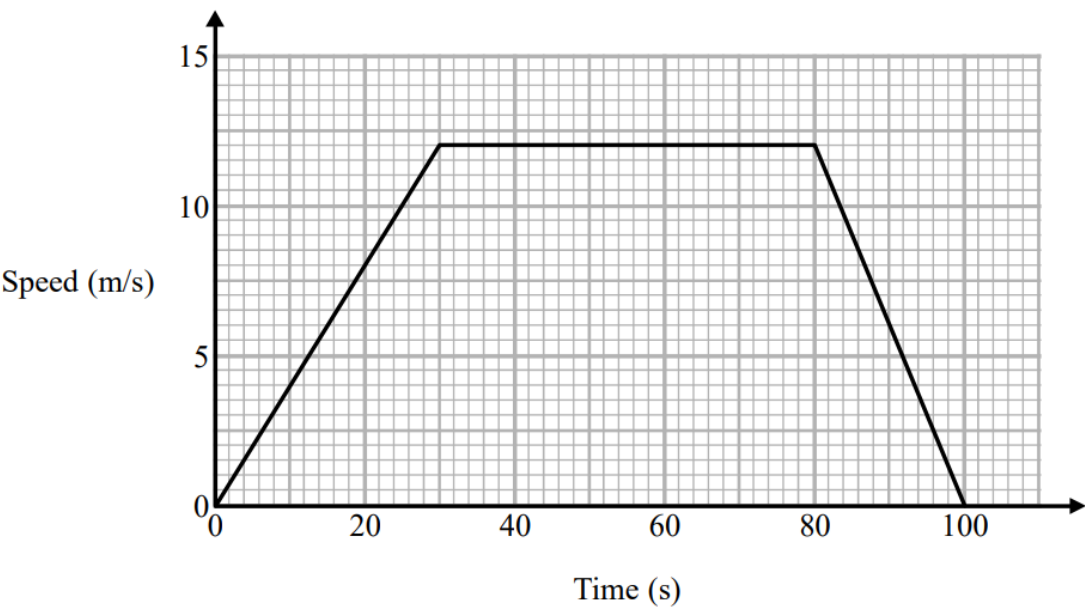


14	(a)(i)	0.83	B1	for a tangent drawn at $t = 15$	Working: $7.5 \div 9 = 0.83\dots$ No tangent scores 0 marks This mark can be awarded if the tangent is drawn at $t \neq 15$ Working may be seen on the diagram
			M1	full method to use the tangent to find the gradient (eg $7.5 \div 9$)	
			A1	for answer in the range 0.6 to 1.0	
	(ii)	Statement	C1	statement Acceptable examples acceleration rate of change of speed increase in speed over time Not acceptable examples rate of change m/s/s increase in speed	
(b)		220	P1	for splitting the area into strips and correct process to find the area of one strip, eg $\frac{5 \times 4}{2} (=10)$ or $\frac{(4+12)}{2} \times 5 (=40)$ or $\frac{(12+18)}{2} \times 5 (=75)$ or $\frac{(18+20)}{2} \times 5 (=95)$	Working 4, 12, 18, 20 Allow one error in the reading of speeds
			P1	for a complete process using at least 4 strips to find the area under the curve eg, “10” + “40” + “75” + “95”	
			A1	for answer in the range 215 to 225 from correct working using at least 4 strips	



Geometry & Measures
Area & Gradient, Graphs
Speed-time graph

- 21 Here is a speed-time graph for a train journey between two stations. The journey took 100 seconds.



- (a) Calculate the time taken by the train to travel half the distance between the two stations. You must show all your working.

(4 marks)

- (b) Compare the acceleration of the train during the first part of its journey with the acceleration of the train during the last part of its journey.

▶ **Video Solutions**

(1 mark)



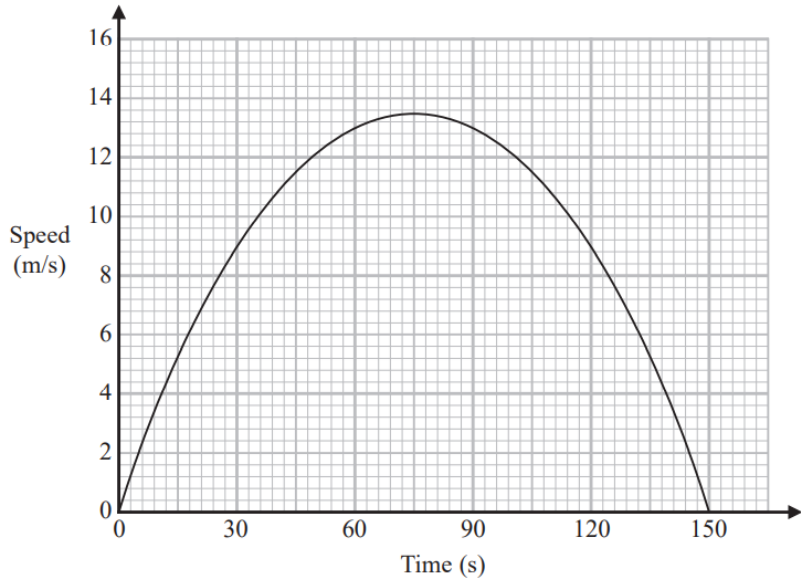
Geometry & Measures
Area & Gradient, Graphs
Speed-time graph

21	(a)	52.5	P1	starts to find area under graph, eg $\frac{30 \times 12}{2}$ (=180) or 50×12 (=600) or $\frac{20 \times 12}{2}$ (=120)
			P1	complete process to find area under graph, eg $\frac{30 \times 12}{2} + 50 \times 12 + \frac{20 \times 12}{2}$ (= 900)
			P1	starts process to find half way time, eg $((\text{“900”} \div 2) - 180) \div 12$ (=22.5)
			A1	52.5 oe
	(b)	Comparison	C1	acceptable comparison Acceptable (acceleration) during first part is positive but (acceleration) during last part is negative / deceleration (acceleration is) greater during the last part than during the first part gradient is steeper in the last part / longer to speed up than slow down speed / (acceleration) is increasing at start and decreasing at end (acceleration) is slower in the first part (acceleration) is ascending in the first part and descending in the last part 0.4 is the first part and -0.6 in the last part Not acceptable goes down in the last part speed is greater in last part than first part



Summer 2020 Paper 3H (Calc)

16 Here is a speed-time graph for a car.



(a) Work out an estimate for the distance the car travelled in the first 30 seconds.

(2 marks)

(b) Is your answer to part (a) an underestimate or an overestimate of the actual distance the car travelled in the first 30 seconds?

Give a reason for your answer.

(1 mark)

Julian used the graph to answer this question.

Work out an estimate for the acceleration of the car at time 60 seconds.

Here is Julian's working.

$$\begin{aligned} \text{acceleration} &= \text{speed} \div \text{time} \\ &= 13 \div 60 \\ &= 0.21\dot{6} \text{ m/s}^2 \end{aligned}$$

Julian's method does not give a good estimate of the acceleration at time 60 seconds.

(c) Explain why.

(1 mark)

Geometry & Measures
Area & Gradient, Graphs
Speed-time graph

Video Solutions

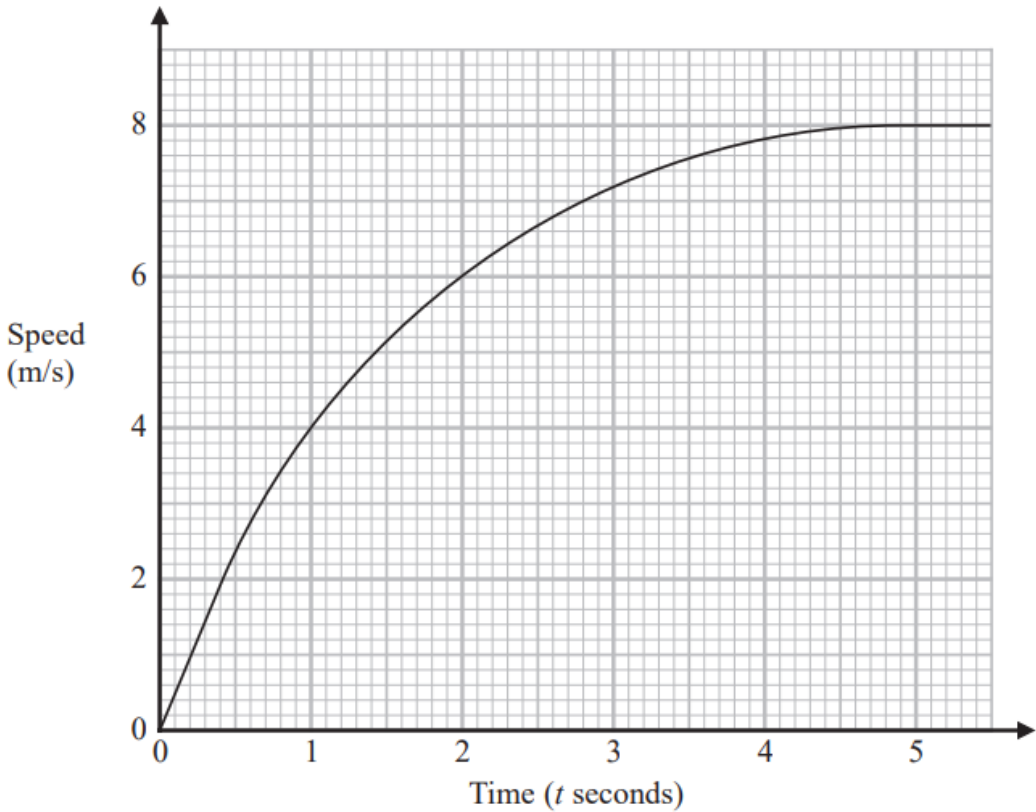


16	(a)	129 to 160	M1	for a method to find an estimate for the area under the curve eg $0.5 \times 30 \times 9$	Do not accept 30×9 Award full marks for any correct method leading to a better estimate.
			A1	for value in the range 129 to 160 (If M0, SC B1 for 126 or 127.5)	
	(b)	underestimate with reason	C1	(dep M1) for “underestimate” and appropriate reason linked to their method, eg area between triangle and curve not included	
	(c)	Explanation	C1	for explanation, Acceptable examples method gives average acceleration (in first 60 seconds) he has not used/drawn a tangent (at time 60 seconds) he has not worked out the gradient (at time 60 seconds) Not acceptable examples he has not used strips he has calculated it accurately rather than using an estimate the estimate of 13 should be about 4.4 the answer should be approximately 0.073	



Geometry & Measures
Area & Gradient, Graphs
Speed-time graph

21 Here is a speed-time graph showing the speed, in metres per second, of an object t seconds after it started to move from rest.



(1 mark)

(b) What does this area represent?

(a) Using 3 trapeziums of equal width, work out an estimate for the area under the graph between $t = 1$ and $t = 4$

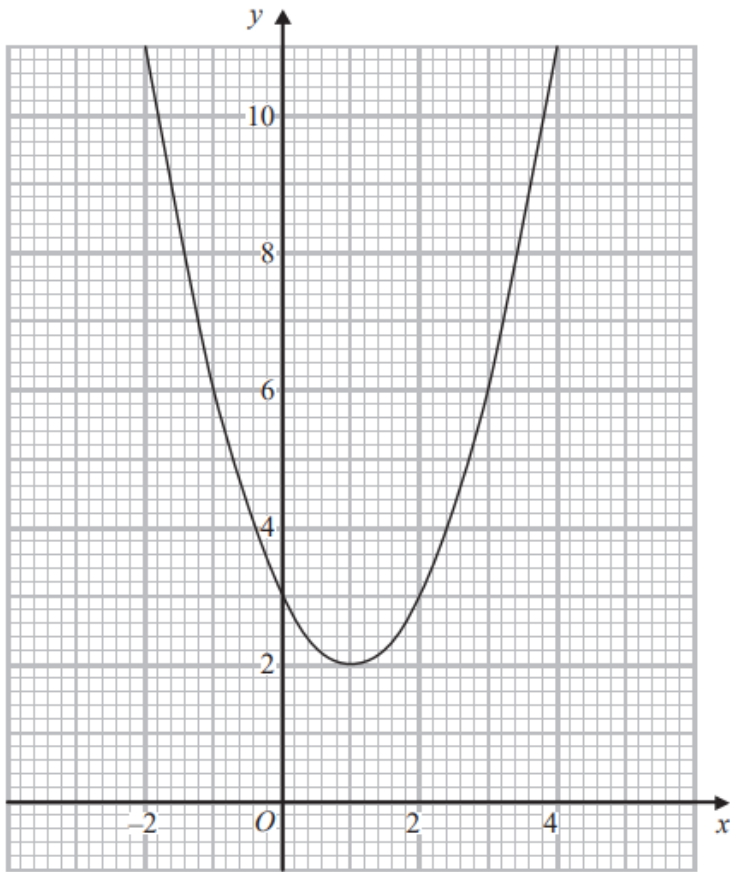
(3 marks)



21	(a)	19.1	M1	for a method to find an estimate for the area of at least 1 trapezium under the curve eg $0.5 \times 1 \times (4 + 6)$ or $0.5 \times 1 \times (6 + 7.2)$ or $0.5 \times 1 \times (7.2 + 7.8)$	Allow a maximum of 2 errors in y values used Ignore any reference to units
			M1	for a complete method eg $0.5 \times 1 \times (4 + 6) + 0.5 \times 1 \times (6 + 7.2) + 0.5 \times 1 \times (7.2 + 7.8)$ or $0.5 \{(4 + 7.8) + 2(6 + 7.2)\}$	
			A1	cao	
	(b)	Statement	C1	eg distance (travelled)	If units are given they must be correct

Summer 2017 Paper 2H (Calc)

20 The diagram shows part of the graph of $y = x^2 - 2x + 3$



Geometry & Measures
Area & Gradient, Graphs
Quadratic graph

P is the point on the graph of $y = x^2 - 2x + 3$ where $x = 2$

(b) Calculate an estimate for the gradient of the graph at the point P .

 **Video Solutions**

(3 marks)



Geometry & Measures
Area & Gradient, Graphs
<i>Quadratic graph</i>

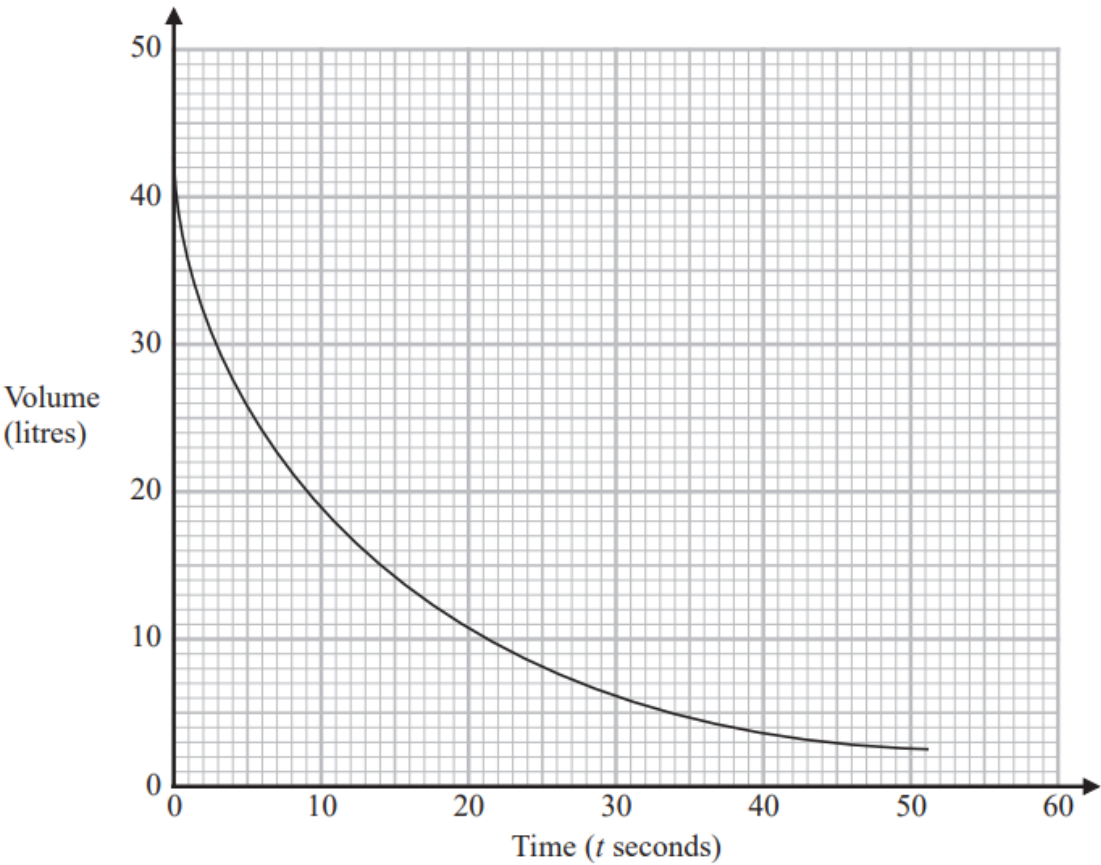
(b)		1.6 to 2.5	M1 M1 A1	for drawing a tangent to the curve at $x = 2$ for method to find gradient of their tangent for answer in the range 1.6 to 2.5
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 **Video Solutions**



November 2021 Paper 3H (Calc)

15 The graph gives the volume of water, in litres, in a container at time t seconds after the water started to flow out of the container.



Using the graph, work out an estimate for the rate at which the water is flowing out of the container when $t = 12$
You must show your working.

Geometry & Measures
Area & Gradient, Graphs
<i>Flow of water</i>

 **Video Solutions**

(3 marks)

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15

0.7 to 1.1

M1

for tangent to the curve drawn at $t = 12$

M1

for method to find the gradient of their tangent, eg $28 \div 30$

A1

for answer in the range 0.7 to 1.1 dependent upon tangent drawn

Working may be seen on the diagram

Ignore negative signs



Probability & Statistics

Averages and Spread

Averages from Tables
and Charts

Reverse Mean

Comparing
Distributions



November 2017 Paper 1H (Non-Calc)

5 The table shows information about the weekly earnings of 20 people who work in a shop.

Weekly earnings (£ x)	Frequency
$150 < x \leq 250$	1
$250 < x \leq 350$	11
$350 < x \leq 450$	5
$450 < x \leq 550$	0
$550 < x \leq 650$	3

(a) Work out an estimate for the mean of the weekly earnings.

(3 marks)

Nadiya says,

“The mean may **not** be the best average to use to represent this information.”

(b) Do you agree with Nadiya?
You must justify your answer.

Probability & Statistics
Averages and Spread
<i>Estimated mean from a table</i>



 **Video Solutions**

(1 mark)

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HOME

5	(a)	365	M1	fx with x consistent within intervals eg 200×1 , 300×11 , 400×5 , 500×0 , 600×3 , if 200, 3300, 2000, 0, 1800 are seen without working then condone 1 error (dep) $\Sigma fx \div \Sigma f$ eg “7300” $\div 20$ cao for comment about outliers affecting mean
			M1	
			A1	
	(b)	Comment	C1	



4 The table gives information about the times taken, in seconds, by 18 students to run a race.

Time (t seconds)	Frequency
$5 < t \leq 10$	1
$10 < t \leq 15$	2
$15 < t \leq 20$	7
$20 < t \leq 25$	8

Work out an estimate for the mean time.
Give your answer correct to 3 significant figures.

 **Video Solutions**

(3 marks)



4	18.6	M1	for finding 4 products within intervals (including end points)
		M1	for $\Sigma fx \div (1 + 2 + 7 + 8)$ or $(7.5 \times 1 + 12.5 \times 2 + 17.5 \times 7 + 22.5 \times 8) \div (1 + 2 + 7 + 8)$ or $(“7.5” + “25” + “122.5” + “180”) \div “18”$ or $“335” \div “18”$
		A1	for 18.6(111...)

Min fx	Max fx
5	10
20	30
105	140
160	200

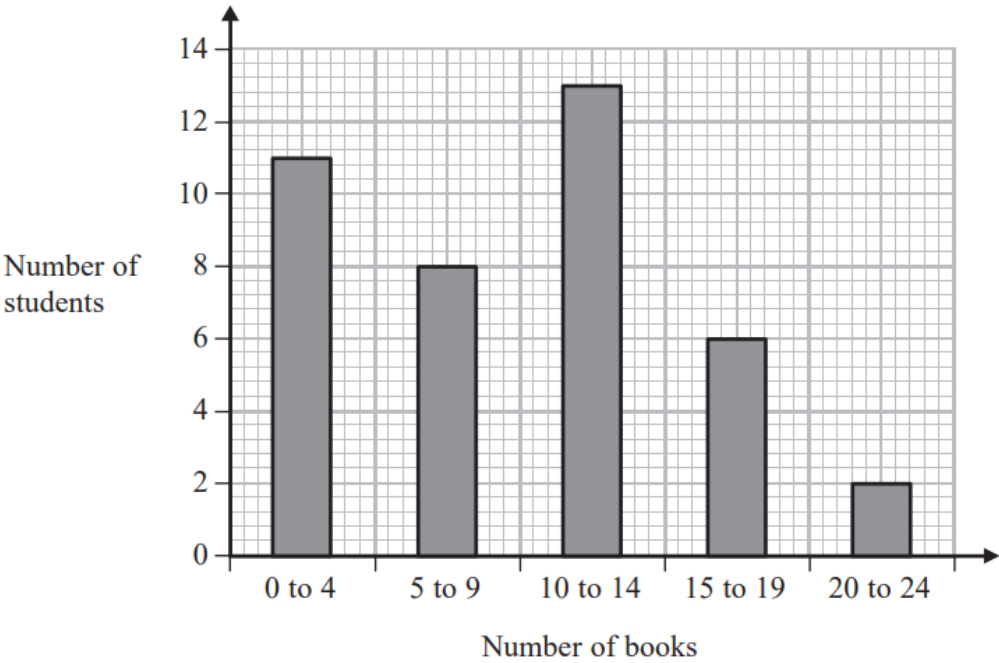
Σfx **must** come from 4 products fx within intervals (including end points)



November 2018 Paper 3H (Calc)

4 Fran asks each of 40 students how many books they bought last year.

The chart below shows information about the number of books bought by each of the 40 students.



(a) Work out the percentage of these students who bought 20 or more books.

(2 marks)

(b) Show that an estimate for the mean number of books bought is 9.5
You must show all your working.

Probability &
Statistics

Averages and Spread

*Estimated mean from
a bar chart*

 **Video Solutions**

(4 marks)

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HOME

4	(a)	5	M1	"2" $\div 40 \times 100$	"2" comes from their reading of the height of the 20 to 24 column
			A1	cao	
	(b)	9.5 shown	M1	for frequencies of 11, 8, 13, 6 and 2 (allow one error) or for midpoints 2, 7, 12, 17 and 22	May be seen on chart
			M1	for finding at least 4 products fx consistently within interval (including end points)	
			M1	for $\Sigma "fx" \div ("11" + "8" + "13" + "6" + "2")$ or $(11 \times 2 + 8 \times 7 + 13 \times 12 + 6 \times 17 + 2 \times 22) \div 40$ or $\Sigma "fx" (=380)$ and $9.5 \times ("11" + "8" + "13" + "6" + "2") (=380)$	Evidence of two different calculations that should lead to 380 are required for this mark
			C1	for correct figures showing the answer or accurate figures to compare from correct working eg 380 from two calculations	



Summer 2017 Paper 3H (Calc)

Probability &
Statistics

Averages and Spread

Median from a table

3 The table shows some information about the dress sizes of 25 women.

Dress size	Number of women
8	2
10	9
12	8
14	6

(a) Find the median dress size.

(1 mark)

3 of the 25 women have a shoe size of 7

Zoe says that if you choose at random one of the 25 women, the probability that she has either a shoe size of 7 or a dress size of 14 is $\frac{9}{25}$ because

$$\frac{3}{25} + \frac{6}{25} = \frac{9}{25}$$

(b) Is Zoe correct?
You must give a reason for your answer.



 **Video Solutions**

(1 mark)



3	(a)		12	B1	cao
	(b)		Explanation	C1	No with statement about not being mutually exclusive events eg a person could be in both categories



Probability & Statistics
Averages and Spread
<i>Median from a table, frequency polygon</i>

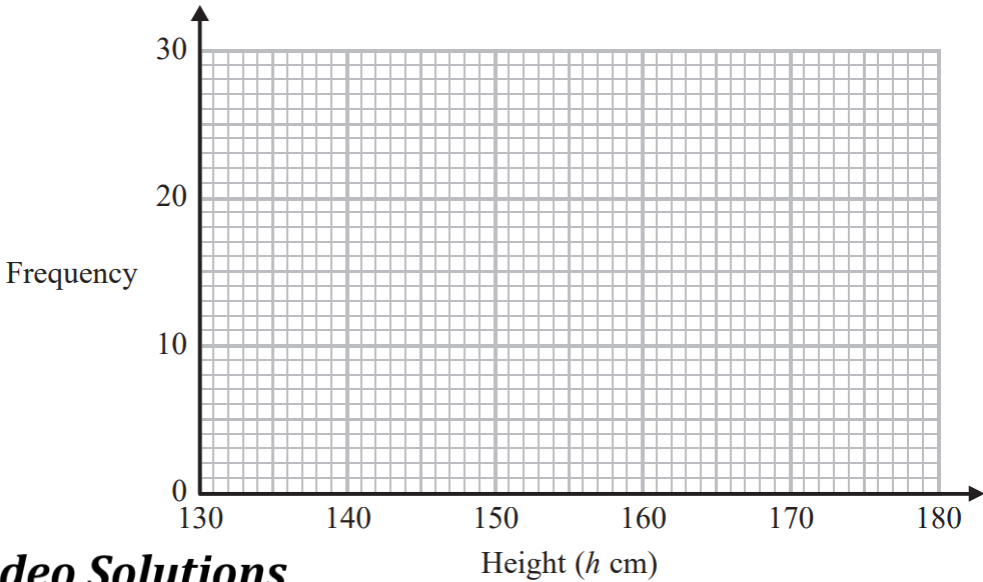
1 The table shows information about the heights of 80 children.

Height (h cm)	Frequency
$130 < h \leq 140$	4
$140 < h \leq 150$	11
$150 < h \leq 160$	24
$160 < h \leq 170$	22
$170 < h \leq 180$	19

(a) Find the class interval that contains the median.

(1 mark)

(b) Draw a frequency polygon for the information in the table.



Video Solutions
(2 marks)



1	(a)	$160 < h \leq 170$	B1	correct class interval
	(b)	Line segments joining the points (135, 4), (145, 11), (155, 24), (165, 22) and (175, 19)	C2 [C1	for fully correct frequency polygon for points plotted correctly at midpoints of intervals OR joining points with line segments at the correct heights and consistent within the intervals (including end values) OR correct frequency polygon with one point incorrect OR correct frequency polygon with first and last point joined] NB: ignore any histogram drawn and any part of frequency polygon outside range of first and last points plotted



Summer 2017 Paper 1H (Non-Calc)

- 7 There are 10 boys and 20 girls in a class.
The class has a test.

The mean mark for all the class is 60

The mean mark for the girls is 54

Work out the mean mark for the boys.

Probability &
Statistics

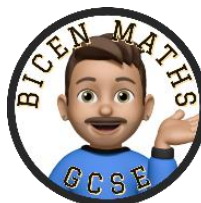
Averages and Spread

Reverse Mean

 **Video Solutions**

(3 marks)

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7		72	P1	for showing the process of $30 \times 60 (=1800)$ or $20 \times 54 (=1080)$
			P1	(dep P1) for showing the complete process e.g. $(\text{“1800”} - \text{“1080”}) \div 10$
			A1	concluding the answer is 72 (and not 66)



- 6 4 red bricks have a mean weight of 5 kg.
5 blue bricks have a mean weight of 9 kg.
1 green brick has a weight of 6 kg.

Donna says,

“The mean weight of the 10 bricks is less than 7 kg.”

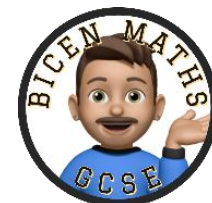
Is Donna correct?

You must show how you get your answer.

 **Video Solutions**

(3 marks)

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6	No (supported)	P1	for process to find total weight of the 4 red bricks, eg. $5 \times 4 (= 20)$ or for process to find total weight of the 5 blue bricks eg. $9 \times 5 (= 45)$	May be seen next to statements 20 must be clearly referenced to the red bricks. $5 + 9 + 6 = 20$ gets no marks Candidates working in grams will need to give 7100 and 7000 for example as comparable figures
		P1	for process to find total weight of all 10 bricks, eg. “20” + “45” + 6 (= 71)	
		C1	No with correct supporting evidence Acceptable examples No, it is 7.1 She is wrong, it is 0.1 more No, (the total weight is) 71 not 70 Not acceptable examples Yes No, it is 71	



Summer 2020 Paper 3H (Calc)

7 There is a total of 45 boys and girls in a choir.

The mean age of the 18 boys is 16.2 years.

The mean age of the 27 girls is 16.7 years.

Calculate the mean age of all 45 boys and girls.

Probability &
Statistics

Averages and Spread

Reverse Mean

 **Video Solutions**

(3 marks)

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7	16.5	M1	for method to find total of ages of boys, eg $18 \times 16.2 (= 291.6)$ or total of ages of girls, eg $27 \times 16.7 (= 450.9)$ or total of ages of boys and girls, eg 742.5	May use an equivalent method with number of boys and girls used in the ratio 2 : 3 $\frac{16.2+16.7}{2}$ scores 0 marks
		M1	for complete method, eg $\frac{"291.6"+"450.9"}{45} (= \frac{742.5}{45})$	
		A1	cao	



Probability & Statistics
Averages and Spread
Comparing Distributions

7 The table shows information about the heights, in cm, of a group of Year 9 girls.

least height	150 cm
median	165 cm
greatest height	170 cm

This stem and leaf diagram shows information about the heights, in cm, of a group of 15 Year 9 boys.

15	8 9 9
16	4 5 7 7 8
17	0 3 4 4 7
18	0 2

Key: 15 | 8 represents 158 cm

Compare the distribution of the heights of the girls with the distribution of the heights of the boys.

.....

.....

.....

 **Video Solutions**

(3 marks)



7	20 or 24 or 168	B1	for identification of the range of the girls (20) or the range (24) or the median (168) of the boys	
	Comparison	C2	for a correct comparison of medians and a correct comparison of ranges supported by correct figures eg the median height for girls (165) is less than the median height for boys (168) and the range for girls (20) is less than the range for boys (24) At least one comparison must be in context referring to height or quoting cm.	Simply quoting values for median, range is insufficient; they must be compared.
		(C1	for a correct comparison of medians or a correct comparison of ranges that could fit their incorrect figure(s))	Context not necessary for C1



Probability & Statistics

Frequency Charts

Two-Way Tables

Frequency Polygons

Time Series

Not technically a frequency chart...



Summer 2018 Paper 2H (Calc)

Probability &
Statistics

Frequency Charts

Two-Way Tables

8 60 people were asked if they prefer to go on holiday in Britain or in Spain or in Italy.

38 of the people were male.

11 of the 32 people who said Britain were female.

8 males said Italy.

12 people said Spain.

One of the females is chosen at random.

What is the probability that this female said Spain?

 **Video Solutions**

(4 marks)

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8	$\frac{3}{22}$	P1	for a process to find a first value eg male/Britain = $32 - 11$ (=21) or Italy/total = $60 - (32+12)$ (=16) or female/total = $60 - 38$ (=22)	<table><tr><td></td><td>Br</td><td>Sp</td><td>It</td><td>Tot</td></tr><tr><td>M</td><td>21</td><td>9</td><td>8</td><td>38</td></tr><tr><td>F</td><td>11</td><td>3</td><td>8</td><td>22</td></tr><tr><td>Tot</td><td>32</td><td>12</td><td>16</td><td>60</td></tr></table>		Br	Sp	It	Tot	M	21	9	8	38	F	11	3	8	22	Tot	32	12	16	60
	Br	Sp	It	Tot																				
M	21	9	8	38																				
F	11	3	8	22																				
Tot	32	12	16	60																				
		P1	for process to find a secondary value, eg male/Spain = $38 - ("21" + 8)$ (=9) or female/Italy = $"16" - 8$ (=8)	May be seen in a frequency tree Values attributed to a category or from method seen																				
		P1	complete process to find female/Spain, eg $12 - "9"$ or $"22" - (11 + "8")$ (=3)																					
		A1	oe accept 0.136 to 0.14 SC B3 for $\frac{3}{60}$																					

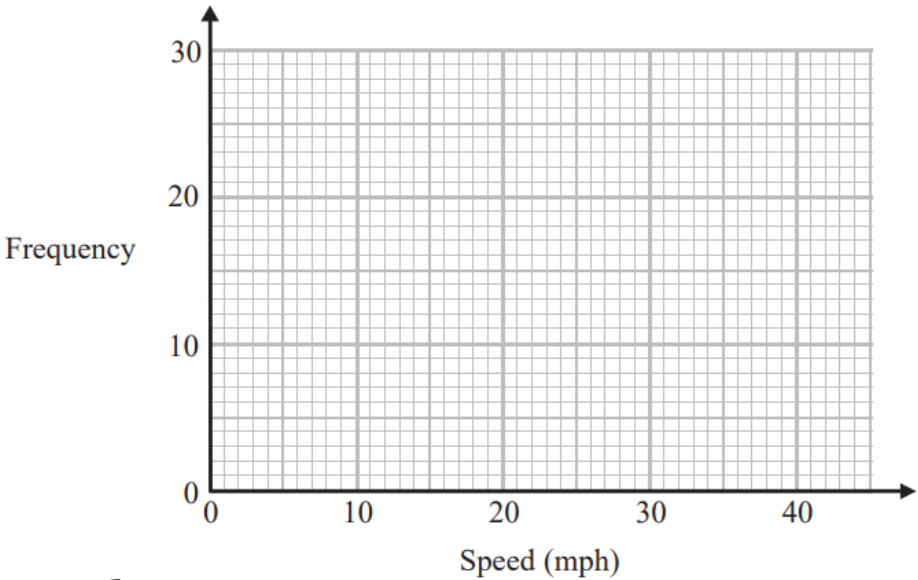


November 2018 Paper 3H (Calc)

7 The table gives information about the speeds of 70 cars.

Speed (s mph)	Frequency
$0 < s \leq 10$	14
$10 < s \leq 20$	18
$20 < s \leq 30$	26
$30 < s \leq 40$	12

Draw a frequency polygon for this information.



Probability & Statistics

Frequency Charts

Frequency Polygons



 **Video Solutions**

(2 marks)

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7	Diagram drawn	B2 (B1)	for correct frequency polygon for points plotted at correct midpoints of intervals or joining points at correct heights consistently within intervals including plotting at end values or correct frequency polygon with one point incorrect or correct frequency polygon with first and last points joined directly)	Plotting at (5,14), (15,18), (25,26), (35,12) Must use line segments for B2 Joining must be with line segments NB ignore any histogram drawn and any part of frequency polygon outside range of first and last points plotted
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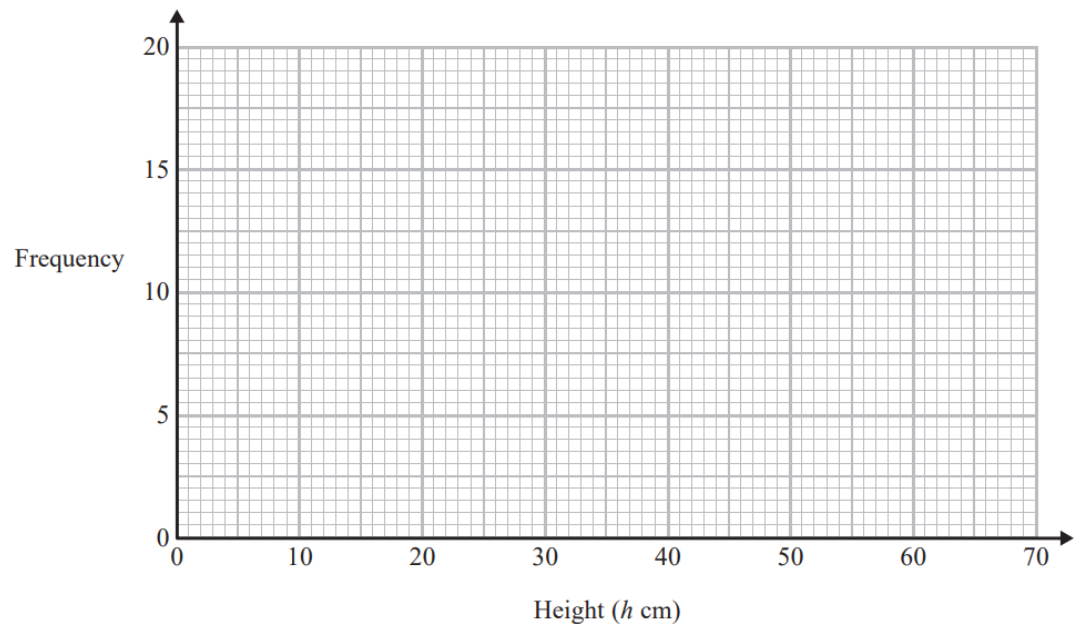
Summer 2019 Paper 3H (Calc)

3 The table shows information about the heights of 80 plants.

Height (h cm)	Frequency
$10 < h \leq 20$	7
$20 < h \leq 30$	13
$30 < h \leq 40$	14
$40 < h \leq 50$	12
$50 < h \leq 60$	16
$60 < h \leq 70$	18

(1 mark)

- (a) Find the class interval that contains the median.
- (b) On the grid, draw a frequency polygon for the information in the table.



(2 marks)

Probability &
Statistics

Frequency Charts

Frequency Polygons



Video Solutions



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HOME

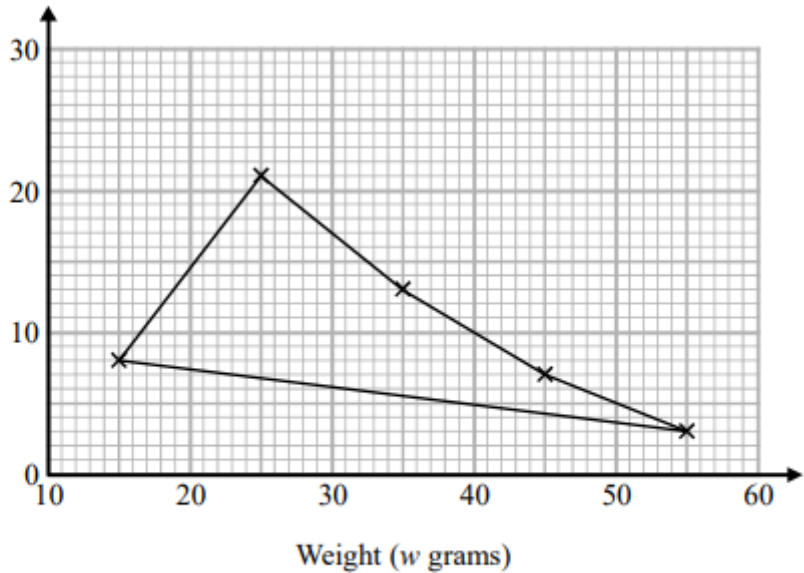
3	(a)	$40 < h \leq 50$	B1	accept 40 – 50 oe	
	(b)	polygon drawn (15,7), (25,13) (35,14), (45,12) (55,16), (65,18)	B2	for fully correct polygon with points plotted at the midpoints	Joining must be with line segments
			(B1	for points plotted correctly but not joined by straight lines or joining points at correct heights consistently within intervals including plotting at end values or correct frequency polygon with one point incorrect or correct frequency polygon with first and last points joined directly)	for example, at 10, 20, 30,...or at 20, 30, 40,... Ignore any histogram drawn and any part of frequency polygon outside range of first and last points plotted



1 The table shows some information about the weights of 50 potatoes.

Weight (w grams)	Frequency
$10 < w \leq 20$	6
$20 < w \leq 30$	21
$30 < w \leq 40$	13
$40 < w \leq 50$	7
$50 < w \leq 60$	3

Iveta drew this frequency polygon for the information in the table.
The frequency polygon is **not** fully correct.



Write down **two** things that are wrong with the frequency polygon.

(2 marks)

 **Video Solutions**

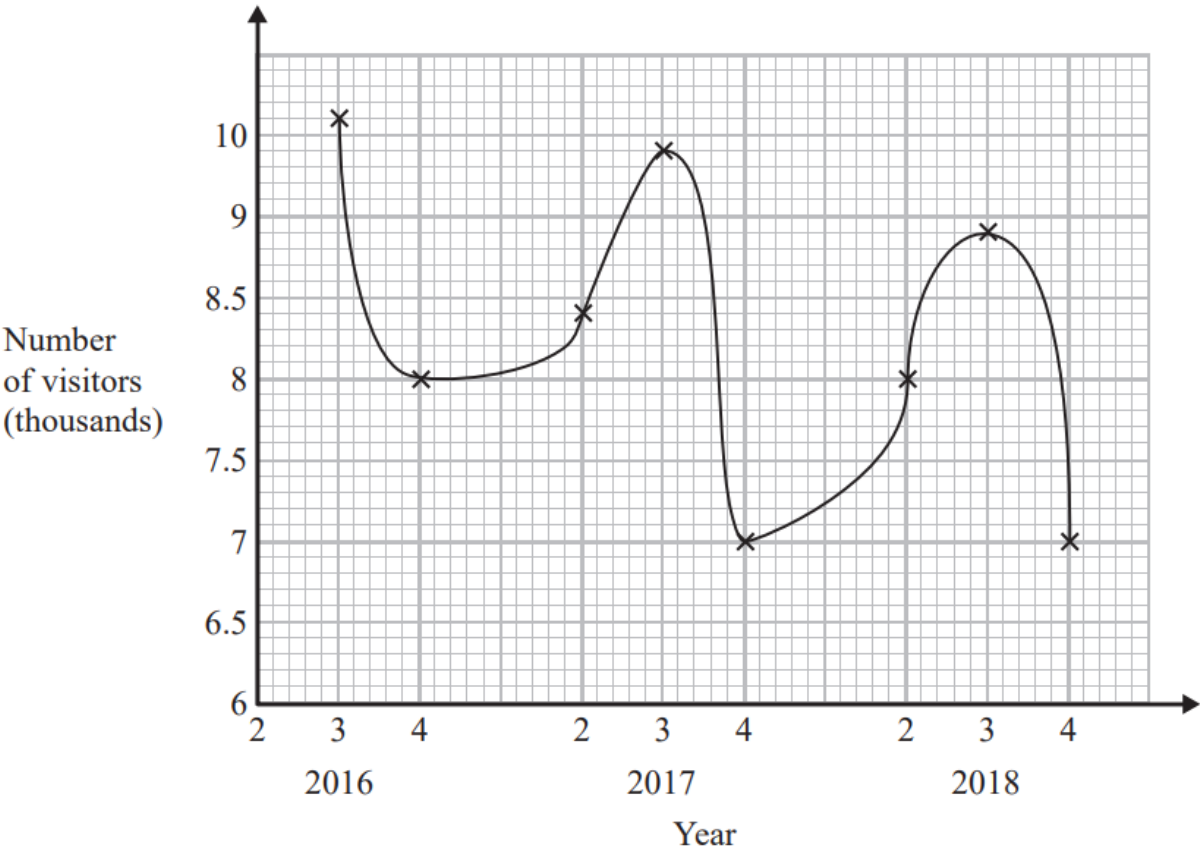


1	Two statements	C2	Two different statements Acceptable There is no 'frequency' label / y-axis is not labelled / no title for the y-axis The polygon should not be closed / have a line at the bottom / have first and last points connected (15, 6) has been plotted incorrectly / at (15, 8) / (The first point is at) 8 rather than 6 / First point is on an incorrect frequency Not acceptable There is no title / Points should be joined with a curve / x-axis doesn't start at 0 There is no label / The axes have not been labelled (x and y) The points haven't (all) been plotted correctly $10 < w \leq 20$ and $30 < w \leq 40$ have been plotted wrong The first point is plotted incorrectly, its at (15, 7) not (15, 6) The points have been joined up wrong / Points should not be joined in the shape of a triangle / They've connected all the points Done the midpoints rather than the numbers on the right side / The points are in the middle (C1 for one statement eg from those above)	Ignore additional statements provided no contradiction
---	----------------	----	---	--



Probability & Statistics
Frequency Charts
Time Series

4 Sean has drawn a time series graph to show the numbers, in thousands, of visitors to a fun park.



Write down two things that are wrong or could be misleading with this graph.

 **Video Solutions**

(2 marks)



HOME

4	statement	B2	Two different statements Acceptable eg should be joined with straight lines (not curve)/should use a ruler 1st (quarter) not shown/plotted/labelled/not all quarters labelled does not show all 4 seasons 9.5 missing from vertical axes/not linear vertical (number) axis does not start at 0/the y axis starts at 6 the graph does not begin at 0, it starts at 6 it is not clear what 2, 3, 4 on the x-axis mean the scale of years doesn't make sense there is lack of clarity about what the numbers on the x axis represent graph is curved line Not acceptable eg no value plotted for 2 in 2016 it does not start at 0 (no reference to vertical axis)/missing 0 they should not have connected the dots like that the numbers on the x axis are repeated the numbers along the x axis 2, 3, 4 the years on the x axis have not been written properly does not follow a sequence it needs a discontinuity wiggle on the axis no title	Ignore additional statements provided no contradiction
	statement	(B1)	One statement eg from those above.)	



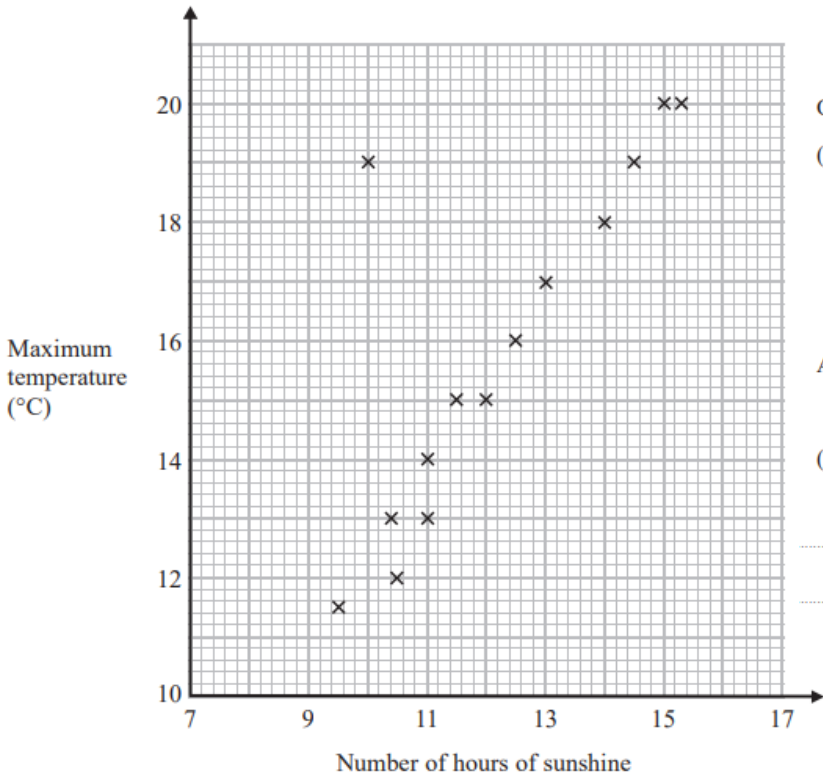
Probability & Statistics

Scatter Diagrams



Summer 2017 Paper 1H (Non-Calc)

1 The scatter graph shows the maximum temperature and the number of hours of sunshine in fourteen British towns on one day.



On the same day, in another British town, the maximum temperature was 16.4°C .

(c) Estimate the number of hours of sunshine in this town on this day.

..... hours
(2)

A weatherman says,

“Temperatures are higher on days when there is more sunshine.”

(d) Does the scatter graph support what the weatherman says?
Give a reason for your answer.

.....
.....
(1)

One of the points is an outlier.

(a) Write down the coordinates of this point.

(..... ,)
(1)

(b) For all the other points write down the type of correlation.

.....
(1)

Video Solutions



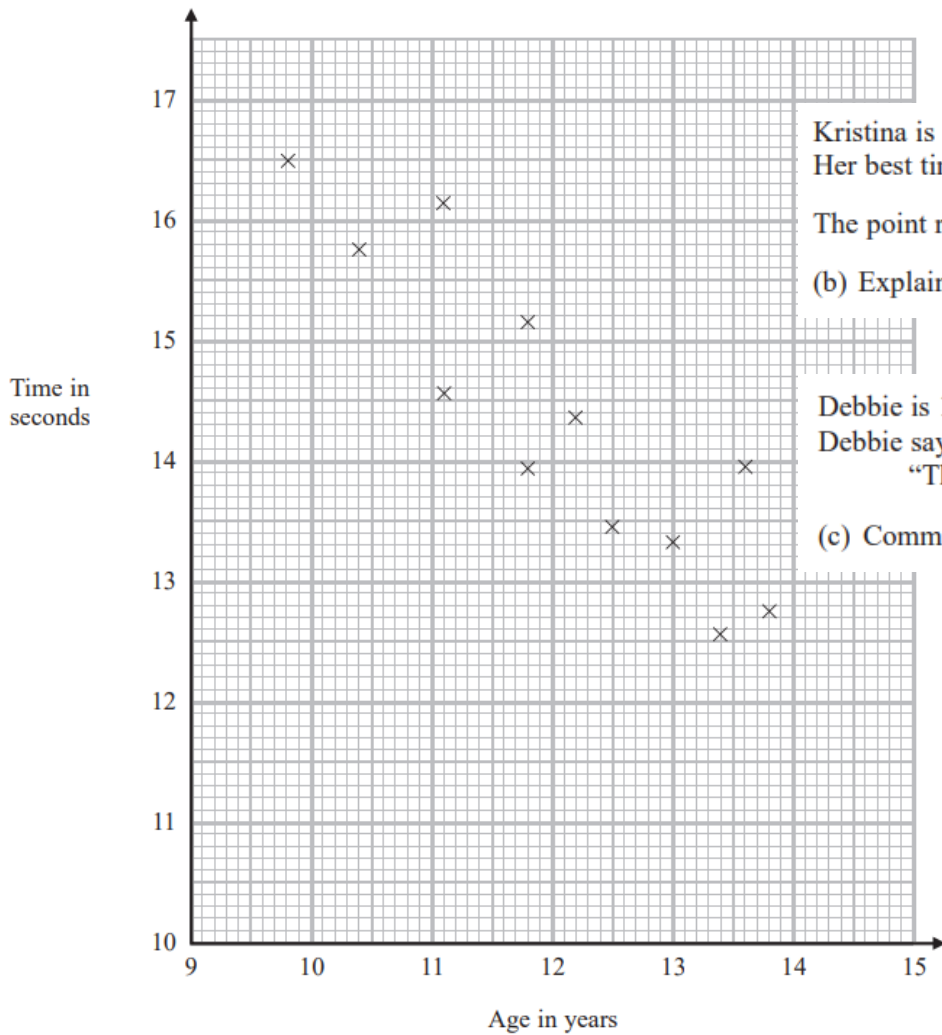
1	(a)	10, 19	B1	cao
	(b)	positive	C1	positive (correlation)
	(c)	12 to 13	M1 A1	for an appropriate line of best fit drawn, or a point marked at $(x, 16.4)$ or a horizontal line drawn from 16.4 across to $(x, 16.4)$ where x is in the range 12 to 13 hours given in the range 12 to 13
	(d)	explanation	C1	(yes) e.g. as the majority of points for high temperature appear when there are more hours of sunshine (positive correlation)



Summer 2018 Paper 3H (Calc)

1 The scatter diagram shows information about 12 girls.

It shows the age of each girl and the best time she takes to run 100 metres.



Kristina is 11 years old.
Her best time to run 100 metres is 12 seconds.

(1 mark)

The point representing this information would be an outlier on the scatter diagram.

(b) Explain why.

Debbie is 15 years old.

(1 mark)

Debbie says,

“The scatter diagram shows I should take less than 12 seconds to run 100 metres.”

(c) Comment on what Debbie says.

(a) Write down the type of correlation.

Video Solutions

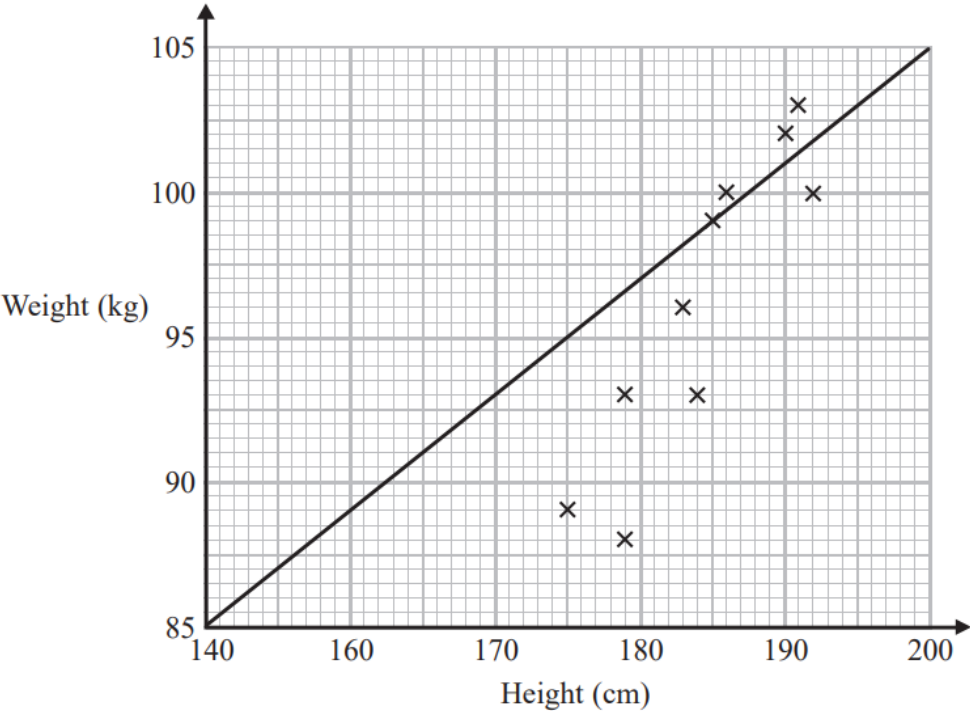
(1 mark)



1	(a)	negative	B1	cao	Ignore any description of a relationship and any reference to strength of correlation
	(b)	Explanation	C1	for a correct explanation, eg “not in line with the trend of the other points” “does not fit in with the correlation” “is far away from the other points or line of best fit”	
	(c)	Comment	C1	for an explanation eg “point would be outside of the range of the scatter diagram”	

November 2018 Paper 2H (Calc)

- 2 Sean has information about the height, in cm, and the weight, in kg, of each of ten rugby players.
- He is asked to draw a scatter graph and a line of best fit for this information.
- Here is his answer.



Sean has plotted the points accurately.

Write down two things that are wrong with his answer.



 **Video Solutions**

(2 marks)

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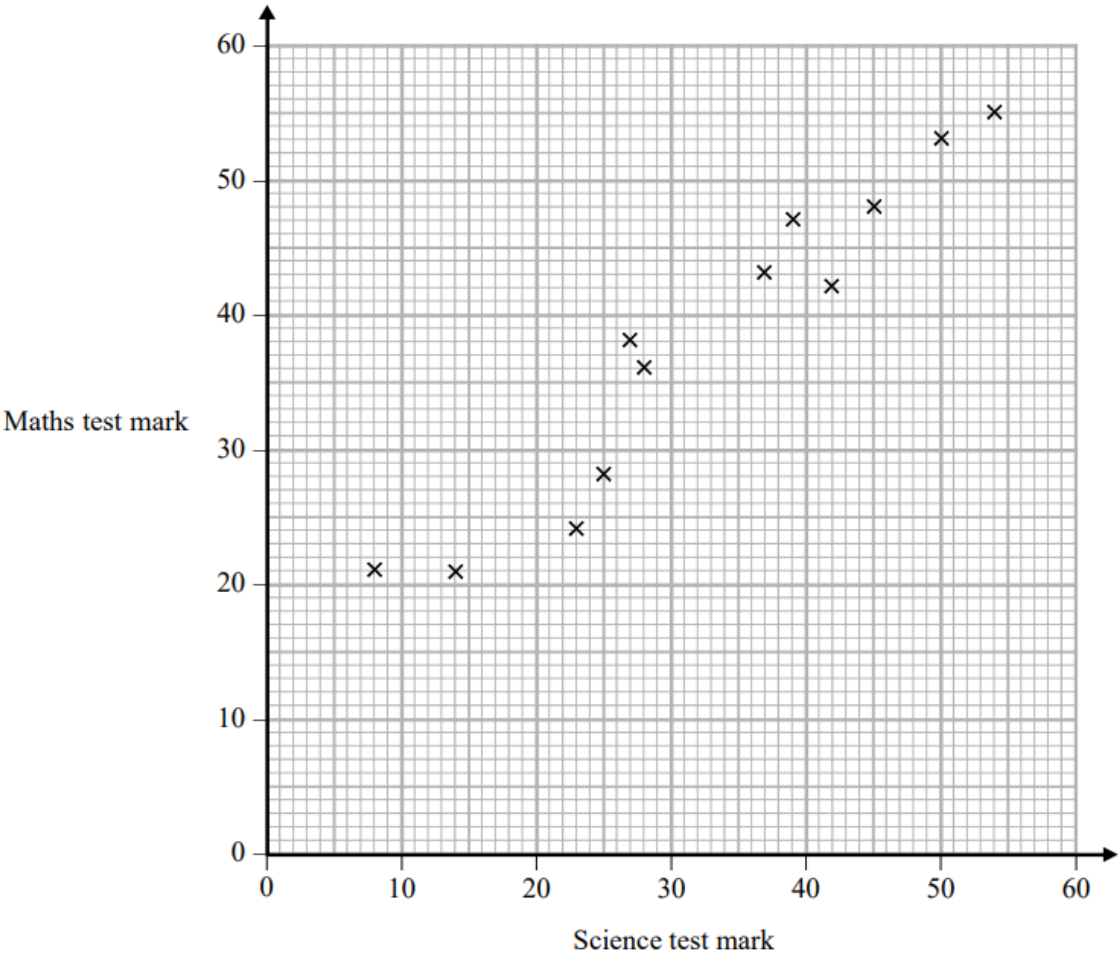
HOME

2	statements	C1	for lobf incorrect Acceptable examples lobf lobf does not suit all points/not a lobf lobf wrong since hits x axis/is inaccurate/should be amongst the crosses lobf goes through the origin/through one point Not acceptable examples no correlation/there is no title
		C1	for height scale not linear Acceptable examples 150 missing Height not linear / Height numbers going up wrong Not acceptable examples 150 graph does not start at 140/graph does not start at 0 height should start at 170



November 2019 Paper 3H (Calc)

- 3 The scatter graph shows information about the marks a group of students got in a Science test and in a Maths test.



Jamie got a mark of 34 in the Science test.

Using the scatter graph, find an estimate for Jamie's mark in the Maths test.

 **Video Solutions**

(2 marks)

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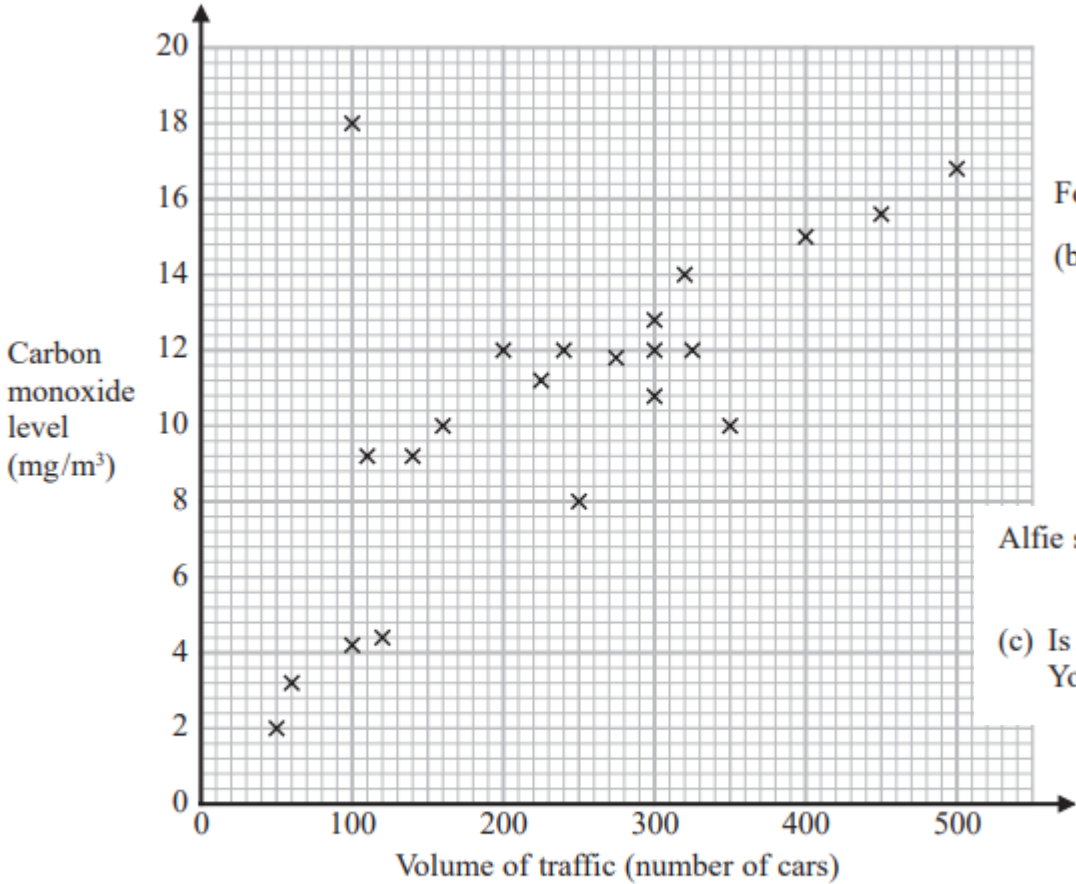
HOME

3	35 to 42	M1	for drawing a suitable line of best fit or for a line from $x = 34$ or for a point marked on the grid at $(34, y)$, y in the range 33 to 44	Line at $x = 34$ does not have to be full length of grid but should be in or reach the data set. Acceptable values for the data set are $y = 33$ to $y = 44$
		A1	answer in the range 35 to 42	



November 2021 Paper 3H (Calc)

1 The scatter graph shows information about the volume of traffic and the carbon monoxide level at a point on a road each day for 22 days.



For another day, 370 cars pass the point on the road.

(b) Estimate the carbon monoxide level for this day.

(2 marks)

Alfie says,
“Because there is an outlier, there is no correlation.”

(c) Is Alfie correct?
You must give a reason for your answer.

(1 mark)

One point is an outlier.

(a) Write down the coordinates of this point.

 **Video Solutions**

(1 mark)



1	(a)	(100,18)	B1	cao
	(b)	12.8 to 14.8	M1	for a method to read off eg line of best fit or line up from 370 or for a point on the grid at (370, y) where y lies between 12.8 and 14.8
			A1	for an answer in the range 12.8 to 14.8
	(c)	Decision and statement	C1	for decision and statement Acceptable examples No, as this point can be disregarded from the general trend No, ignore this point No, the correlation is positive No, because even with an outlier you can still have a negative or positive correlation. No, there is still a correlation. No, as you can use the rest of the data to determine a correlation. No, as outlier does not affect the majority No as a line of best fit can still be drawn No, it is an anomaly Not acceptable examples Yes, Outliers can be ignored [no decision] No, the outlier can be ignored so the correlation is negative No there are other things that can affect the test



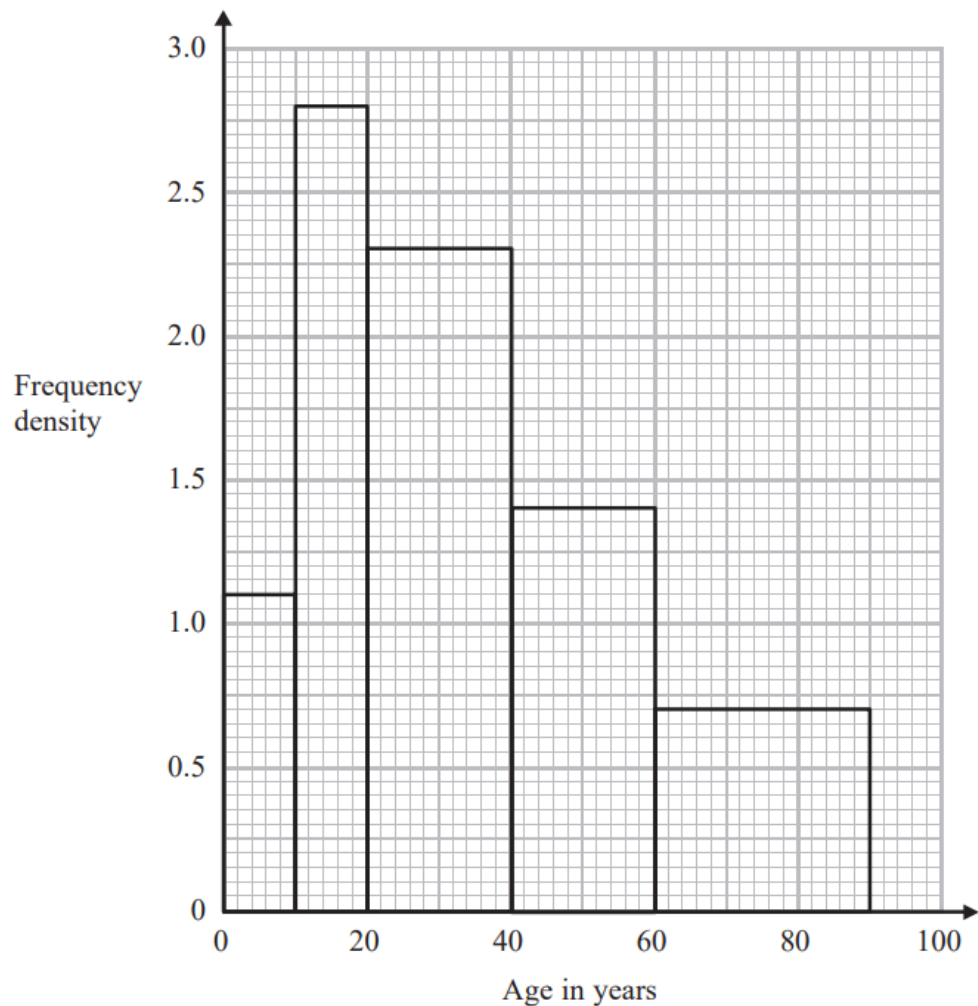
Probability & Statistics

Histograms



Summer 2017 Paper 2H (Calc)

13 The histogram shows some information about the ages of the 134 members of a sports club.



20% of the members of the sports club who are over 50 years of age are female.

Work out an estimate for the number of female members who are over 50 years of age.

 **Video Solutions**
(3 marks)

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Probability & Statistics
Frequency Charts
Histograms



  [HOME](#)

13

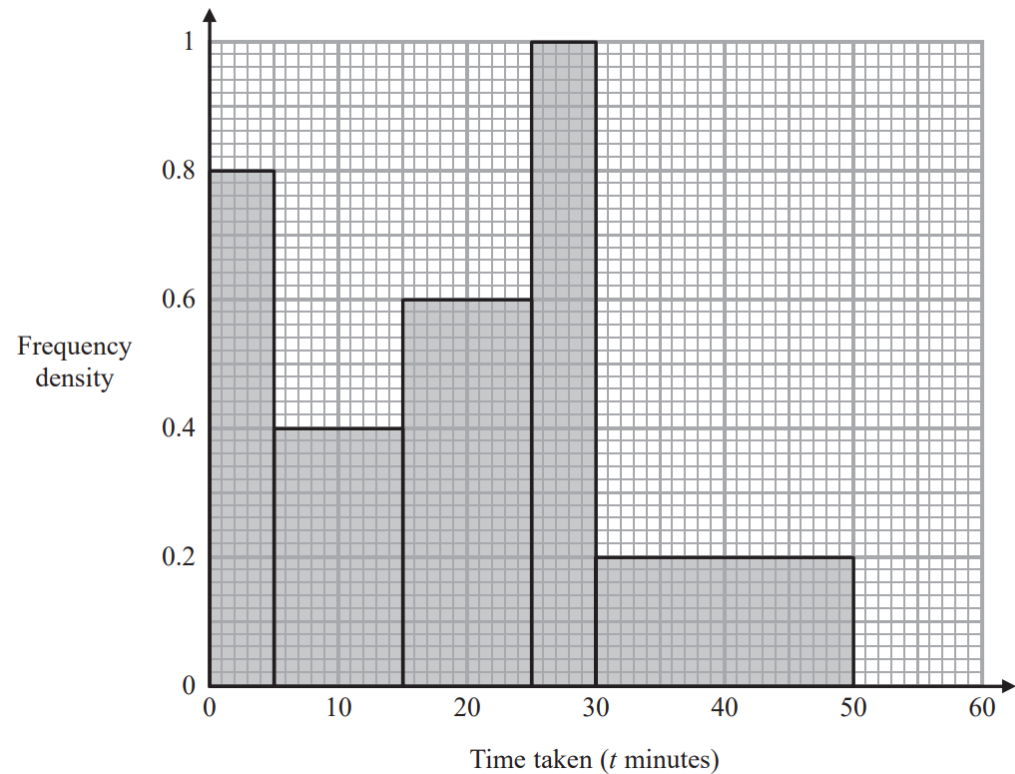
7

- P1 for correct process to find any frequency,
eg. $"1.1" \times 10 (= 11)$ or $"2.8" \times 10 (= 28)$ or $"2.3" \times 20 (= 46)$
or $"1.4" \times 20 (= 28)$ or $"1.4" \times 10 (= 14)$ or $"0.7" \times 30 (= 21)$
- or for a correct process to find the total area and an area of any block,
eg. using $1 \text{ cm}^2 = 1$ unit of area to get 53.6 and one of 4.4, 11.2, 18.4, 11.2, 5.6, 8.4
- P1 (dep P1) for complete process to find 20% of $(\text{"1.4"} \times 10 + \text{"0.7"} \times 30)$,
eg. $\frac{20}{100} \times \text{"35"}$
or $\frac{\text{"5.6"} + \text{"8.4"}}{53.6} \times 134 \times \frac{20}{100}$
- A1 cao



Summer 2018 Paper 2H (Calc)

17 The histogram shows information about the times taken by some students to finish a puzzle.



(a) Complete the frequency table for this information.

Time taken (t minutes)	Frequency
$0 < t \leq 5$	4
$5 < t \leq 15$	
$15 < t \leq 25$	
$25 < t \leq 30$	
$30 < t \leq 50$	

(2 marks)

(b) Find an estimate for the lower quartile of the times taken to finish the puzzle.

(2 marks)



17	(a)	4, 6, 5, 4	M1	for a correct method to find at least 2 frequencies from bars of different widths, eg 10×0.4 (=4), 10×0.6 (=6), 5×1 (=5), 20×0.2 (=4)	Be aware of 10 coming from incorrect working it does not apply to the A1
			A1	cao	
	(b)	10	M1	for $\frac{23+1}{4}$ (=6) or $\frac{23}{4}$ (=5.75) could fit from their table in (a)	
			A1	for 10 or 9.375	



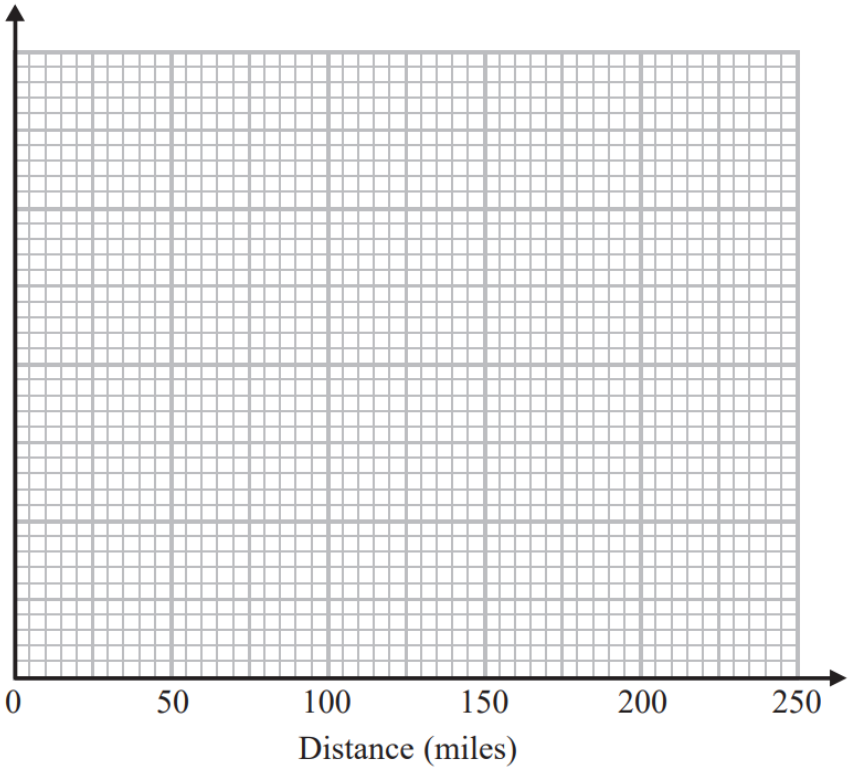
November 2018 Paper 3H (Calc)

17 The table shows information about the distances 570 students travelled to a university open day.

Distance (d miles)	Frequency
$0 < d \leq 20$	120
$20 < d \leq 50$	90
$50 < d \leq 80$	120
$80 < d \leq 150$	140
$150 < d \leq 200$	100

(a) Draw a histogram for the information in the table.

(3 marks)



(b) Estimate the median distance.

(2 marks)

Probability & Statistics

Frequency Charts

Histograms

 **Video Solutions**

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HOME

17	(a)	Histogram drawn	B3	for fully correct histogram eg relative heights 6, 3, 4, 2, 2	
			(B2)	for 4 correct blocks or all 5 frequency $\div$ class interval and 1 correct block)	
			(B1)	for at least 2 correct blocks of different widths or for frequency $\div$ class interval for at least 3 frequencies)	
	(b)	66 to 71	M1	indication of the median in the third interval or proportional method shown	
			A1	ft answer between 66 and 71	Just stating the interval is sufficient for this mark May be implied by the number on the answer line Median is at (approx.) 68.75 by a proportional method



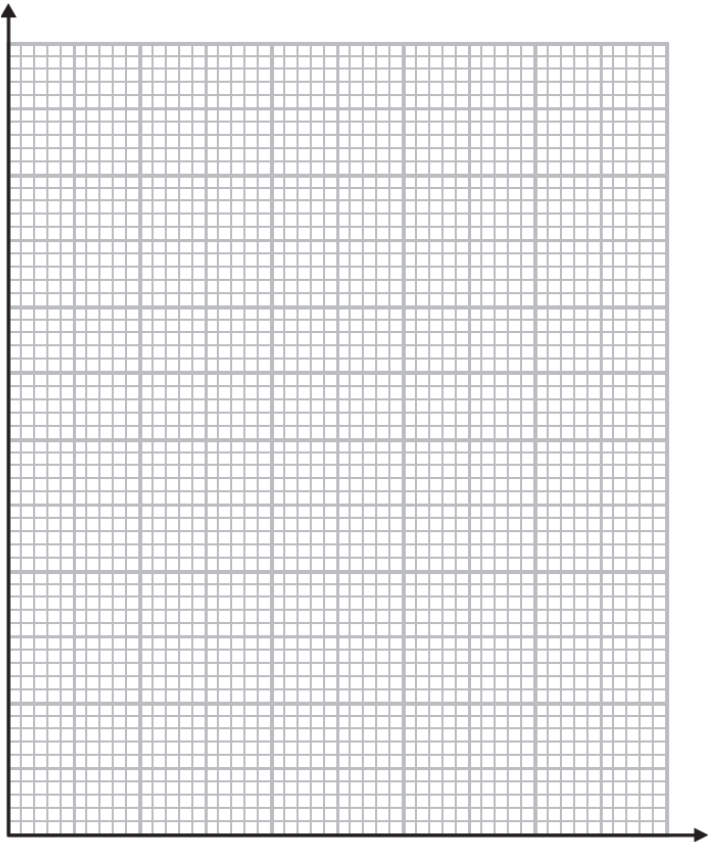
November 2017 Paper 2H (Calc)

17 The table gives information about the heights of 150 students.

Height (h cm)	Frequency
$140 < h \leq 150$	15
$150 < h \leq 155$	30
$155 < h \leq 160$	51
$160 < h \leq 165$	36
$165 < h \leq 180$	18

(a) On the grid, draw a histogram for this information.

(3 marks)



(b) Work out an estimate for the fraction of the students who have a height between 150 cm and 170 cm.

 **Video Solutions**

(2 marks)

**Probability &
Statistics**

Frequency Charts

Histograms

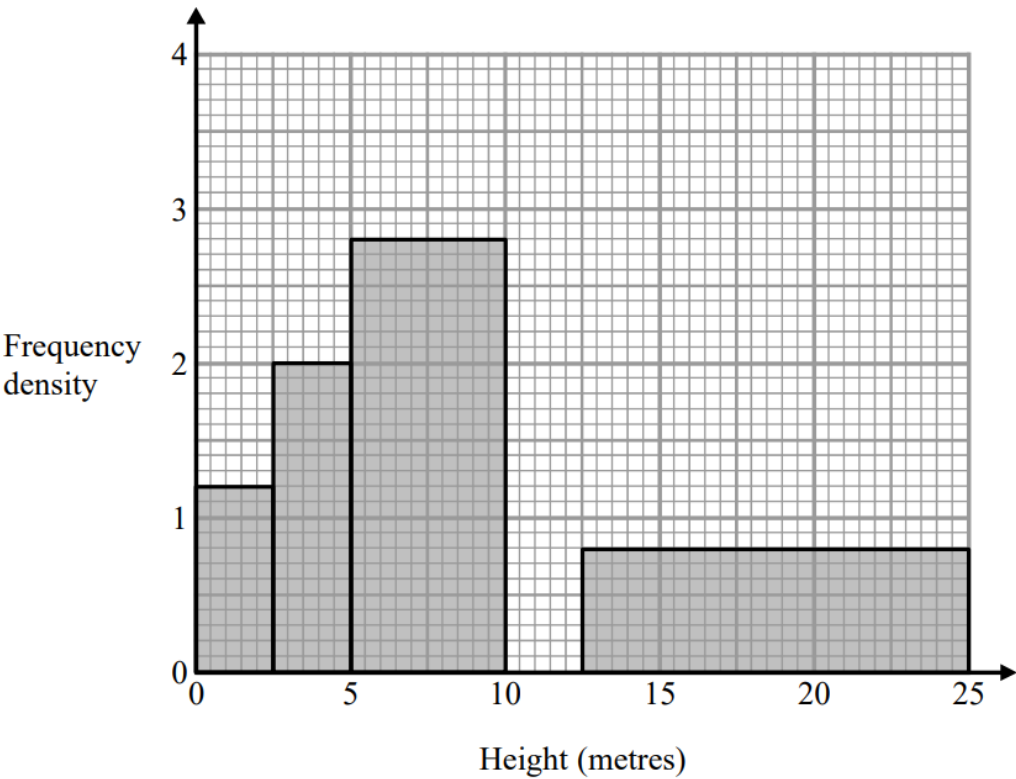


17 (a)	1.5, 6, 10.2, 7.2, 1.2	Histogram drawn	C1	for 2 correct bars of different widths or at least 3 correct frequency densities.
			C1	for all bars in correct proportions or 4 correct bars with axes scaled and labelled.
			C1	for fully correct histogram with axes scaled and labelled.
(b)		$\frac{123}{150}$	M1	for a method to find number of students in interval, eg $30 + 51 + 36 + \frac{1}{3} \times 18 (= 123)$ or $150 - 15 - \frac{2}{3} \times 18 (= 123)$
			A1	for $\frac{123}{150}$ oe or 0.82 or 82%



Probability & Statistics
Frequency Charts
Histograms

- 18 The histogram gives information about the heights, in metres, of the trees in a park. The histogram is incomplete.



20% of the trees in the park have a height between 10 metres and 12.5 metres. None of the trees in the park have a height greater than 25 metres.

Complete the histogram.


Video Solutions

(3 marks)



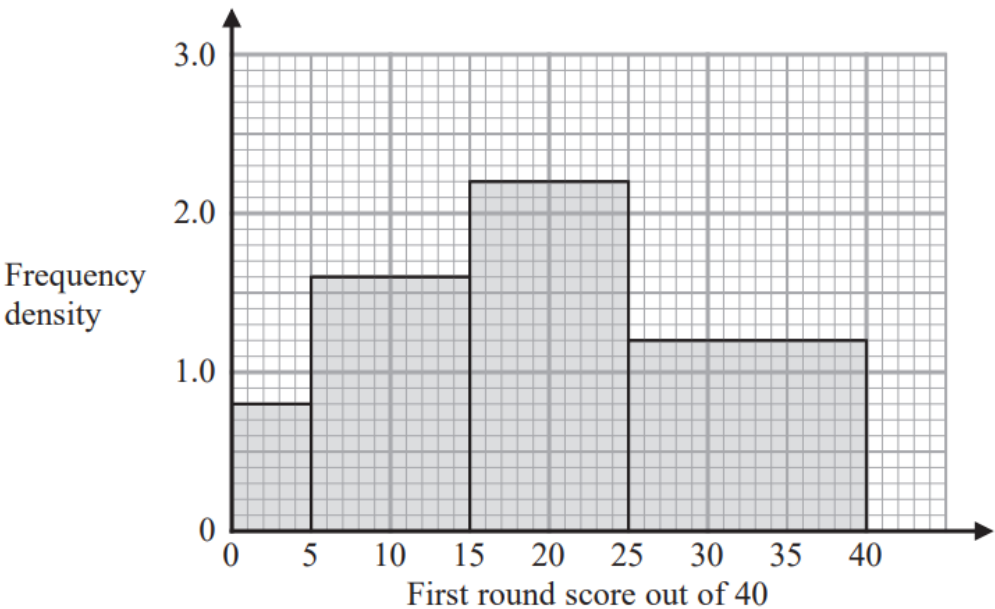
18	Bar of height 3.2	M1	method to find any frequency eg $1.2 \times 2.5 (= 3)$ or $2 \times 2.5 (= 5)$ or $2.8 \times 5 (= 14)$ or $0.8 \times 12.5 (= 10)$ or method to use areas eg $12 \times 5 (=60)$ or $20 \times 5 (=100)$ or $28 \times 10 (=280)$ or $8 \times 25 (=200)$	Accept equivalent methods proportional to those shown
		M1	complete method to find total frequency for the four intervals eg “3” + “5” + “14” + “10” (=32) or “60” + “100” + “280” + “200” (=640)	
		C1	cao	



November 2021 Paper 2H (Calc)

17 Some people took part in the first round of a competition.

The histogram gives information about the scores of these people in the first round.



20% of the people got a score high enough for them to qualify for the second round.

Work out an estimate for the score needed to qualify for the second round.

You must show all your working.

Probability &
Statistics

Frequency Charts

Histograms

 **Video Solutions**

(4 marks)

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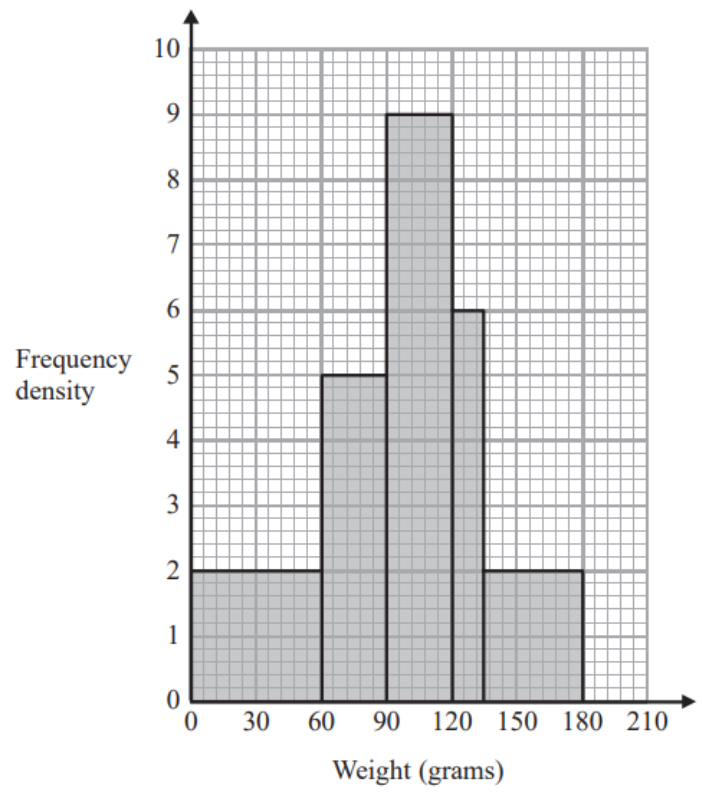
HOME

17	30	P1 for process to find one correct frequency, eg. $0.8 \times 5 (= 4)$ or $1.6 \times 10 (= 16)$ or $2.2 \times 10 (= 22)$ or $1.2 \times 15 (= 18)$ or to find one correct area eg $5 \times 8 (=40)$ or $10 \times 16 (=160)$ or $10 \times 22 (=220)$ or $15 \times 12 (=180)$ P1 for process to find total number of people, eg. “4” + “16” + “22” + “18” (= 60) or for process to find total area eg “40” + “160” + “220” + “180” (= 600) P1 for process to find 20% of the total number of people, eg. “60” $\times 0.2$ oe (= 12) or for process to find 20% of the total area “600” $\times 0.2$ oe (=120) A1 cao	Accept equivalent methods proportional to those shown. Condone 1 error in reading from the graph for 2nd and 3rd P marks NB: correct answer without supportive working gets 0 marks
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Summer 2019 Paper 3H (Calc)

21 The histogram gives information about the distribution of the weights of some onions grown by a farmer.



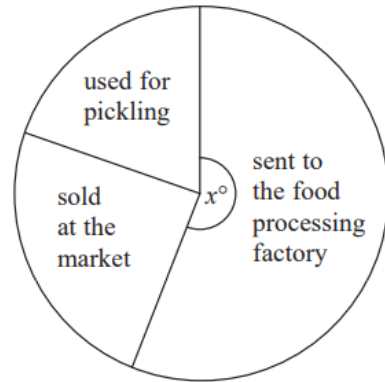
Onions less than 60 grams in weight are used for pickling.
Onions greater than 120 grams in weight are sold at the market.
The rest of the onions are sent to a food processing factory.

Probability & Statistics

Frequency Charts

Histograms and Pie Charts

A pie chart is drawn using the information opposite to show what the farmer does with the onions he grows.



The angle of the sector for the onions sent to the food processing factory is x° .
Work out the value of x .

 **Video Solutions**

(4 marks)

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  **HOME**

21

210

M1

for method to find total frequency,
 $60 \times 2 (= 120) + 30 \times 5 (= 150) + 30 \times 9 (= 270) + 15 \times 6 (= 90)$
 $+ 45 \times 2 (= 90)$ or 720

OR

for method to find the total area, $4 + 5 + 9 + 3 + 3 (= 24 \text{ cm}^2)$

M1

for finding the number of onions less than 60g or greater than 120 g =
 $120 + 90 + 90 (= 300)$,

OR

for finding the number of onions between 60g and 120g
 $= 150 + 270 (= 420)$

OR

for finding the area under the graph less than 60 or greater than 120
 $= 4 + 3 + 3 (= 10 \text{ cm}^2)$

OR

for finding the area under the graph between 60 and 120
 $= 5 + 9 (= 14 \text{ cm}^2)$

M1

(dep M2) for $1 - \frac{300}{720} (= \frac{7}{12})$ oe OR for $\frac{420}{720} (= \frac{7}{12})$ oe OR for $\frac{14}{24} (= \frac{7}{12})$
oe

A1

cao

Accept one error in total for the award of the
method marks

24 must be from adding areas of bars not heights
of bars

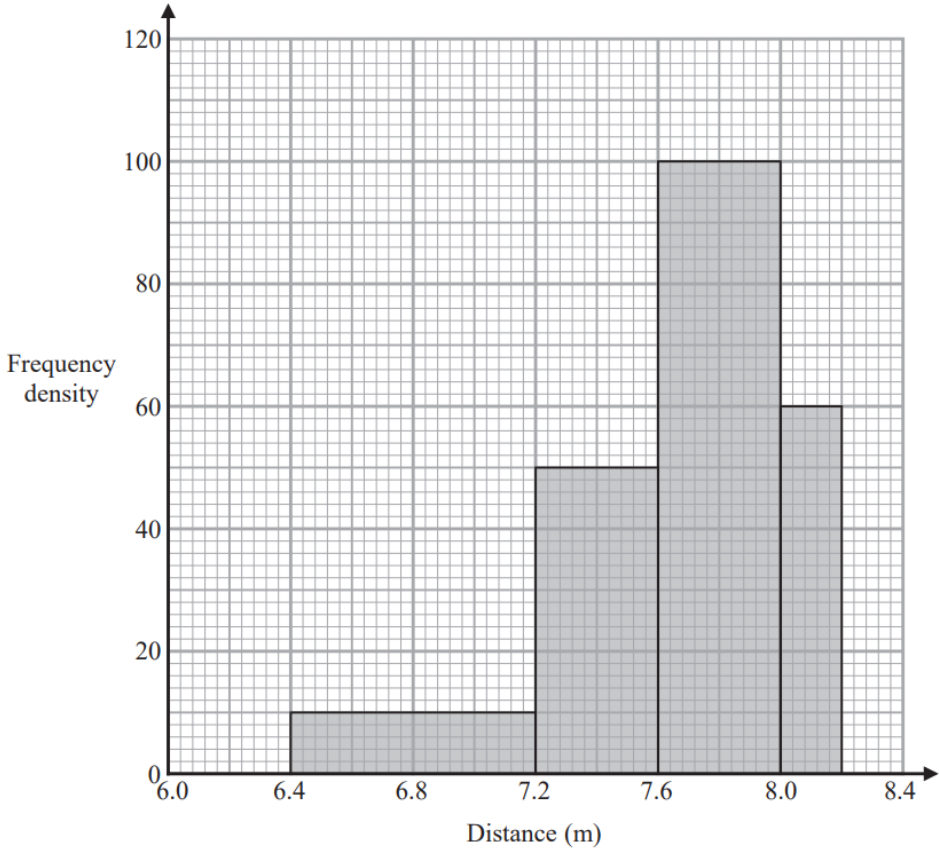
14 must be from adding areas of bars not heights
of bars

Accept 58.3...%



Summer 2020 Paper 3H (Calc)

17 The histogram gives information about the distances 80 competitors jumped in a long jump competition.



Calculate an estimate for the mean distance.

Probability & Statistics

Frequency Charts

*Histograms,
estimating the mean*



 **Video Solutions**

(4 marks)

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HOME

17	7.645	P1	for process to use area to find at least one frequency, eg for first frequency $(7.2 - 6.4) \times 10 (= 8)$ or $(7.2 - 6.4) \times 5 (= 4)$ or $4 \times 5 \times 5 (= 100)$	Frequencies could be written on the graph
		P1	for process to find all frequencies, eg 8, 20, 40, 12 or multiples eg 4, 10, 20, 6 or 100, 250, 500, 150	Marks are for correct processes, one or more frequencies may be incorrect
		P1	(dep P2) for process to estimate mean, eg $((6.8 \times [8]) + (7.4 \times [20]) + (7.8 \times [40]) + (8.1 \times [12])) \div ([8] + [20] + [40] + [12])$	
		A1	for 7.645 (accept 7.65)	Award full marks if a correct answer is seen in working and is then incorrectly rounded.



Probability & Statistics

Cumulative Frequency & Box Plots

Quartiles

Box Plots

Cumulative Frequency
Diagrams



Summer 2019 Paper 1H (Non-Calc)

11 A bus company recorded the ages, in years, of the people on coach A and the people on coach B.

Here are the ages of the 23 people on coach A.

41 42 44 48 52 53 53 53 56 57 57 59
60 61 63 64 64 66 67 69 74 77 79

(a) Complete the table below to show information about the ages of the people on coach A.

Median	
Lower quartile	
Upper quartile	
Least age	41
Greatest age	79

(2 marks)

(2)

Here is some information about the ages of the people on coach B.

Median	70
Lower quartile	54
Upper quartile	73
Least age	42
Greatest age	85

Richard says that the people on coach A are younger than the people on coach B.

(b) Is Richard correct?
You must give a reason for your answer.

(1 mark)

Richard says that the people on coach A vary more in age than the people on coach B.

(c) Is Richard correct?
You must give a reason for your answer.

(1 mark)

Probability & Statistics
Cumulative Frequency & Box Plots
Quartiles

 **Video Solutions**



Summer 2019 Paper 1H (Non-Calc)

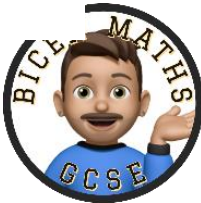
Probability & Statistics
Cumulative Frequency & Box Plots
Quartiles

11	(a)	59, 53, 66	B2	for Median = 59, LQ = 53, UQ = 66, may be seen in working
			(B1)	for one correct)
	(b)	Yes, with reason	C1	for Yes and comment comparing median ages, ft from (a) Acceptable examples “59” < 70 All statistics/values are lower for coach A (so they are younger) Median is lower The middle age is lower on coach A Not acceptable examples Median is higher Median for coach A is “59” and coach B is 70 The oldest on coach A is 79 and the oldest on coach B is 85 There are people on coach B that are older than on coach A
	(c)	No, with reason	C1	for No and comment comparing spreads of ages from ranges or IQRs, ft from (a) Acceptable examples 38 < 43 or “13” < 19 Greater difference between greatest and least age for coach B Range for coach B is larger than coach A The range of ages is wider on coach B than on coach A The range is 5 greater on coach B There is a smaller difference between the lower and upper quantiles on coach A than on coach B The IQR is shorter for coach A Not acceptable examples Quartiles are less for coach A 53 < 54 or 79 < 85 (oe) Range for coach A is 38 and range for coach B is 43 Coach A ranges from 41-79 but coach B ranges from 42-85

Working
A: Range = 38, IQR = “13”
B: Range = 43, IQR = 19

 **Video Solutions**

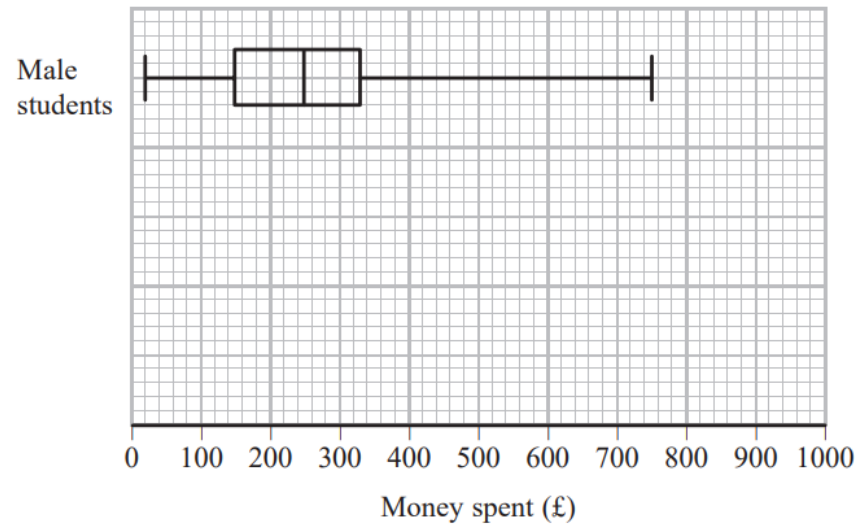
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  **HOME**

Summer 2017 Paper 3H (Calc)

9 The box plot shows information about the distribution of the amounts of money spent by some male students on their holidays.



(a) Work out the interquartile range for the amounts of money spent by these male students.

(2 marks)

The table below shows information about the distribution of the amounts of money spent by some female students on their holidays.

	Smallest	Lower quartile	Median	Upper quartile	Largest
Money spent (£)	60	180	300	350	650

(b) On the grid above, draw a box plot for the information in the table.

(2 marks)

Chris says,

“The box plots show that the female students spent more money than the male students.”

(c) Is Chris correct?
Give a reason for your answer.

(1 mark)

Probability & Statistics

Cumulative Frequency & Box Plots

Box Plots

Video Solutions



Probability & Statistics
Cumulative Frequency & Box Plots
Box Plots

9	(a)		180	M1 A1	for evidence of using the LQ (150) and UQ (330) eg 330 – 150 cao
	(b)	60,180,300,350,650		B2 (B1)	for fully correct box plot for showing a box and at least 3 correctly plotted values
	(c)	Medians 250 and 300	Statement	C1	for a correct comparative statement relevant to the question e.g. Yes because the female students have a greater median than the male students

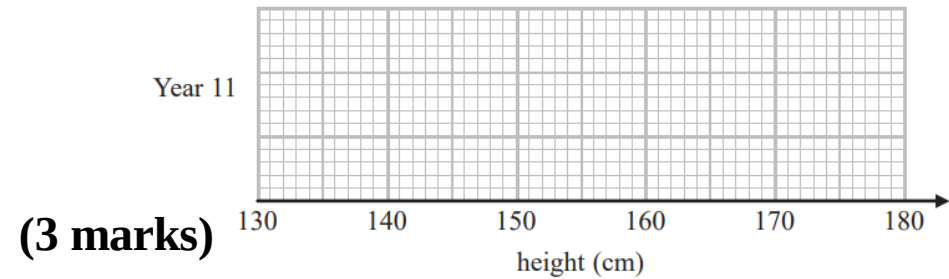


November 2017 Paper 1H (Non-Calc)

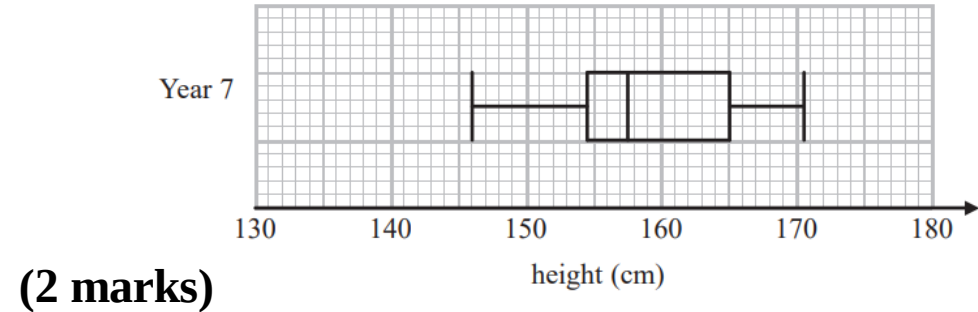
12 The table shows information about the heights, in cm, of a group of Year 11 girls.

	height (cm)
least height	154
median	165
lower quartile	161
interquartile range	7
range	20

(a) Draw a box plot for this information.



The box plot below shows information about the heights, in cm, of a group of Year 7 girls.



(b) Compare the distribution of heights of the Year 7 girls with the distribution of heights of the Year 11 girls.

Probability &
Statistics

Cumulative
Frequency & Box
Plots

Box Plots

 **Video Solutions**



 YouTube

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HOME

Probability & Statistics
Cumulative Frequency & Box Plots
Box Plots

12	(a)	161 + 7 154 + 20	Box plot	M1 M1 A1	for method to find UQ (168) or highest value (174), may be implied by correct values plotted for showing a box and at least 3 correctly plotted values from 154, 161, 165, 168, 174 for fully correct box plot
	(b)	Med IQR Range Y11 165 7 20 Y7 157.5 10.5 24.5	Comparison	C1 C1	(ft) for comparison of the median (ft) for comparison of the spread NB: for award of both marks, at least one comparison must be in context. NB: figures need not be stated, but if they are they must be correct (ft)



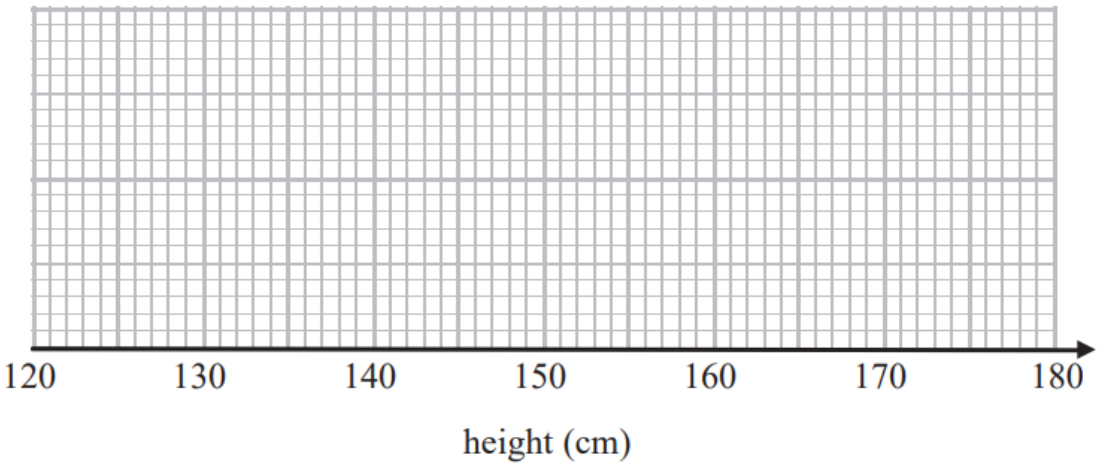
Summer 2018 Paper 1H (Non-Calc)

10 The table gives some information about the heights of 80 girls.

Least height	133 cm
Greatest height	170 cm
Lower quartile	145 cm
Upper quartile	157 cm
Median	151 cm

Probability & Statistics
Cumulative Frequency & Box Plots
Box Plots

(a) Draw a box plot to represent this information. (3 marks)



(b) Work out an estimate for the number of these girls with a height between 133 cm and 157 cm.

 **Video Solutions**

(2 marks)



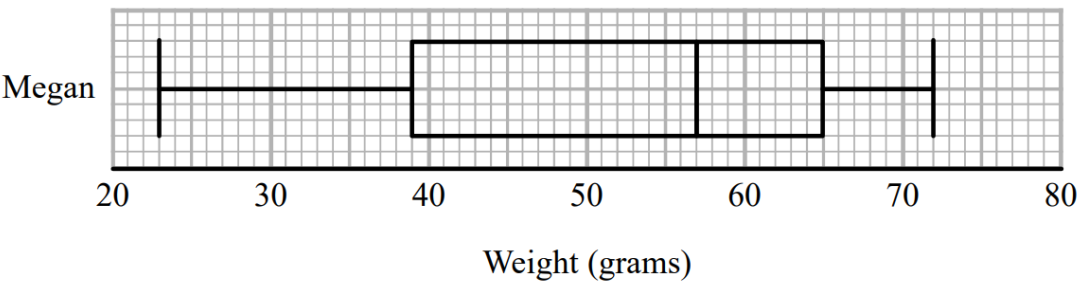
Probability & Statistics
Cumulative Frequency & Box Plots
Box Plots

10	(a)	Box plot drawn	B3	for a fully correct box plot	Condone the lack of a vertical marker at the end of the tails Note that a box must be present, as must “tails”
			(B2	for at least 3 correctly plotted values including box and whiskers/tails)	
			(B1	for at least 2 correctly plotted values including box or whiskers/tails or 5 correct values plotted or clearly identified and no box or whiskers/tails)	
	(b)	60	M1	for a method to find $\frac{3}{4}$ of 80 eg $20 + 20 + 20$ or $\frac{3}{4} \times 80$	
			A1	cao	



11 Megan grows potatoes.

The box plot below shows information about the weights of Megan’s potatoes.



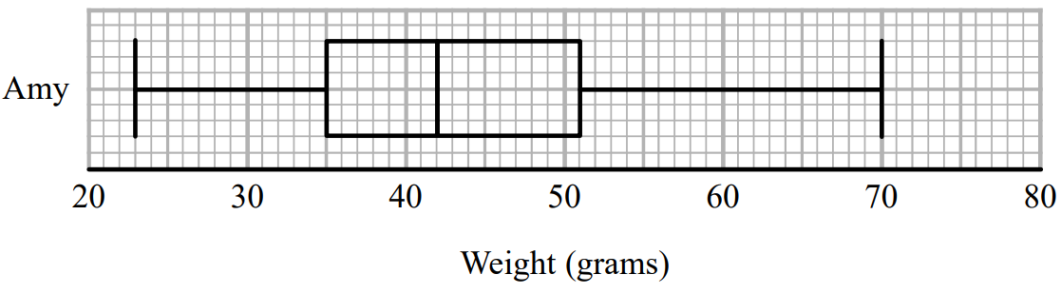
Megan says that half of her potatoes weigh less than 50 grams each.

- (a) Is Megan correct?
Give a reason for your answer.

(1 mark)

Amy also grows potatoes.

The box plot below shows information about the weights of Amy’s potatoes.



- (b) Compare the distribution of the weights of Megan’s potatoes with the distribution of the weights of Amy’s potatoes.

(2 marks)

Probability & Statistics
Cumulative Frequency & Box Plots
Box Plots

Video Solutions



Probability & Statistics
Cumulative Frequency & Box Plots
Box Plots

11	(a)	Explanation	C1	eg 'No' the median is 57	
	(b)	Comparison	C1	(ft) a correct comparison of medians eg the median weight for Megan was greater than the median weight for Amy	Simply quoting values for median, range and IQR is insufficient, they must be compared Median Range IQR Megan 57 49 26 Amy 42 47 16 Figures given must be correct. Comparisons can relate to the range or the IQR
			C1	a correct comparison of a measure of spread eg the interquartile range of weights for Megan was greater than the interquartile range of weights for Amy For the award of both marks at least one of the comparisons must be in the context of the question	

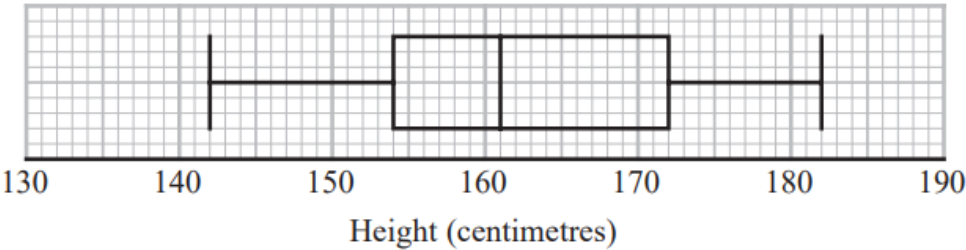


Summer 2020 Paper 2H (Calc)

9 Aisha recorded the heights, in centimetres, of some girls.
She used her results to work out the information in this table.

Least height	142 cm
Lower quartile	154 cm
Interquartile range	17 cm
Median	162 cm
Range	40 cm

Aisha drew this box plot for the information in the table.
The box plot is **not** fully correct.



Write down the two things Aisha should do to make the box plot fully correct.

Probability &
Statistics

Cumulative
Frequency & Box
Plots

Box Plots

 **Video Solutions**

(2 marks)

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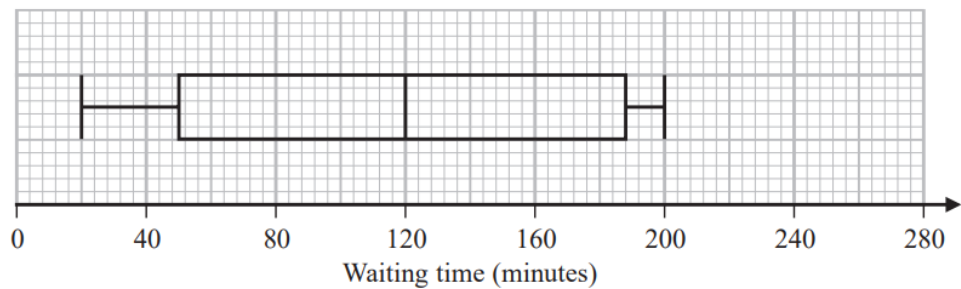
HOME

9	Two changes	C1	plot the median at 162, not 161 oe
		C1	plot the upper quartile at 171, not 172 oe Acceptable examples the median has been plotted at 161 / upper quartile at 172 the upper quartile should be 171 (not 172) UQ is wrong as IQR is 17 not 18 Not acceptable examples the median / upper quartile have been plotted / drawn wrong the upper quartile has been worked out incorrectly She needs to work out the UQ



November 2021 Paper 2H (Calc)

9 The box plot shows information about the length of time, in minutes, some people waited to see a doctor at a hospital on Monday.



(a) Work out the interquartile range of the information in the box plot.

..... minutes
(2)

Becky says,
“50% of the people waited for at least 2 hours.”

(b) Is Becky correct?
Explain why.

(1 mark)

The table gives information about the length of time, in minutes, some people waited to see a doctor at the same hospital on Tuesday.

	Waiting time (minutes)
Shortest time	20
Lower quartile	50
Median	100
Upper quartile	140
Longest time	210

Becky was asked to compare the distribution of the lengths of times people waited on Monday with the distribution of the lengths of times people waited on Tuesday.

She wrote,
“People had to wait longer on Tuesday than on Monday.”

(c) Give **one** reason why Becky may be wrong.

(1 mark)

Probability & Statistics
Cumulative Frequency & Box Plots
Box Plots

Video Solutions



9	(a)	138	M1	for upper quartile = 188 or lower quartile = 50 or an indication that they are trying UQ – LQ	Could be written on the grid																							
			A1	cao																								
(b)	Yes, with reason	C1	Yes, with reason Acceptable examples Yes, because the median is at 2 hour (120 min) Yes, since 50% is at the 2 hour mark Yes, because the middle is at 2 hours Not acceptable examples No The median is at the 2 hour mark Yes, because 50% is exactly half way between “188” and “50”																									
(c)	statement	C1	Acceptable examples The median is lower on Tuesday (higher on Monday) The upper quartile is lower on Tuesday (higher on Monday) There may just have been one person waiting for 210 mins We don’t know how many people were waiting for each time Not acceptable examples The range is bigger for Tuesday (smaller for Monday) The IQR is smaller for Tuesday (bigger for Monday)	<table><tr><td></td><td>M</td><td>T</td></tr><tr><td>Shortest time</td><td>20</td><td>20</td></tr><tr><td>Lower quartile</td><td>50</td><td>50</td></tr><tr><td>Median</td><td>120</td><td>100</td></tr><tr><td>Upper quartile</td><td>188</td><td>140</td></tr><tr><td>Longest time</td><td>200</td><td>210</td></tr><tr><td>Range</td><td>180</td><td>190</td></tr><tr><td>IQR</td><td>138</td><td>90</td></tr></table>		M	T	Shortest time	20	20	Lower quartile	50	50	Median	120	100	Upper quartile	188	140	Longest time	200	210	Range	180	190	IQR	138	90
	M	T																										
Shortest time	20	20																										
Lower quartile	50	50																										
Median	120	100																										
Upper quartile	188	140																										
Longest time	200	210																										
Range	180	190																										
IQR	138	90																										

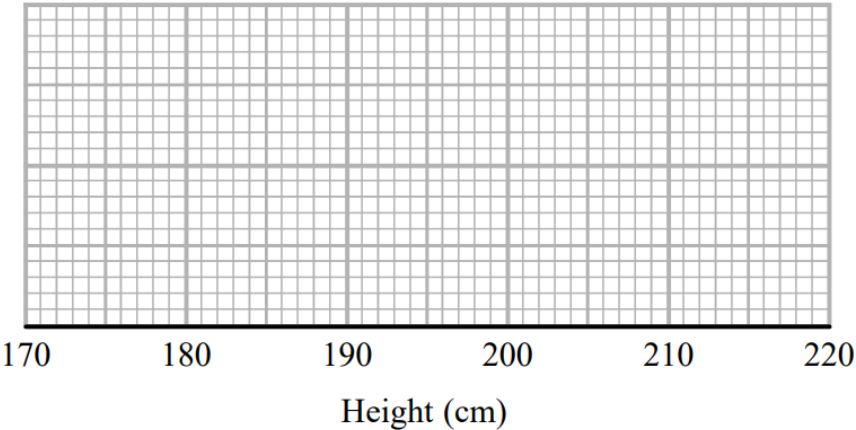


12 The stem and leaf diagram shows information about the heights, in cm, of 23 sunflowers.

17	3	4	9				
18	6	8	8				
19	0	0	1	4	6	7	8
20	1	4	7	7	9	9	
21	4	8	8	9			

Key: 17|3 represents 173 cm

On the grid, draw a box plot for this information.



Probability & Statistics
Cumulative Frequency & Box Plots
Box Plots from Stem and Leaf

 **Video Solutions**

(3 marks)

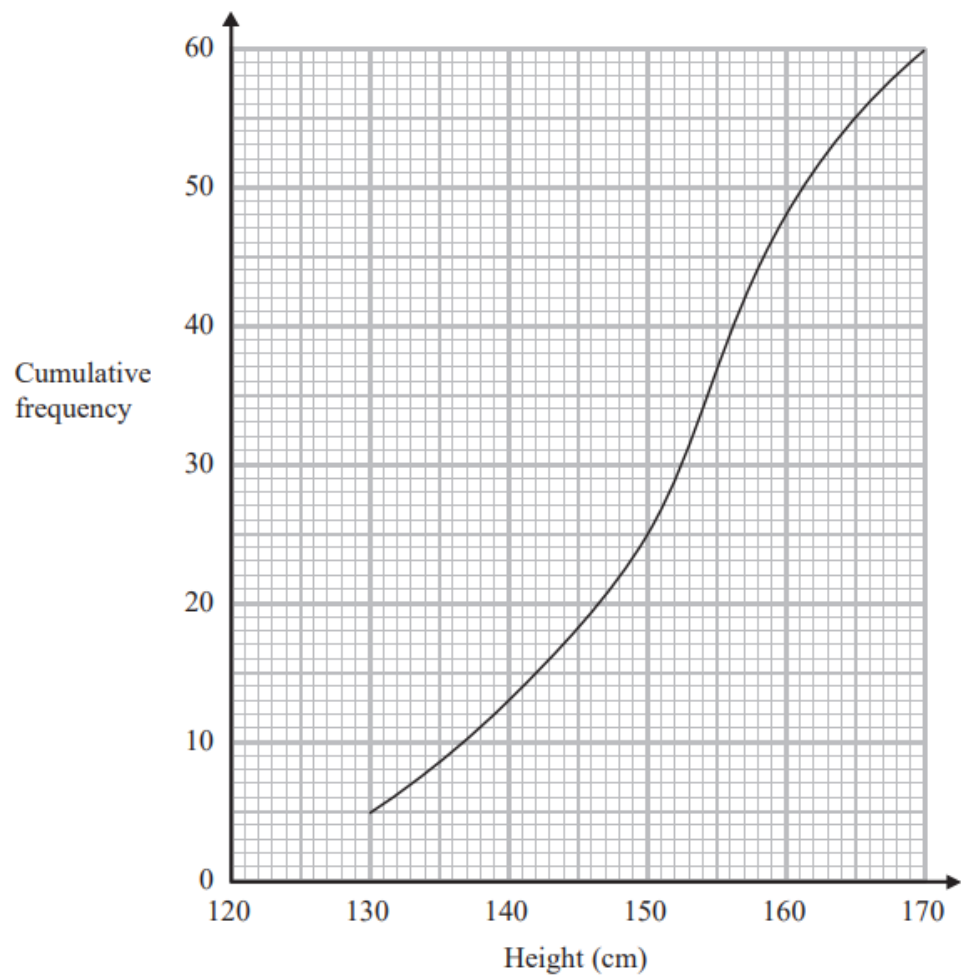


12	Box plot	M1	for correctly identifying one of the LQ (188), median (197) or UQ (209) from the stem leaf	May be implied by one of these values being correctly plotted.
		M1	for showing a box and at least 3 correctly plotted values from 173, 188, 197, 209, 219	
		A1	for a fully correct box plot	



Summer 2017 Paper 2H (Calc)

8 The cumulative frequency graph shows some information about the heights, in cm, of 60 students.



Work out an estimate for the number of these students with a height greater than 160 cm.

Probability & Statistics

Cumulative Frequency & Box Plots

Cumulative Frequency Graphs

 **Video Solutions**
(2 marks)

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Probability & Statistics
Cumulative Frequency & Box Plots
Cumulative Frequency Graphs

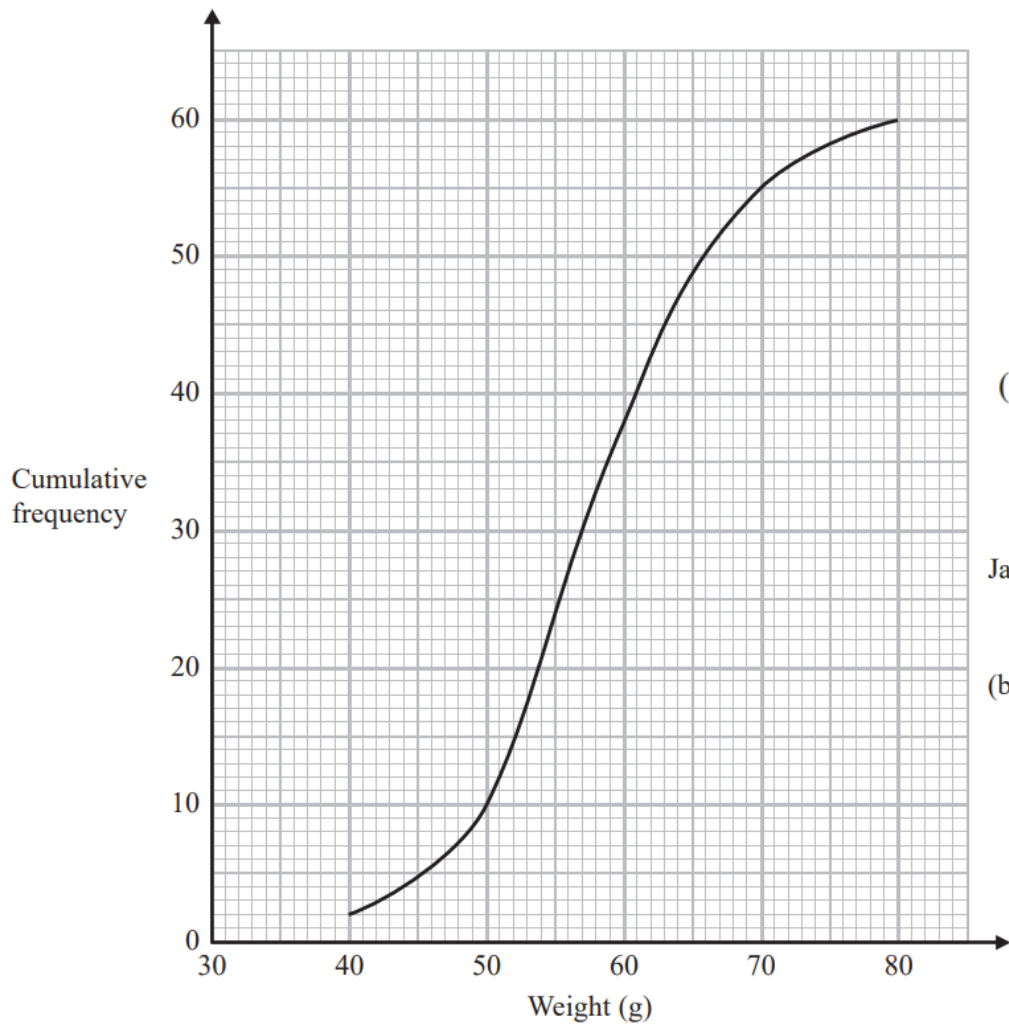
8		12	M1 A1	for evidence of taking a reading from the graph from $h = 160$ for answer in the range 11.8 to 12.2
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 **Video Solutions**



November 2017 Paper 3H (Calc)

11 The cumulative frequency graph shows information about the weights of 60 potatoes.



(a) Use the graph to find an estimate for the median weight.

(1 mark)

Jamil says,

“ $80 - 40 = 40$ so the range of the weights is 40 g.”

(b) Is Jamil correct?
You must give a reason for your answer.

(1 mark)

(c) Show that less than 25% of the potatoes have a weight greater than 65 g.

 **Video Solutions**
(2 marks)



11	(a)	57	B1	cao
	(b)	Decision and reason	C1	Jamil might not be correct and reason, eg the maximum weight could be less than 80 or the minimum weight could be less than 40
	(c)	Shown	C1	for evidence of reading from the graph at weight 65 (= 48 to 49) or at cf 45 (= 63)
			C1	eg 25% of 60 is 15 but only 11 potatoes have a weight greater than 65g or 25% of potatoes have a weight greater than 63g



Summer 2019 Paper 2H (Calc)

11 The grouped frequency table gives information about the times, in minutes, that 80 office workers take to get to work.

Time (t minutes)	Frequency
$0 < t \leq 20$	5
$20 < t \leq 40$	30
$40 < t \leq 60$	20
$60 < t \leq 80$	15
$80 < t \leq 100$	8
$100 < t \leq 120$	2

(a) Complete the cumulative frequency table.

(1 mark)

Time (t minutes)	Cumulative frequency
$0 < t \leq 20$	
$0 < t \leq 40$	
$0 < t \leq 60$	
$0 < t \leq 80$	
$0 < t \leq 100$	
$0 < t \leq 120$	

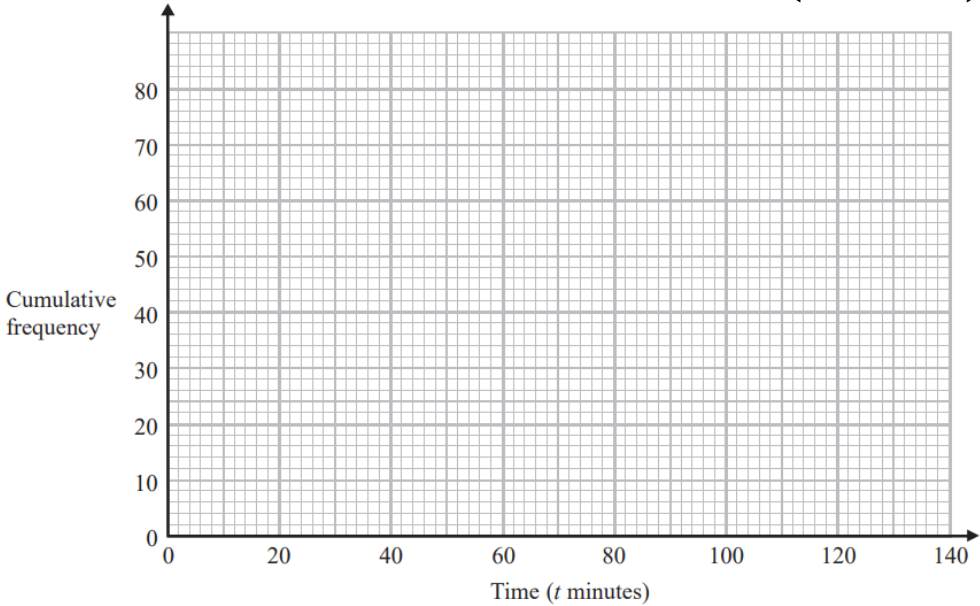
Probability & Statistics

Cumulative Frequency & Box Plots

Cumulative Frequency Graphs

(b) On the grid, draw the cumulative frequency graph for this information.

(2 marks)



(2)

(c) Use your graph to find an estimate for the percentage of these office workers who take more than 90 minutes to get to work.

(3 marks)



Video Solutions

Probability & Statistics
Cumulative Frequency & Box Plots
Cumulative Frequency Graphs

11	(a)	5, 35, 55, 70, 78, 80	B1	cao	
	(b)	cf graph	M1	for 5 or 6 of their points plotted correctly from a cf table	Ignore to the left of the first point and right of the last point
			A1	for a fully correct graph	Accept a smooth curve or line segments
				SCB1 if 5 or 6 of their points plotted not at end but consistent within each interval and joined by a curve or line segments providing no gradient is negative	
	(c)	7.5	M1	for a clear method to read off the cf graph at 90	Sight of 74 or 6 implies M1
			M1	for a full method to find the percentage eg $(80 - "74") \div 80 \times 100 (=7.5)$	The following readings give the following percentages
			A1	for 7.5 or ft cf graph	72 = 10% 73 = 8.75% 74 = 7.5% 75 = 6.25% 76 = 5%



November 2019 Paper 1H (Non-Calc)

10 The cumulative frequency table shows information about the times, in minutes, taken by 40 people to complete a puzzle.

Time (m minutes)	Cumulative frequency
$20 < m \leq 40$	5
$20 < m \leq 60$	25
$20 < m \leq 80$	35
$20 < m \leq 100$	38
$20 < m \leq 120$	40

Probability & Statistics

Cumulative Frequency & Box Plots

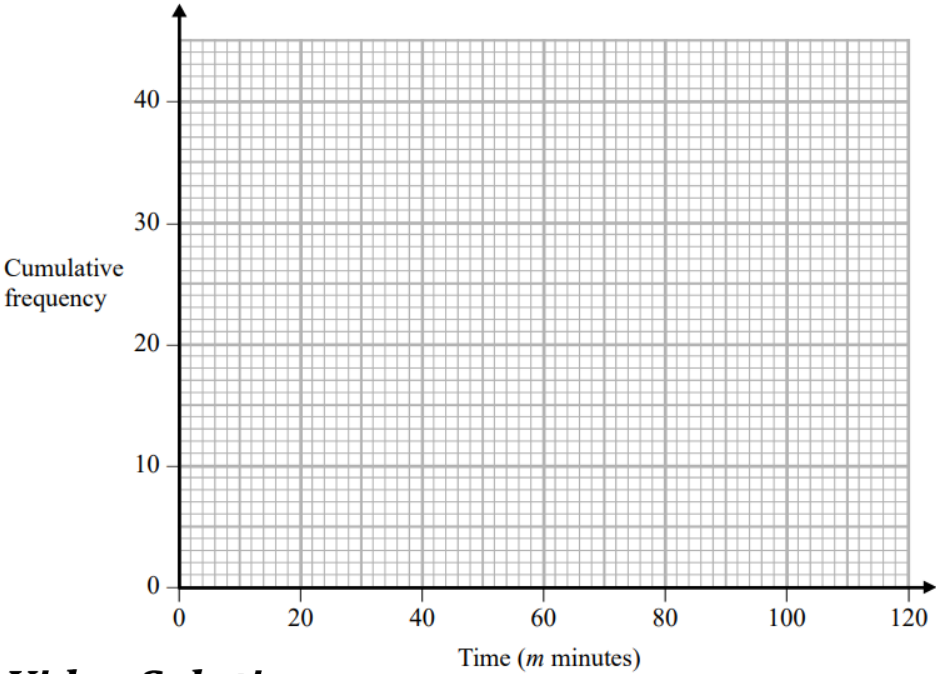
Cumulative Frequency Graphs

(2 marks)

(a) On the grid below, draw a cumulative frequency graph for this information.

(b) Use your graph to find an estimate for the interquartile range.

(2 marks)



One of the 40 people is chosen at random.

(c) Use your graph to find an estimate for the probability that this person took between 50 minutes and 90 minutes to complete the puzzle.

(2 marks)

 **Video Solutions**

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  **HOME**

Probability & Statistics
Cumulative Frequency & Box Plots
Cumulative Frequency Graphs

10	(a)	cf graph through (40, 5), (60, 25), (80, 35), (100, 38) and (120, 40)	C2	for a complete and accurate cf graph	May be a cumulative frequency curve or a cumulative frequency polygon Ignore any graph drawn to the left of the first point If histograms drawn, plots must be identified
			(C1)	for at least 4 or 5 cf values plotted correctly SC: B1 for 4 or 5 points plotted not at end but consistently within each interval and joined provided no gradient is negative	
	(b)	answer in range 21 to 28	M1 A1	for UQ in the range 66 to 70 or LQ in the range 42 to 46 or ft their cf graph for answer in range 21 to 28 or ft their cf graph	
	(c)	answer in the range $\frac{19}{40}$ to $\frac{24}{40}$	M1 A1	for finding the difference between readings taken from the cf axis at points from a mark of 50 and a mark of 90 or ft their graph (if possible) for an answer in the range $\frac{19}{40}$ to $\frac{24}{40}$ or ft their cf graph	Their graph must be a cf graph Accept any equivalent fraction, decimal from 0.475 to 0.6 or percentage from 47.5% – 60%



Summer 2020 Paper 1H (Non-Calc)

12 The table gives information about the weekly wages of 80 people.

Wage (£ w)	Frequency
$200 < w \leq 250$	5
$250 < w \leq 300$	10
$300 < w \leq 350$	20
$350 < w \leq 400$	20
$400 < w \leq 450$	15
$450 < w \leq 500$	10

(a) Complete the cumulative frequency table.

Wage (£ w)	Cumulative frequency
$200 < w \leq 250$	
$200 < w \leq 300$	
$200 < w \leq 350$	
$200 < w \leq 400$	
$200 < w \leq 450$	
$200 < w \leq 500$	

(1)

(b) On the grid opposite, draw a cumulative frequency graph for your completed table.

(2)

Juan says

“60% of this group of people have a weekly wage of £360 or less.”

(c) Is Juan correct?

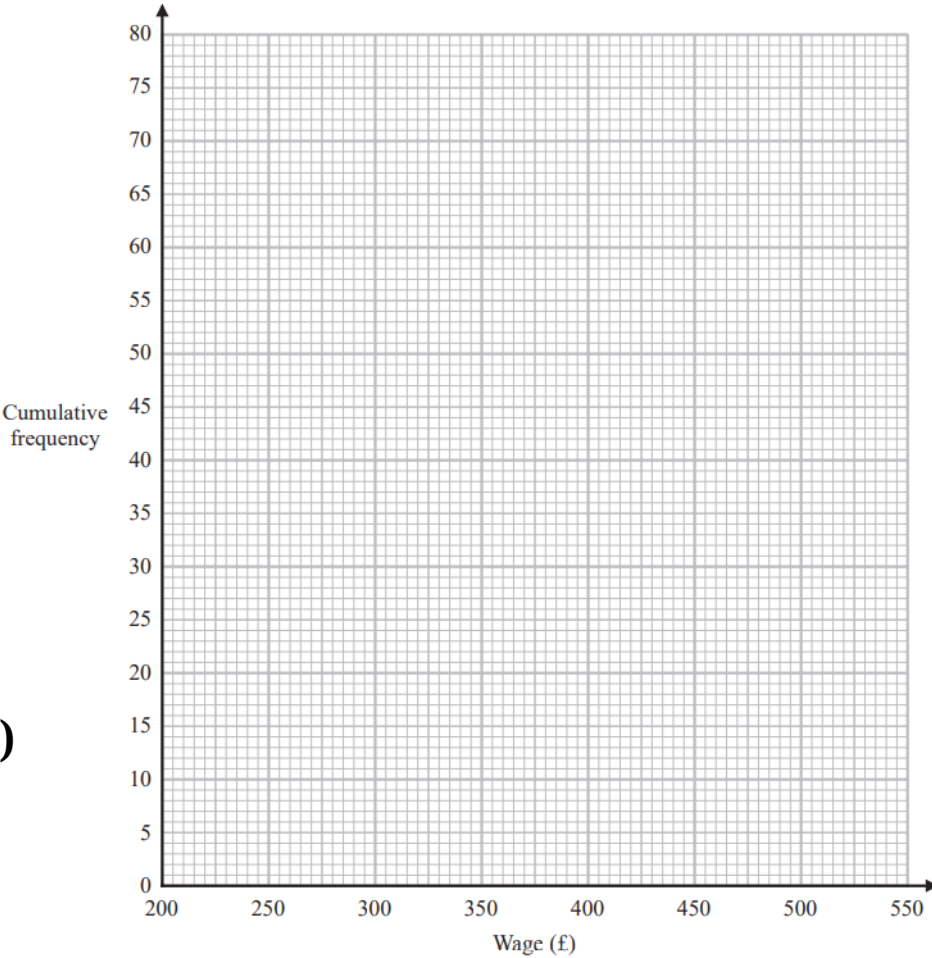
You must show how you get your answer.

(3 marks)

Probability & Statistics

Cumulative Frequency & Box Plots

Cumulative Frequency Graphs



Probability & Statistics
Cumulative Frequency & Box Plots
Cumulative Frequency Graphs

12	(a)	5,15,35,55,70,80	B1	cao	
	(b)	Graph drawn	M1	for 5 or 6 of their points plotted correctly from a cf table	Ignore to the left of the first point and right of the last point
			A1	for a fully correct graph SC B1 if 5 or 6 of their points plotted not at end but consistent within each interval and joined by a curve or line segments providing no gradient is negative	If histograms drawn, points must be identified Accept a smooth curve or line segments
	(c)	Correct decision and correct figures	M1	for $60 \div 100 \times 80 (=48)$ oe	ft from a cum freq graph
				reading value from graph at wage = 360 (=40) or for $35 + \frac{1}{5} \times 20 (=39)$	
			M1	reading value from graph at cf = 48 (=380)	for "40" $\div 80 \times 100 (=50(\%))$ or for $60 \div 100 \times 80 (=48)$
			C1	ft for correct decision and correct figures, eg No with 48 and "380" or with "40" and "50"($\%$) or with "40" and 48	

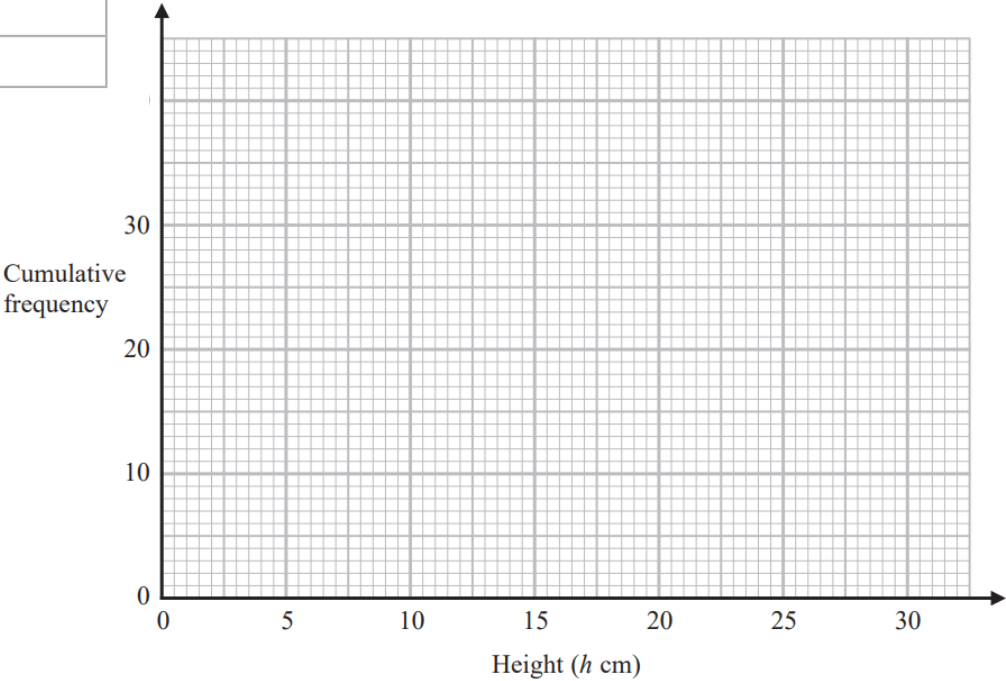


November 2021 Paper 1H (Non-Calc)

12 The cumulative frequency table gives information about the heights, in cm, of 40 plants.

Height (h cm)	Cumulative Frequency
$0 < h \leq 5$	4
$0 < h \leq 10$	11
$0 < h \leq 15$	24
$0 < h \leq 20$	34
$0 < h \leq 25$	38
$0 < h \leq 30$	40

(a) On the grid, draw a cumulative frequency graph for this information.



(2)

(b) Use the graph to find an estimate for the median height of the plants.

Probability & Statistics
Cumulative Frequency & Box Plots
Cumulative Frequency Graphs

Probability & Statistics
Cumulative Frequency & Box Plots
Cumulative Frequency Graphs

12	(a)	cf graph	M1	for 5 or 6 points plotted correctly	If histograms drawn, points must be identified
			A1	for a fully correct graph SC B1 if 5 or 6 of their points plotted not at the end but consistent within each interval and joined by a curve or line segments providing no gradient is negative	Accept a smooth curve or line segments Ignore to the left of the first point and right of the last point
	(b)	13 to 14	B1	for answer in the range 13 to 14 or ft their cf graph	ft only from a cf graph



November 2021 Paper 2H (Calc)

- 8 The grouped frequency table gives information about the time, in minutes, taken by 50 people to solve a puzzle.

Time (t minutes)	Frequency
$0 < t \leq 10$	5
$10 < t \leq 20$	8
$20 < t \leq 30$	12
$30 < t \leq 40$	15
$40 < t \leq 50$	7
$50 < t \leq 60$	3

Brian was asked to draw a cumulative frequency table for this information.

This is the table that Brian drew.

Time (t minutes)	Cumulative frequency
$0 < t \leq 10$	5
$10 < t \leq 20$	13
$20 < t \leq 30$	25
$30 < t \leq 40$	40
$40 < t \leq 50$	47
$50 < t \leq 60$	50

Write down **one** thing that is wrong with this cumulative frequency table.

(1 mark)



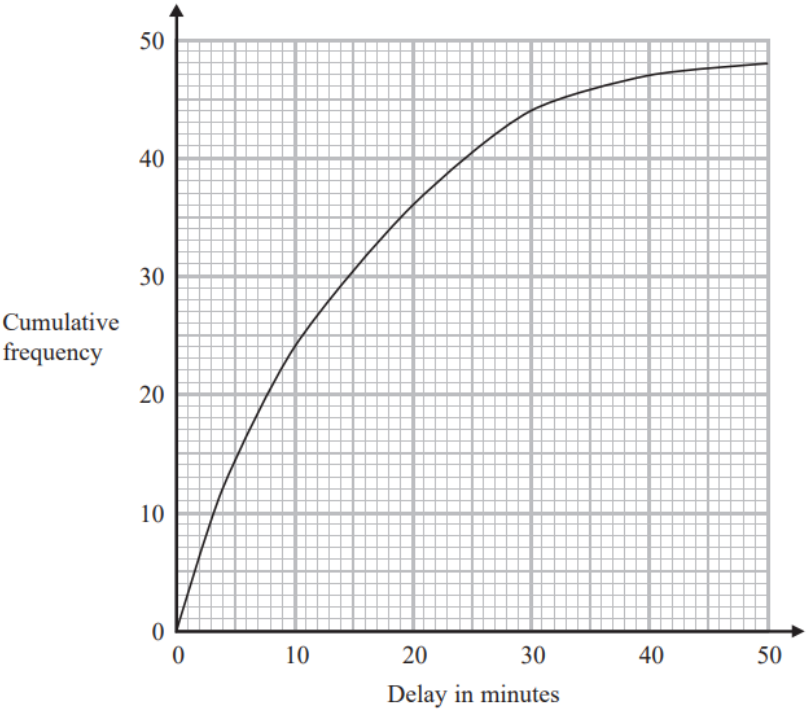
8	Error in inequalites	C1	for identifying incorrect inequalities Acceptable examples gives at least one correct inequality eg $(10 < t \leq 20)$ should be $0 < t \leq 20$ it should be $t \leq 20$ (all) inequalities should start with 0 should start with 0 Not acceptable examples $10 < t \leq 20$ is wrong the numbers have been added wrong
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November 2018 Paper 1H (Non-Calc)

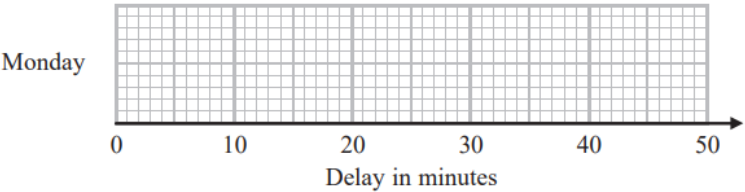
9 The times that 48 trains left a station on Monday were recorded.

The cumulative frequency graph gives information about the numbers of minutes the trains were delayed, correct to the nearest minute.



The shortest delay was 0 minutes.
The longest delay was 42 minutes.

(a) On the grid below, draw a box plot for the information about the delays on Monday.



Video Solutions

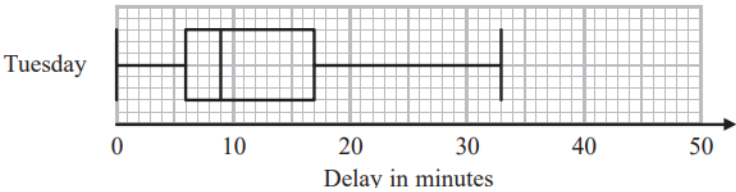
**Probability &
Statistics**

**Cumulative
Frequency & Box
Plots**

All combined

48 trains left the station on Tuesday.

The box plot below gives information about the delays on Tuesday.



(b) Compare the distribution of the delays on Monday with the distribution of the delays on Tuesday.

Mary says,

“The longest delay on Tuesday was 33 minutes.

This means that there must be some delays of between 25 minutes and 30 minutes.”

(c) Is Mary right?

You must give a reason for your answer.



9	(a)	box plot drawn	B1	ends of whiskers at 0 and 42 with a box	The box can be of any height. Accept ends that are marked (eg line, cross, dot) or defined by the end of the whiskers if clear.
			B1	median at 10 inside a box	Has to be inside a box; whiskers not required
			B1	for ends of box at 4 and 20	An independent mark that can be awarded for just a box; do not need whiskers for this mark.
	(b)	Comparison	C1	for a correct comparison of medians, eg. the median delay time on Mon was greater than the median delay time on Tues. or ft (a)	Simply quoting values for median, range and IQR is insufficient, they must be compared
			C1	for a correct comparison of a measure of spread, eg. the interquartile range (range) of delay times on Mon was greater than the interquartile range (range) of delay times on Tues. or ft (a) For the award of both marks at least one of the comparisons must be in context	Comparisons can relate to the median, and then either the range or the IQR.
	(c)	statement	C1	'No' with statement explaining that there might not be any delays between 25 minutes and 30 minutes as in the upper 25% (12 trains) the delays may all be between 17 and 25 or 30 and 33	The 'No' may be implied from their wording, and could be written next to the "?" The statement must mention (or imply) values above the UQ of 17



Probability & Statistics

Capture-Recapture



- 11 There are p counters in a bag.
12 of the counters are yellow.

Shafiq takes at random 30 counters from the bag.
5 of these 30 counters are yellow.

Work out an estimate for the value of p .

 **Video Solutions**

(2 marks)

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11	72	M1	for $\frac{5}{30} = \frac{12}{p}$ oe, eg $\frac{12}{p} \times 30 = 5$ or $12 \div \frac{5}{30}$ or $5 : 30 = 12 : p$ or 1 in 6 ($30 \div 5$) counters are yellow, so $12 \times "6"$ or using equivalent ratios to $5 : 30$, eg. $2 : 12$ and $10 : 60$ and adding to give $2 + 10 : 12 + 60$
		A1	cao



16 Shirley wants to find an estimate for the number of bees in her hive.

On Monday she catches 90 of the bees.

She puts a mark on each bee and returns them to her hive.

On Tuesday she catches 120 of the bees.

She finds that 20 of these bees have been marked.

(a) Work out an estimate for the total number of bees in her hive.

(3 marks)

Shirley assumes that none of the marks had rubbed off between Monday and Tuesday.

(b) If Shirley's assumption is wrong, explain what effect this would have on your answer to part (a).

 **Video Solutions**

(1 mark)

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16	(a)	540	P1	for $\frac{120}{20} (=6)$ or $\frac{20}{120} (=0.16\ldots)$ or $\frac{90}{20} (=4.5)$ or $\frac{20}{90} (=0.22\ldots)$	Decimal values truncated or rounded to 2 dp or more
			P1	for $\frac{20}{120} = \frac{90}{n}$ or $\frac{20}{90} = \frac{120}{n}$ or $\frac{90 \times 120}{20}$ oe	
			A1	cao	
	(b)	Explanation	C1	for explanation Acceptable examples If marks fall off Shirley will have over-estimated the number of bees There will be fewer bees Her amount will go down Not acceptable examples My answer will be wrong It will increase the answer	



Probability & Statistics

Probability

From tables

Relative Frequency

Tree Diagrams

These questions tend to be more challenging, and are usually towards the end of the exam paper:

Multiple Events
(problem solving)

... with algebra



Probability & Statistics
Probability
... from tables

1 The table shows the probabilities that a biased dice will land on 2, on 3, on 4, on 5 and on 6

Number on dice	1	2	3	4	5	6
Probability		0.17	0.18	0.09	0.15	0.1

Neymar rolls the biased dice 200 times.

Work out an estimate for the total number of times the dice will land on 1 or on 3

 **Video Solutions**

(3 marks)



1		98	P1	for process to find P(1), eg. $1 - 0.17 - 0.18 - 0.09 - 0.15 - 0.1 (= 0.31)$ or for a process to find P(1 or 3), eg. $1 - 0.17 - 0.09 - 0.15 - 0.1 (= 0.49)$
			P1	for process to find the number of 3s eg. $0.18 \times 200 (= 36)$ or process to find the number of 1s, e.g. $P(1) \times 200 (= 62)$, or process to find the number of (1 or 3)s, eg. $[P(1) + 0.18] \times 200$ or for process to find any expected frequency using any probability $\times 200$ eg. 0.17×200
			A1	cao
				OR
			P1	for process to find P(2 or 4 or 5 or 6), eg. $0.17 + 0.09 + 0.15 + 0.1 (= 0.51)$
			P1	for process to find the number of (2 or 4 or 5 or 6)s, eg. $"0.51" \times 200 (= 102)$
			A1	cao



- 10 There are only blue counters, yellow counters, green counters and red counters in a bag.
A counter is taken at random from the bag.

The table shows the probabilities of getting a blue counter or a yellow counter or a green counter.

Colour	blue	yellow	green	red
Probability	0.2	0.35	0.4	

- (a) Work out the probability of getting a red counter.

(1 mark)

- (b) What is the least possible number of counters in the bag?
You must give a reason for your answer.

 **Video Solutions**

(2 marks)



10	(a)		0.05	B1	for 0.05 oe
	(b)		20	C1	for stating that at least 20 required
		Reason		C1	for reason eg explains that number of each colour must be a whole number or that there must be (at least) 1 red counter or shows that $0.05 = \frac{1}{20}$



Summer 2018 Paper 3H (Calc)

- 6 There are some counters in a bag.
The counters are red or white or blue or yellow.

Bob is going to take at random a counter from the bag.

The table shows each of the probabilities that the counter will be blue or will be yellow.

Colour	red	white	blue	yellow
Probability			0.45	0.25

There are 18 blue counters in the bag.

The probability that the counter Bob takes will be red is twice the probability that the counter will be white.

- (a) Work out the number of red counters in the bag.

(4 marks)

A marble is going to be taken at random from a box of marbles.
The probability that the marble will be silver is 0.5

There must be an even number of marbles in the box.

- (b) Explain why.

(1 mark)

Probability &
Statistics

Probability

... from tables



Video Solutions



6	(a)	8	P1 for process to find sum of unknown probabilities, eg $1 - 0.45 - 0.25 (= 0.3)$ OR to find the total number of counters in the bag, eg $\frac{18}{0.45} (= 40)$ OR to find the number of yellow counters, eg $\frac{0.25}{0.45} \times 18 (= 10)$ P1 for process to find $P(\text{red}) = 0.2$ oe or $P(\text{white}) = 0.1$ oe OR for process to find the total number of red and white counters, eg “40” – 18 – “10” (=12) OR for process to derive an equation in x, eg $2x + x = 1 - 0.45 - 0.25$ or $2x + x = \text{“0.3”}$ or $x = 0.1$ P1 for a complete process to find the number of red counters, eg $\frac{2 \times 0.1}{0.45} \times 18$ or $\frac{2}{3} \times \text{“12”}$ or $0.2 \times \text{“40”}$ or $\frac{0.2}{0.025}$ A1 cao C1 for explanation eg 0.5 multiplied by an odd number will never be a whole number, for half of a number to be an integer that number must be even, you can’t have half a marble	Award mark for any two probabilities given that sum to 0.3 eg given in the table. Award P2 for $P(\text{red})$ or $P(\text{white})$ (could be shown in table) Equations could be given as written statements or working but must be fully equivalent.
(b)	Explanation			



Summer 2019 Paper 1H (Non-Calc)

1 There are only blue cubes, red cubes and yellow cubes in a box.

The table shows the probability of taking at random a blue cube from the box.

Colour	blue	red	yellow
Probability	0.2		

The number of red cubes in the box is the same as the number of yellow cubes in the box.

(a) Complete the table.

(2 marks)

(2)

There are 12 blue cubes in the box.

(b) Work out the total number of cubes in the box.

Probability &
Statistics

Probability

... from tables

 **Video Solutions**

(2 marks)

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HOME

1	(a)	0.4, 0.4	P1	for process to find sum of unknown probabilities, eg $1 - 0.2 (= 0.8)$	Award mark for any two probabilities given that sum to 0.8, eg given in the table Accept any equivalent fraction or 40%
			A1	oe	
	(b)	60	P1	for complete process to find total number of cubes, eg $12 \div 0.2$ or 12×5 or $(“0.4” \div 0.2) \times 12 + (“0.4” \div 0.2) \times 12 + 12$	
			A1	OR states $0.1 = 6$ or $0.4 = 24$ cao	



Summer 2020 Paper 3H (Calc)

- 8 There are some counters in a bag.
The counters are blue or green or red or yellow.

The table shows the probabilities that a counter taken at random from the bag will be blue or will be green.

Colour	blue	green	red	yellow
Probability	0.32	0.20		

The probability that a counter taken at random from the bag will be red is five times the probability that the counter will be yellow.

There are 300 counters in the bag.

Work out the number of yellow counters in the bag.

Probability &
Statistics

Probability

... from tables

 **Video Solutions**

(3 marks)

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Probability & Statistics
Probability
... from tables

8	24	P1	for start to process of working out the unknown probabilities, eg $1 - 0.32 - 0.20 (= 0.48)$ or assigning probabilities as $5x$ and x or process to work out the number of blue or green counters, eg $0.32 \times 300 (= 96)$ or $0.20 \times 300 (= 60)$ or $0.52 \times 300 (= 156)$	Award for $P(R) + P(Y) = 0.48$, may be seen in table
		P1	for process to find the probability, eg $5x + x = "0.48"$ or $"0.48" \div 6 (= 0.08)$ or process to find the number of red or yellow counters, eg $300 - "96" - "60"$ or $300 \times "0.48"$	
		A1	cao	



November 2021 Paper 3H (Calc)

6 In a bag there are only red counters, blue counters, green counters and pink counters. A counter is going to be taken at random from the bag.

The table shows the probabilities of taking a red counter or a blue counter.

Colour	red	blue	green	pink
Probability	0.05	0.15		

The probability of taking a green counter is 0.2 more than the probability of taking a pink counter.

(a) Complete the table.

(2 marks)

There are 18 blue counters in the bag.

(b) Work out the total number of counters in the bag.

Probability & Statistics

Probability

... from tables

 **Video Solutions**

(2 marks)



HOME

6	(a)	0.5, 0.3	P1	for $1 - 0.05 - 0.15 (= 0.8)$	Award this mark for any two probabilities that sum to 0.8
			A1	oe	
	(b)	120	M1	$18 \div 0.15$ oe or $6 + 18 + a + b$ where $a + b = 96$	
			A1	cao	



8 When a drawing pin is dropped it can land point down or point up.

Lucy, Mel and Tom each dropped the drawing pin a number of times.

The table shows the number of times the drawing pin landed point down and the number of times the drawing pin landed point up for each person.

	Lucy	Mel	Tom
point down	31	53	16
point up	14	27	9

Rachael is going to drop the drawing pin once.

- (a) Whose results will give the best estimate for the probability that the drawing pin will land point up?
Give a reason for your answer.

(1 mark)

Stuart is going to drop the drawing pin twice.

- (b) Use all the results in the table to work out an estimate for the probability that the drawing pin will land point up the first time and point down the second time.

 **Video Solutions**

(2 marks)



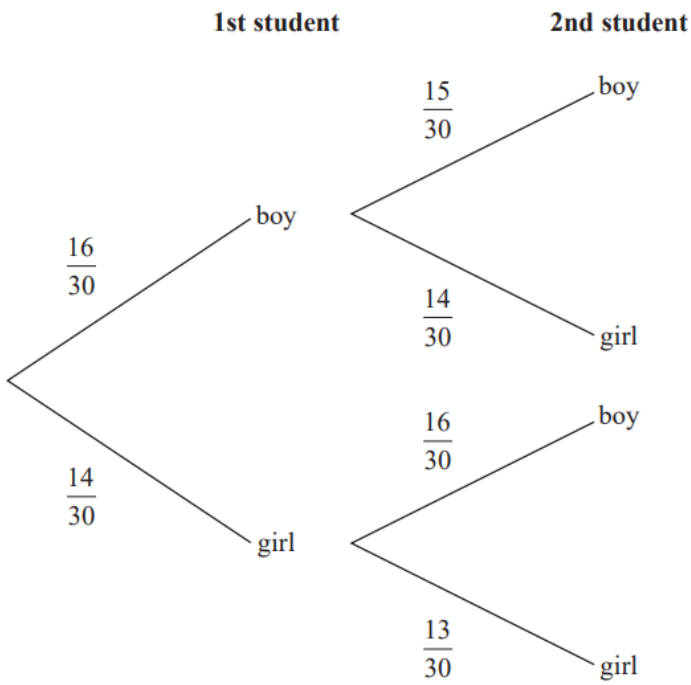
Probability & Statistics
Probability
Relative Frequency

8	(a)		Mel (supported)	B1	Mel with reference to greatest number of throws
	(b)		$\frac{2}{9}$	M1	selects overall total and multiplies P(point up)×P(point down) eg $\frac{50}{150} \times \frac{100}{150}$ oe (accept $\frac{14}{45} \times \frac{31}{45}$ or $\frac{27}{80} \times \frac{53}{80}$ or $\frac{9}{25} \times \frac{16}{25}$)
				A1	for $\frac{2}{9}$ oe



Summer 2017 Paper 2H (Calc)

- 12 There are 30 students in Mr Lear's class.
16 of the students are boys.
- Two students from the class are chosen at random.
- Mr Lear draws this probability tree diagram for this information.



(1 mark)

(a) Write down **one** thing that is wrong with the probabilities in the probability tree diagram.

Owen and Wasim play for the school football team.

The probability that Owen will score a goal in the next match is 0.4
The probability that Wasim will score a goal in the next match is 0.25

Mr Slater says,
“The probability that both boys will score a goal in the next match is $0.4 + 0.25$ ”

(b) Is Mr Slater right?
Give a reason for your answer.

(1 mark)

Probability & Statistics
Probability
Probability Trees

 **Video Solutions**



Probability & Statistics
Probability
<i>Probability Trees</i>

12	(a)		comment	C1	for comment e.g. incorrect denominator for the 2nd student or probabilities for 2 nd student do not add up to 1
	(b)		No (supported)	C1	for "no" with supporting evidence, e.g. probabilities should be multiplied together or 0.4×0.25



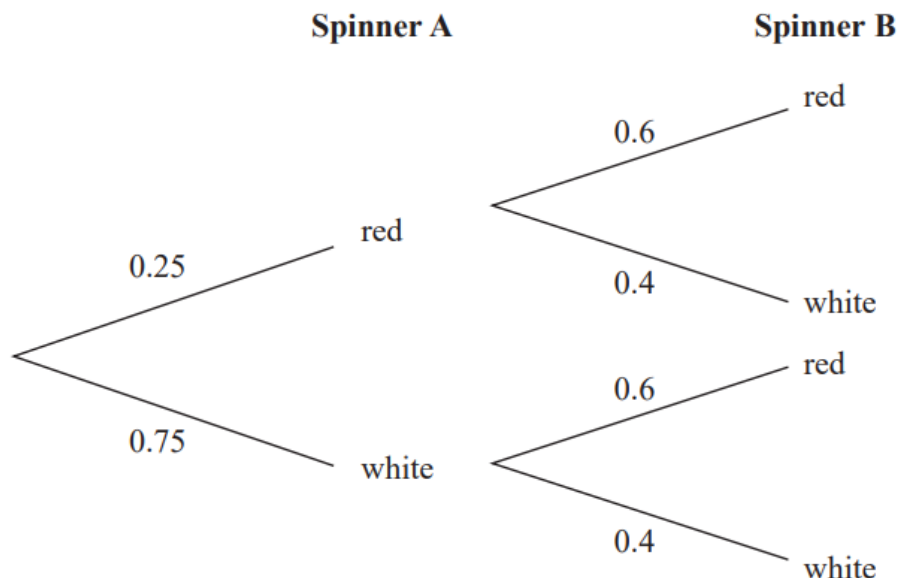
November 2017 Paper 3H (Calc)

- 12 Alan has two spinners, spinner A and spinner B.
Each spinner can land on only red or white.

The probability that spinner A will land on red is 0.25

The probability that spinner B will land on red is 0.6

The probability tree diagram shows this information.



Alan spins spinner A once and he spins spinner B once.
He does this a number of times.

The number of times **both** spinners land on red is 24

Work out an estimate for the number of times **both** spinners land on white.

**Probability &
Statistics**

Probability

Probability Trees

 **Video Solutions**

(3 marks)

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Probability & Statistics
Probability
<i>Probability Trees</i>

12

48

M1

for $0.25 \times 0.6 (= 0.15)$ or $0.75 \times 0.4 (= 0.3)$

M1

for $0.25 \times 0.6 (= 0.15)$ and $0.75 \times 0.4 (= 0.3)$ or for $24 \div "0.15" (= 160)$

A1

cao

 **Video Solutions**



Summer 2018 Paper 3H (Calc)

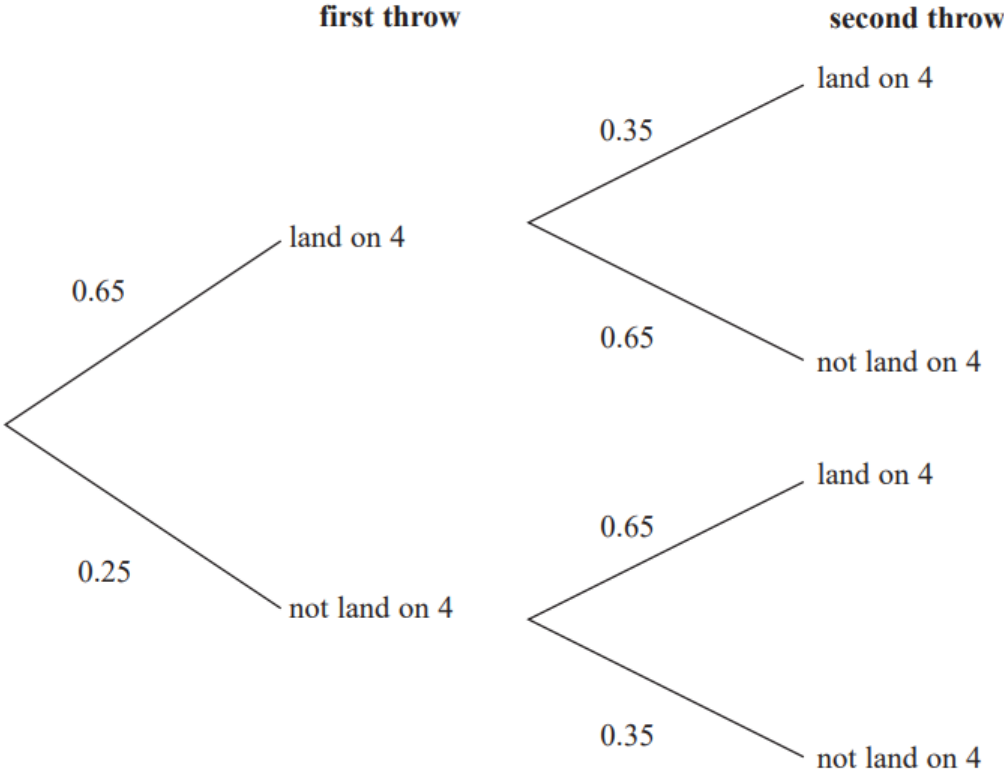
Probability &
Statistics

Probability

Probability Trees

- 4 When a biased 6-sided dice is thrown once, the probability that it will land on 4 is 0.65
The biased dice is thrown twice.

Amir draws this probability tree diagram.
The diagram is **not** correct.



Write down **two** things that are wrong with the probability tree diagram.

 **Video Solutions**

(2 marks)

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HOME

4

Probabilities
should sum to 1

0.35 and 0.65
reversed

- C1 for stating that the probabilities should total 1
eg 0.25 should be 0.35
- C1 for recognising that the 0.35 and 0.65 in the first branches for the 2nd
throw should be reversed
eg, “for the second throw, the probability it lands on 4 should be 0.65”

Can be shown on the diagram



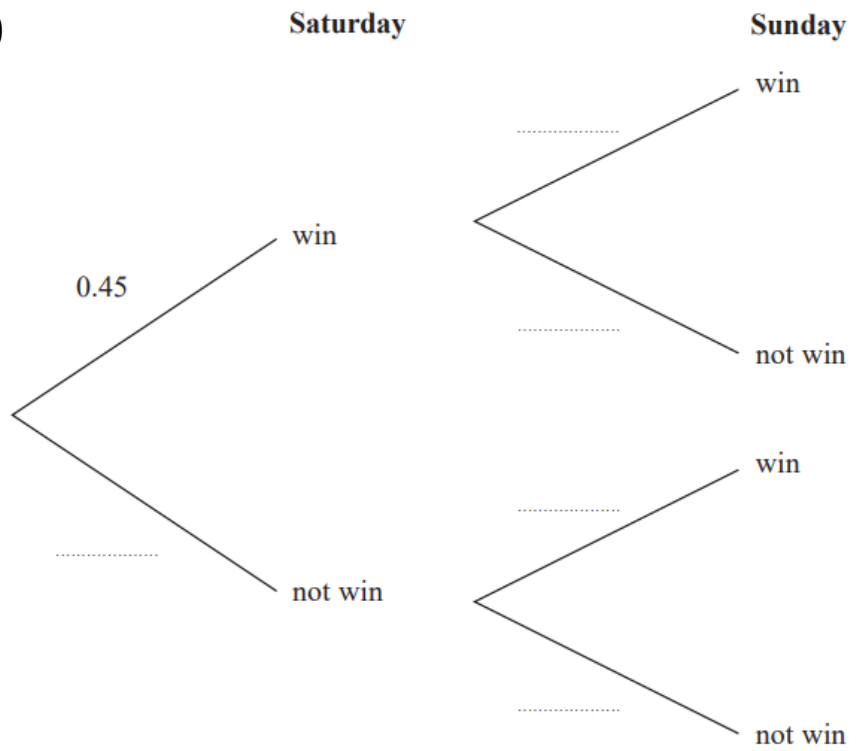
Summer 2018 Paper 2H (Calc)

15 A darts team is going to play a match on Saturday and on Sunday.
The probability that the team will win on Saturday is 0.45

If they win on Saturday, the probability that they will win on Sunday is 0.67
If they do **not** win on Saturday, the probability that they will win on Sunday is 0.35

(a) Complete the probability tree diagram.

(2 marks)



(b) Find the probability that the team will win exactly one of the two matches.

Video Solutions

(3 marks)

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Probability & Statistics
Probability
Probability Trees



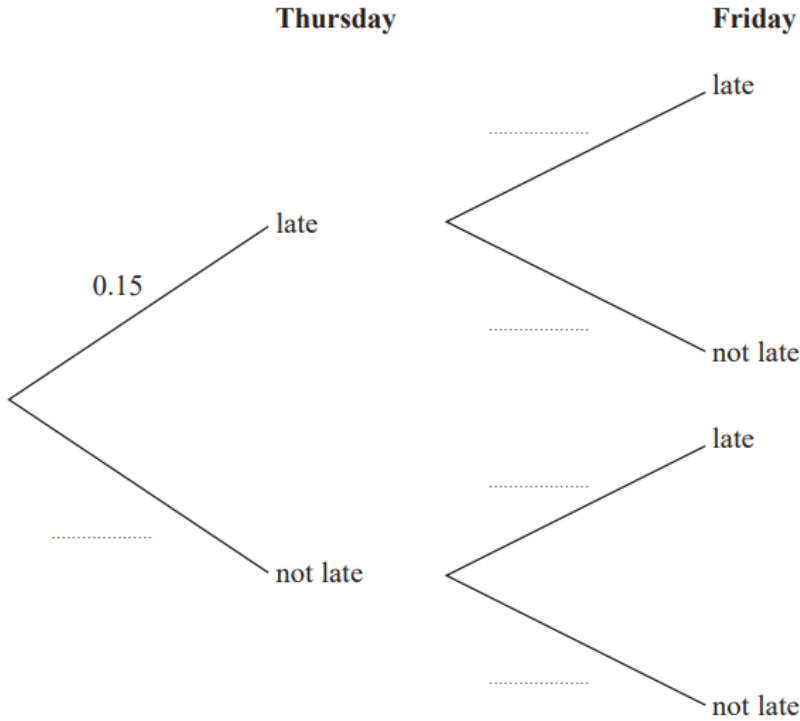
15	(a)	0.55, 0.67, 0.33, 0.35, 0.65	B1	for 0.55 in correct position	Can be seen as fractions or percentages
			B1	for the branches for the second game correct	
	(b)	0.341	M1	for one correct product, eg $0.45 \times "0.33" (=0.1485)$ or $"0.55" \times "0.35" (=0.1925)$ or $0.45 \times "0.67" (=0.3015)$ or $"0.55" \times "0.65" (=0.3575)$	
			M1	for correct method eg $(0.45 \times "0.33") + ("0.55" \times "0.35")$ or $1 - (0.45 \times "0.67") - ("0.55" \times "0.65")$	
			A1	answer in range 0.34 – 0.341 oe	Follow through acceptable for method marks from their tree in part (a) providing probabilities are less than 1. Accept fractional equivalents



Summer 2019 Paper 2H (Calc)

10 Mary travels to work by train every day.
The probability that her train will be late on any day is 0.15

(a) Complete the probability tree diagram for Thursday and Friday.



(2 marks)

(2)

(b) Work out the probability that her train will be late on at least one of these two days.

 **Video Solutions**

(3 marks)

Probability & Statistics
Probability
Probability Trees

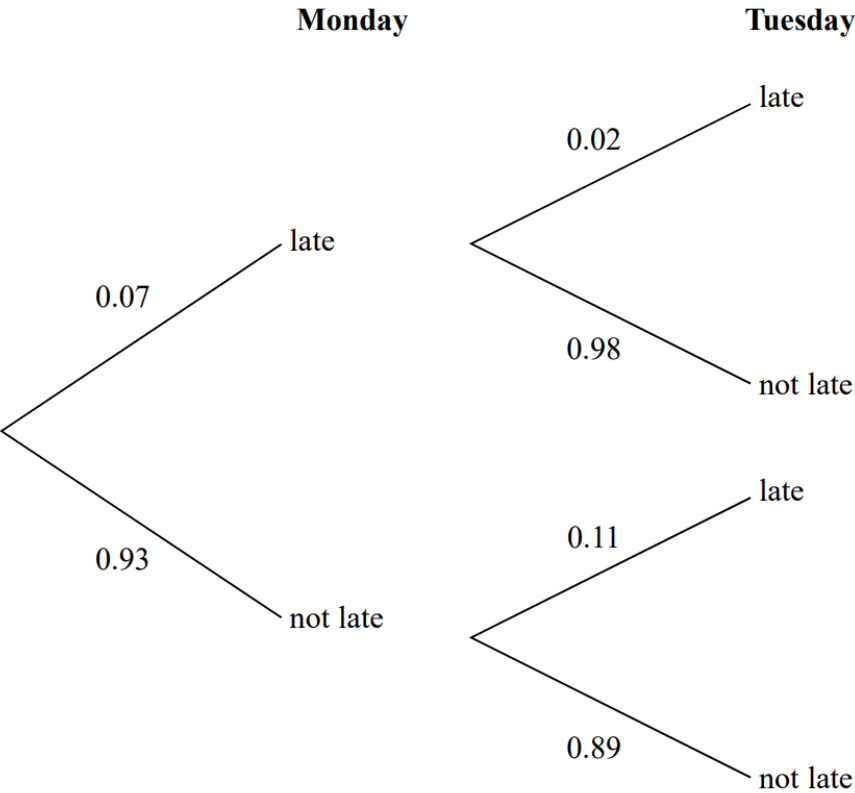


Probability & Statistics
Probability
Probability Trees

10	(a)	Diagram completed	M1	for $1 - 0.15 (=0.85)$		
		0.85	A1	fully correct diagram		
	0.15, 0.85, 0.15, 0.85					
	(b)	0.2775	M1	for one correct product eg $0.15 \times 0.15 (= 0.0225)$ or $0.15 \times 0.85 (= 0.1275)$ or $0.85 \times 0.85 (= 0.7225)$		ft their diagram provided probabilities are less than 1
				M1		for a complete method eg “0.0225” + $2 \times$ “0.1275” OR $1 - “0.7225”$ oe
			A1	oe, eg $\frac{111}{400}$		



11 The probability tree diagram shows the probabilities that Bismah will be late for work on two days next week.



Calculate the probability that Bismah will be late on exactly one of the two days.

Probability & Statistics
Probability
Probability Trees



Video Solutions

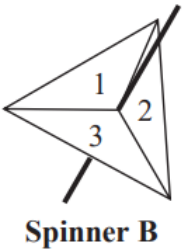
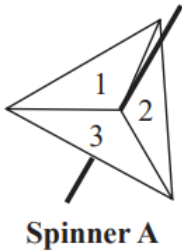
(3 marks)

11	0.1709	M1	for one product, $0.07 \times 0.98 (=0.0686)$ or $0.93 \times 0.11 (=0.1023)$ or $0.07 \times 0.02 (=0.0014)$ or $0.93 \times 0.89 (= 0.8277)$	If all products shown, award this mark
		M1	for a fully correct method, eg $0.07 \times 0.98 + 0.93 \times 0.11$ or $1 - (0.07 \times 0.02) - (0.93 \times 0.89)$	
		A1	oe	



Summer 2020 Paper 3H (Calc)

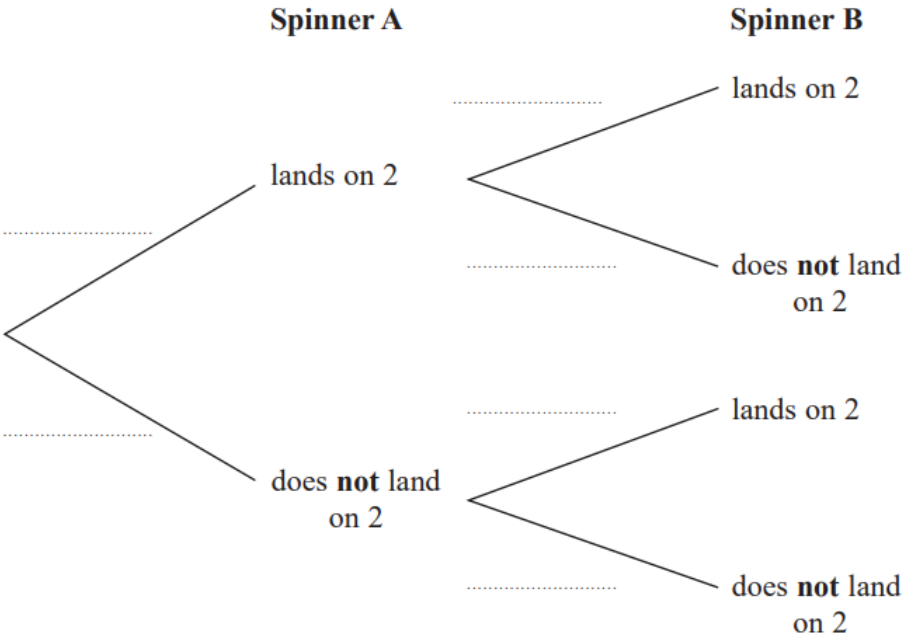
5 Amanda has two fair 3-sided spinners.



Amanda spins each spinner once.

(a) Complete the probability tree diagram.

(2 marks)



(2)

(b) Work out the probability that Spinner A lands on 2 and Spinner B does **not** land on 2

(2 marks)

Probability & Statistics
Probability
Probability Trees

 **Video Solutions**



Probability & Statistics
Probability
Probability Trees

5	(a)	$\frac{1}{3}, \frac{2}{3}$	$\frac{1}{3}, \frac{2}{3}, \frac{1}{3}, \frac{2}{3}$	B2	six fully correct probabilities
				(B1	at least 2 correct probabilities)
	(b)	$\frac{2}{9}$		M1	for $\frac{1}{3} \times \frac{2}{3}$ oe or ft probabilities from diagram
				A1	for $\frac{2}{9}$ oe

Accept any equivalent fraction, decimal form 0.33(3...) and 0.66(6...) or 0.67 or percentage form 33(.3...)%, 66(.6...)%, or 67%
Accept any equivalent fraction, decimal form 0.22(2...) or percentage form 22(.2...)%



- 21** There are 12 counters in a bag.
There is an equal number of red counters, blue counters and yellow counters in the bag.
There are no other counters in the bag.

3 counters are taken at random from the bag.

- (a) Work out the probability of taking 3 red counters.

(2 marks)

The 3 counters are put back into the bag.

Some more counters are now put into the bag.

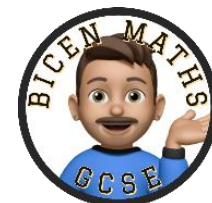
There is still an equal number of red counters, blue counters and yellow counters in the bag.
There are no counters of any other colour in the bag.

3 counters are taken at random from the bag.

- (b) Is it now less likely or equally likely or more likely that the 3 counters will be red?
You must show how you get your answer.

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(2 marks)

Probability & Statistics
Probability
Multiple Events

21 (a)		$\frac{1}{55}$	M1	for $\frac{4}{12} \times \frac{3}{11} \times \frac{2}{10}$
			A1	for $\frac{1}{55}$ oe
(b)		Conclusion (supported)	C1	starts correct argument, eg by calculating a relevant probability, eg $\frac{5}{15} \times \frac{4}{14} \times \frac{3}{13}$
			C1	statement of “more likely” from eg comparison of probabilities, ft answer to (a) eg $\frac{1}{55}$ (= 0.018...) and $\frac{2}{91}$ (= 0.021...or 0.022)



Summer 2017 Paper 1H (Non-Calc)

Probability &
Statistics

Probability

Multiple Events

17 There are 9 counters in a bag.

7 of the counters are green.

2 of the counters are blue.

Ria takes at random two counters from the bag.

Work out the probability that Ria takes one counter of each colour.

You must show your working.

 **Video Solutions**

(4 marks)

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17

$\frac{28}{72}$

P1 for $\frac{6}{8}$ or $\frac{2}{8}$ or $\frac{7}{8}$ or $\frac{1}{8}$ oe seen on diagram or in a calculation

P1 for $\frac{7}{9} \times \frac{2}{8}$ or $\frac{2}{9} \times \frac{7}{8}$ or $\frac{14}{72}$ oe for $\frac{7}{9} \times \frac{6}{8}$ or $\frac{2}{9} \times \frac{1}{8}$ or $\frac{42}{72}$ or $\frac{2}{72}$ or $\frac{44}{72}$ oe

P1 for $\frac{7}{9} \times \frac{2}{8} + \frac{2}{9} \times \frac{7}{8}$ for $1 - (\frac{7}{9} \times \frac{6}{8} + \frac{2}{9} \times \frac{1}{8})$ or $1 - (\frac{42}{72} + \frac{2}{72})$ oe

or $\frac{14}{72} + \frac{14}{72}$ oe or $1 - \frac{44}{72}$ oe

A1 oe
SC B1 for $\frac{14}{81}$ B2 for $\frac{28}{81}$



November 2018 Paper 2H (Calc)

16 There are only red counters and blue counters in a bag.

Joe takes at random a counter from the bag.
The probability that the counter is red is 0.65
Joe puts the counter back into the bag.

Mary takes at random a counter from the bag.
She puts the counter back into the bag.

(a) What is the probability that Joe and Mary take counters of different colours?

(2 marks)

There are 78 red counters in the bag.

(b) How many blue counters are there in the bag?

 **Video Solutions**

(2 marks)

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**Probability &
Statistics**

Probability

Multiple Events



HOME

16	(a)	0.455	M1	for $0.65 \times (1 - 0.65)$ or 0.65×0.35 ($=0.2275$ or $\frac{91}{400}$) or 2×0.2275 oe	Could be shown on a tree diagram but must show an intention to multiply Acceptable equivalents are 45.5% or $\frac{91}{200}$ oe $\frac{78 \times 0.35}{0.65}$, $\frac{78}{0.65} - 78$
			A1	oe	
	(b)	42	M1	for a start of the process eg $78 \div 0.65$ ($= 120$) or 78×0.35 ($=27.3$)	
			A1	cao	



21 When a biased coin is thrown 4 times, the probability of getting 4 heads is $\frac{16}{81}$

Work out the probability of getting 4 tails when the coin is thrown 4 times.

 **Video Solutions**

(2 marks)

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21	$\frac{1}{81}$	M1	for finding the probability of heads eg $\sqrt[4]{\frac{16}{81}}$ ($=\frac{2}{3}$) or for finding the probability of tails $1 - \sqrt[4]{\frac{16}{81}}$ ($=\frac{1}{3}$)	Seeing a probability of $\frac{2}{3}$ or $\frac{1}{3}$ is enough for this mark
		A1	oe	



- 16 Marek has 9 cards.
There is a number on each card.



Marek takes at random two of the cards.
He works out the product of the numbers on the two cards.
Work out the probability that the product is an even number.

16

$$\frac{52}{72}$$

P1

for $\frac{4}{9} \times \frac{3}{8} \left(\frac{12}{72} \right)$ **or** $\frac{4}{9} \times \frac{5}{8}$ **or** $\frac{5}{9} \times \frac{4}{8} \left(\frac{20}{72} \right)$

P1

for $1 - \left(\frac{5}{9} \times \frac{4}{8} \right)$ **or** $\frac{4}{9} \times \frac{3}{8} + \frac{4}{9} \times \frac{5}{8} + \frac{5}{9} \times \frac{4}{8}$ oe

A1

for $\frac{52}{72}$, $\frac{13}{18}$ oe

SC B1 for answer of $\frac{56}{81}$ (replacement)

Accept equivalent fractions, decimals (0.72...)
or percentages (72.22.....%)



Summer 2020 Paper 1H (Non-Calc)

Probability &
Statistics

Probability

Multiple Events

- 14 Sally plays two games against Martin.
In each game, Sally could win, draw or lose.

In each game they play,
the probability that Sally will win against Martin is 0.3
the probability that Sally will draw against Martin is 0.1

Work out the probability that Sally will win **exactly** one of the two games against Martin.

 **Video Solutions**

(3 marks)

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HOME

14	0.42	P1	for appropriate multiplication eg $0.3 \times 0.7 (=0.21)$ or $0.3 \times 0.1 (=0.03)$ or $0.3 \times 0.6 (=0.18)$	Probabilities could also be given in fraction or percentage form
		P1	(dep) for complete process eg $0.3 \times 0.7 + 0.7 \times 0.3$ or $0.3 \times 0.1 + 0.3 \times 0.6 + 0.6 \times 0.3 + 0.1 \times 0.3$	
		A1	oe	Acceptable equivalents are 42% or $\frac{42}{100}$ oe



16 There are only 3 red counters and 5 yellow counters in a bag.

Jude takes at random 3 counters from the bag.

Work out the probability that he takes exactly one red counter.

 **Video Solutions**

(4 marks)

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16

$$\frac{180}{336}$$

- P1 for $\frac{3}{7}$ or $\frac{4}{7}$ or $\frac{5}{7}$ as probability for second counter
- P1 for one correct product
eg $\frac{3}{8} \times \frac{5}{7} \times \frac{4}{6} (= \frac{60}{336})$ or $\frac{5}{8} \times \frac{3}{7} \times \frac{4}{6} (= \frac{60}{336})$ or $\frac{5}{8} \times \frac{4}{7} \times \frac{3}{6} (= \frac{60}{336})$
- P1 for a complete process
eg $\frac{3}{8} \times \frac{5}{7} \times \frac{4}{6} + \frac{5}{8} \times \frac{3}{7} \times \frac{4}{6} + \frac{5}{8} \times \frac{4}{7} \times \frac{3}{6}$
- A1 oe, eg $\frac{15}{28}$
SC B1 for answer of $\frac{225}{512}$ (replacement)

May be seen in a calculation or on a diagram

Accept equivalent fractions, decimals (0.53... or 0.54) or percentages (53% or 54%)



20 In a village,

if it rains on one day, the probability that it will rain on the next day is 0.8

if it does **not** rain on one day, the probability that it will rain on the next day is 0.6

A weather forecaster says,

“There is a 70% chance that it will rain in the village on Monday.”

Work out an estimate for the probability that it will rain in the village on Wednesday.

You must show all your working.

 **Video Solutions**

(4 marks)

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November 2018 Paper 1H (Non-Calc)

22 There are only green pens and blue pens in a box.

There are three more blue pens than green pens in the box.

There are more than 12 pens in the box.

Simon is going to take at random two pens from the box.

The probability that Simon will take two pens of the same colour is $\frac{27}{55}$

Work out the number of green pens in the box.

Probability &
Statistics

Probability

... with algebra

 **Video Solutions**

(6 marks)

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22	21	P1	for a relevant probability, eg $P(\text{green}) = \frac{x}{2x+3}$ or $P(\text{blue}) = \frac{x+3}{2x+3}$
		P1	for a relevant product, eg. " $\frac{x}{2x+3}$ " $\times$ " $\frac{x-1}{2x+2}$ " or " $\frac{x+3}{2x+3}$ " $\times$ " $\frac{x+2}{2x+2}$ " OR $\left(\frac{x}{x+3}\right)^2 + \left(\frac{x+3}{2x+3}\right)^2 = \frac{27}{75}$
		P1	forms an appropriate equation, eg. " $\frac{x}{2x+3} \times \frac{x-1}{2x+2}$ " + " $\frac{x+3}{2x+3} \times \frac{x+2}{2x+2}$ " = $\frac{27}{55}$
		P1	(dep P3) process to reduce equation to $ax^2 + bx + c = 0$ eg. $x^2 - 25x + 84 = 0$
		P1	process to solve quadratic equation eg. $(x - 21)(x - 4) = 0$
		A1	cao

the number of green and blue pens could be $x - 3$ and x or equivalent
probabilities must be in an algebraic form in a single variable

This is an exception using replacements. No further credit is available



Summer 2019 Paper 1H (Non-Calc)

Probability &
Statistics

Probability

... with algebra

22 There are only r red counters and g green counters in a bag.

A counter is taken at random from the bag.

The probability that the counter is green is $\frac{3}{7}$

The counter is put back in the bag.

2 more red counters and 3 more green counters are put in the bag.

A counter is taken at random from the bag.

The probability that the counter is green is $\frac{6}{13}$

Find the number of red counters and the number of green counters that were in the bag originally.

 **Video Solutions**

(5 marks)

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HOME

Probability & Statistics
Probability
... with algebra

22	12 red, 9 green	P1	for process to find a relationship between r and g eg $\frac{g}{r+g} = \frac{3}{7}$ or $\frac{g}{r} = \frac{3}{4}$
		P1	for process to find a second relationship between r and g eg $\frac{g+3}{r+2+g+3} = \frac{6}{13}$ or $\frac{g+3}{r+2} = \frac{6}{7}$
		P1	(dep P2) for start to process of solving pair of equations, eg eliminates one variable from the equations or removes fractions from both equations
		P1	(dep P3) for complete process to solve equations to find g or r
		A1	cao OR
		P1	for two of $3x + 3$, $4x + 2$ and $7x + 5$
		P1	for $\frac{3x+3}{7x+5} = \frac{6}{13}$
		P1	(dep P2) for removing fractions from the equation, eg $13(3x + 3) = 6(7x + 5)$ or $39x + 39 = 42x + 30$
		P1	(dep P3) for complete process to solve $13(3x + 3) = 6(7x + 5)$
		A1	cao

 **Video Solutions**



Summer 2020 Paper 2H (Calc)

Probability &
Statistics

Probability

... with algebra

20 There are only red sweets and yellow sweets in a bag.

There are n red sweets in the bag.

There are 8 yellow sweets in the bag.

Sajid is going to take at random a sweet from the bag and eat it.

He says that the probability that the sweet will be red is $\frac{7}{10}$

(a) Show why the probability cannot be $\frac{7}{10}$

(3 marks)

After Sajid has taken the first sweet from the bag and eaten it, he is going to take at random a second sweet from the bag.

Given that the probability that both the sweets he takes will be red is $\frac{3}{5}$

(b) work out the number of red sweets in the bag.
You must show all your working.

 **Video Solutions**

(5 marks)

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HOME

20	(a)	Shown	M1 for $\frac{n}{n+8}$ or starts to work with ratios, eg 3:7	
		M1	forms equation and clears fractions, eg $10n = 7n + 56$ or $10n + 3(n+8) = 10(n+8)$ or equates $\frac{3}{10} = \frac{8}{x}$ or $\frac{3}{10} = \frac{8}{n+8}$ or continues to work with ratios, eg $3:7 = 24:56$	
		C1	gives the total sweets eg $\frac{80}{3}$ oe or number of red sweets $n = \frac{56}{3}$ oe or gives number of red as $\frac{56}{3}$ OR award 3 marks for a complete written argument, eg, $P(y) = \frac{3}{10}$ and there are 8 yellows. This cannot work as 3 is not a factor of 8 (and $\frac{3}{10}$ is in its simplest form)	Does not have to restate the $\frac{7}{10}$; giving a different probability will suffice
20	(b)	28	P1 for $\frac{n}{n+8}$ and $\frac{n-1}{n+7}$ oe	
		P1	forms an appropriate equation, eg $\frac{n}{n+8} \times \frac{n-1}{n+7} = \frac{3}{5}$	
		P1	for correctly forming a quadratic ready for solving, eg $an^2 + bn + c (=0)$, $2n^2 - 50n - 168 (=0)$, $n^2 - 25n - 84 (=0)$ oe	Note we do not need to see “= 0”; just the LHS is sufficient.
		P1	process to solve quadratic equation, ft a 3 term quadratic factorising eg $(n+3)(n-28) (=0)$ oe or completing the square or correct use of formula eg $\frac{- -25 \pm \sqrt{25^2 - 4 \times -84}}{2}$, $\frac{- -50 \pm \sqrt{50^2 - 4 \times 2 \times -168}}{2 \times 2}$	
		A1	cao	Award 0 marks for a correct answer with no supportive working.



20 Pat throws a fair coin n times.

Find an expression, in terms of n , for the probability that Pat gets at least 1 head and at least 1 tail.

 **Video Solutions**

(2 marks)

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HOME

20

$\left 1 - \left(\frac{1}{2}\right)^n - \left(\frac{1}{2}\right)^n \right $	M1	$\left \text{for } \left(\frac{1}{2}\right)^n \text{ oe} \right $
	A1	$\left \text{oe eg } 1 - \left(\frac{1}{2}\right)^{n-1} \right $

 **Video Solutions**



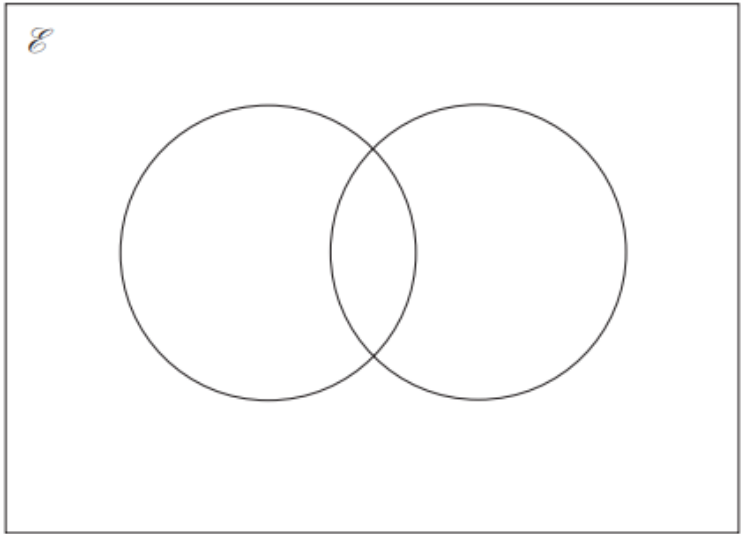
Probability & Statistics

Venn Diagrams



- 1 $\mathcal{E} = \{\text{odd numbers less than } 30\}$
 $A = \{3, 9, 15, 21, 27\}$
 $B = \{5, 15, 25\}$

(a) Complete the Venn diagram to represent this information.



(4)

A number is chosen at random from the universal set, $\mathcal{E}$.

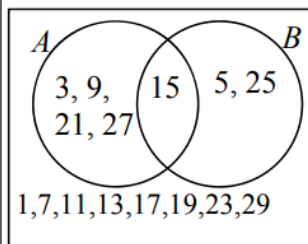
(b) What is the probability that the number is in the set $A \cup B$?

(2)



1

(a)



Venn Diagram

B1

for labels on diagram

M1

for just 15 in the intersection

M1

for just 5 and 25 in only set B or just 3, 9, 21 and 27 in only set A or just 1, 7, 11, 13, 17, 19, 23, 29 in $(A \cup B)'$

C1

for all numbers correctly placed in the Venn Diagram

Ignore all entries except the region you are marking for each method mark

(b)

$$\frac{7}{15}$$

P1

ft for $\frac{"7"}{a}$ where $a \geq "7"$ or $\frac{b}{"15"}$ where $b \leq "15"$

A1

ft $\frac{7}{15}$ oe



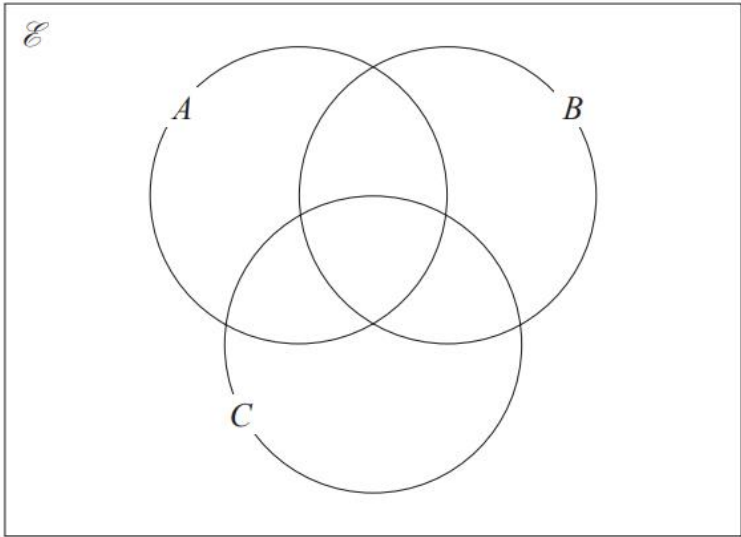
Video Solutions



Probability & Statistics
Venn Diagrams
Filling a Venn

- 1 $\mathcal{E} = \{\text{even numbers between 1 and 25}\}$
 $A = \{2, 8, 10, 14\}$
 $B = \{6, 8, 20\}$
 $C = \{8, 18, 20, 22\}$

(a) Complete the Venn diagram for this information.



(4)

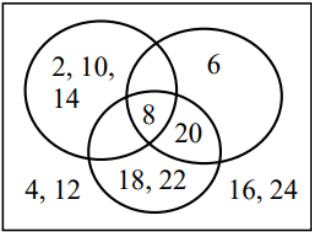
A number is chosen at random from $\mathcal{E}$.

(b) Find the probability that the number is a member of $A \cap B$.

(2)



1	(a)	Venn diagram	C4	fully correct Venn diagram
			(C3	7 of the 8 regions correct or for a diagram with only one number incorrectly placed)
			(C2	5 or 6 of the 8 regions correct)
			(C1	3 or 4 of the 8 regions correct)
	(b)	$\frac{1}{12}$	M1	ft for identification of 1 or 12 eg from the diagram
			A1	ft oe



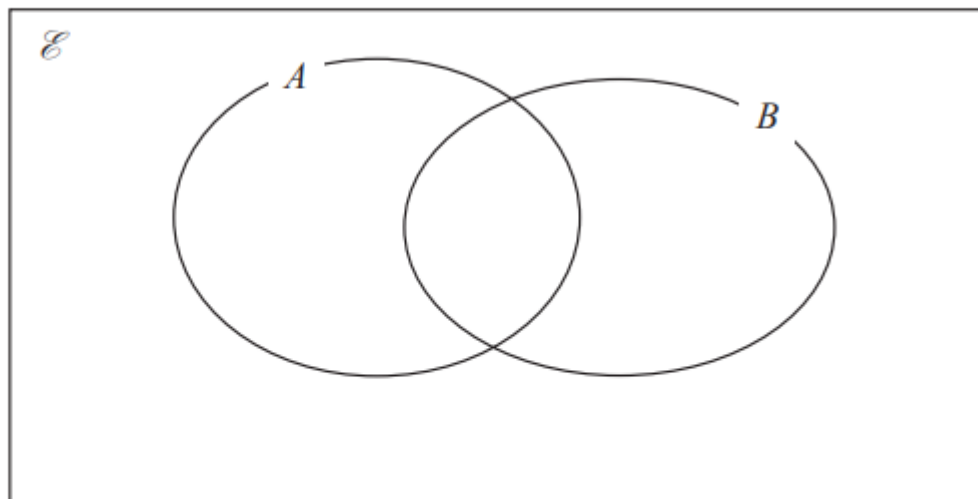
Need not be written as a fraction or probability at this stage. eg could be a ratio 1:12

Acceptable equivalents are (eg, could fit) any fraction equivalent to $\frac{1}{12}$, 0.08(33..) or 8(.33..)%



Summer 2019 Paper 3H (Calc)

- 1 $\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$
 $A = \{1, 5, 6, 8, 9\}$
 $B = \{2, 6, 9\}$



(a) Complete the Venn diagram to represent this information.

(3 marks)

A number is chosen at random from the universal set $\mathcal{E}$.

(b) Find the probability that the number is in the set $A \cap B$

Probability &
Statistics

Venn Diagrams

Filling a Venn

 **Video Solutions**

(2 marks)

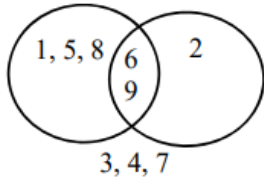
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HOME

1	(a)	6, 9	M1	for 6, 9 in the intersection only
		1, 5, 8	M1	for 1, 5, 8 in set A only or 2 in set B only or 3, 4, 7 in set $(A \cup B)'$ only
		2		
	(b)	3, 4, 7	C1	for all numbers correctly placed in the Venn Diagram
		$\frac{2}{9}$	M1	ft for identification of 2 or 9 or ft diagram
			A1	$\frac{2}{9}$ oe or ft diagram

Ignore all entries except the region you are marking for each method mark



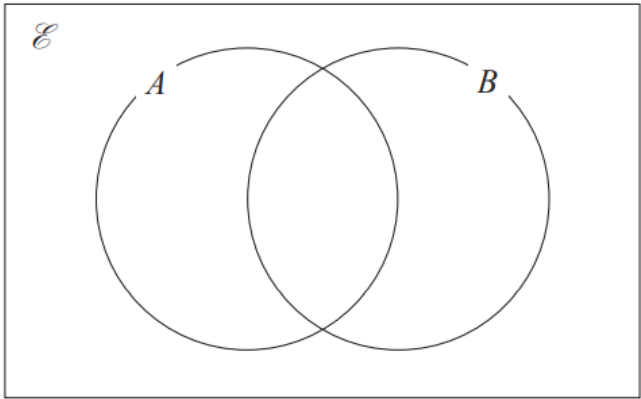
Need not be written in correct form at this stage
eg could be a ratio 2 : 9
Repeated digits in the diagram should be counted as 2 elements
Accept any equivalent fraction, decimal form 0.22(22..) or percentage form 22(.22...)%



Probability & Statistics
Venn Diagrams
Filling a Venn

- 2 $\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
 $A = \{\text{even numbers}\}$
 $B = \{\text{factors of } 10\}$

(a) Complete the Venn diagram for this information.



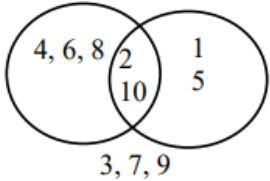
(3)

A number is chosen at random from the universal set, $\mathcal{E}$

(b) Find the probability that this number is in the set $A \cap B$

(2)



2	(a)	Venn diagram	M1	for correct numbers in at least one region	Ignore all entries except the region you are marking for each method mark 
			M1	for correct numbers in at least two regions	
			A1	for all regions correct	
	(b)	$\frac{2}{10}$	M1	for $\frac{a}{10}$ where $0 < a < 10$ and a is an integer or $\frac{2}{b}$ where $b > 2$ and b is an integer or ft diagram	Need not be written in correct form at this stage eg could be a ratio 2 : 10 Repeated digits in the diagram should be counted as 2 elements Accept any equivalent fraction, decimal form 0.2 or percentage form 20%
			A1	$\frac{2}{10}$ oe or ft diagram	

Summer 2018 Paper 3H (Calc)

20 50 people were asked if they speak French or German or Spanish.

Of these people,

31 speak French

2 speak French, German and Spanish

4 speak French and Spanish but not German

7 speak German and Spanish

8 do not speak any of the languages

all 10 people who speak German speak at least one other language

Two of the 50 people are chosen at random.

Work out the probability that they both only speak Spanish.

Probability &
Statistics

Venn Diagrams

*Drawing a Venn and
problem solving*

 **Video Solutions**

(5 marks)

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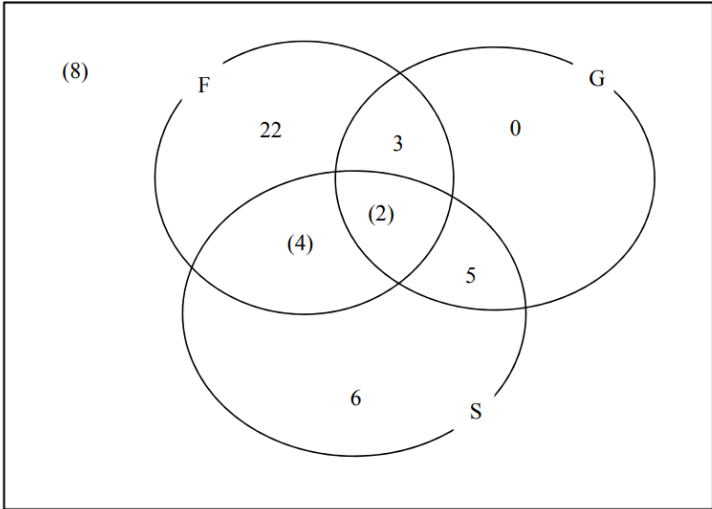
20	$\frac{6}{490}$	P1	for start to process information, eg draws Venn diagram and shows at least 1 unknown amount, eg 5 speak German and Spanish but not French
		P1	for process to find at least 3 unknown amounts from, eg 5 speak German and Spanish but not French 3 speak French and German but not Spanish 22 speak French but not German or Spanish 0 speak German but not French or Spanish
		P1	for complete process to find number of people who speak only Spanish (= 6)
		P1	for $\frac{[\text{number speaking Spanish only}]}{50} \times \frac{[\text{number speaking Spanish only}] - 1}{49}$, eg $\frac{6}{50} \times \frac{5}{49}$
		A1	for $\frac{6}{490}$ oe

See Venn Diagram at end of mark scheme – rectangle not needed

Award first 3 marks to students who show this on the Venn diagram or in a statement.

Award this mark for use of their number of students who speak Spanish. Must be a clear link, eg from Venn diagram

See note 8 in general marking guidance but 0.01 or 1% must be from seen correct working.

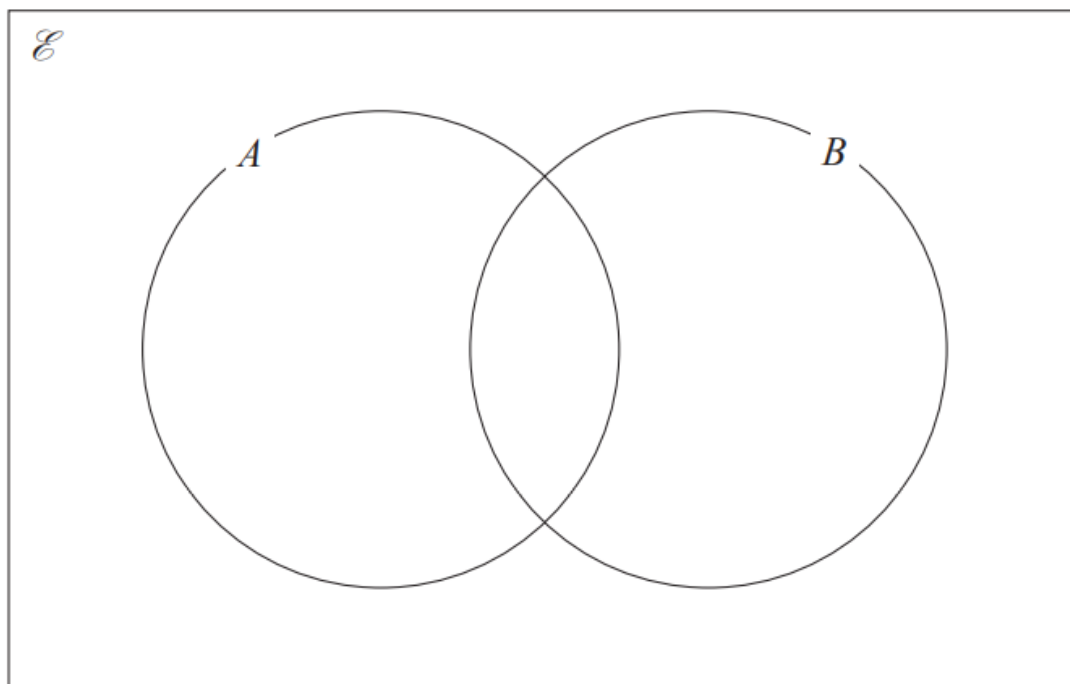


2 $\mathcal{E} = \{\text{even numbers less than 19}\}$

$A = \{6, 12, 18\}$

$B = \{2, 6, 14, 18\}$

Complete the Venn diagram for this information.



 **Video Solutions**

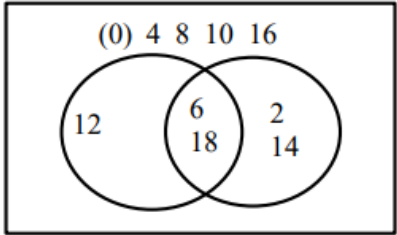
(3 marks)

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2	Venn Diagram	C1	for one correct region
		C1	for two correct regions
		C1	for all regions correct



Ignore all entries except the region you are marking for each mark



Probability & Statistics

Product Rule for Counting



11 Jeff is choosing a shrub and a rose tree for his garden.

At the garden centre there are 17 different types of shrubs and some rose trees.

Jeff says,

“There are 215 different ways to choose one shrub and one rose tree.”

Could Jeff be correct?

You must show how you get your answer.

 **Video Solutions**

(2 marks)

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11

No
(supported)

P1

Process to find number of rose trees e.g. $215 \div 17 (=12.647\dots)$ or show number of choices with 12 and 13 eg $17 \times 12 = 204$ and $17 \times 13 = 221$

C1

No with interpretation that 12.6.. is not a whole number or a whole number of plants must be bought or number of plants would have to be between 12 and 13 which is not possible



- 15 Tracey is going to choose a main course and a dessert in a cafe.
She can choose from 8 main courses and 7 desserts.

Tracey says that to work out the number of different ways of choosing a main course and a dessert you add 8 and 7

- (a) Is Tracey correct?
You must give a reason for your answer.

(1 mark)

12 teams play in a competition.
Each team plays each other team exactly once.

- (b) Work out the total number of games played.

 **Video Solutions**

(2 marks)



15 (a)		No with reason	C1	for “no” with reason, eg Tracey should multiply 8 and 7
(b)		66	M1	for starting a method to find number of games played, eg $12 \times 11 (= 132)$ or sum of integers from 1 to 11
			A1	cao



- 14** There are 16 hockey teams in a league.
Each team played two matches against each of the other teams.
Work out the total number of matches played.

 **Video Solutions**

(2 marks)

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14	240	M1	for start to method to find total number of matches, eg 16×15 or $16^2 - 16$ or $16 \times 15 \times 2 (= 480)$ or $\frac{16 \times 15}{2} (= 120)$	Credit complete listing strategies
		A1	cao	



11 In a restaurant there are

9 starter dishes

15 main dishes

8 dessert dishes

Janet is going to choose one of the following combinations for her meal.

a starter dish and a main dish

or a main dish and a dessert dish

or a starter dish, a main dish and a dessert dish

Show that there are 1335 different ways to choose the meal.

 **Video Solutions**

(3 marks)

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11	1335	M1	for one correct procedure eg $9 \times 15 (=135)$ or $15 \times 8 (=120)$ or $9 \times 15 \times 8 (=1080)$	Ignore additional products. Only these three products must be identified. There is no need to indicate summing at this stage. There is no need to show the three products sum to 1335
		M1	for all three correct products eg “135”, “120”, “1080” or 9×15 , 15×8 , $9 \times 15 \times 8$ oe	
		C1	for showing the three correct products added eg $135 + 120 + 1080$	



Summer 2019 Paper 1H (Non-Calc)

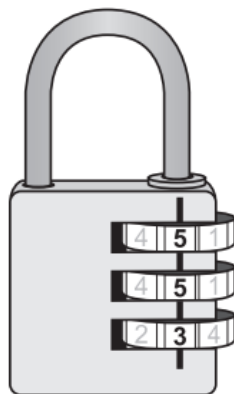
Probability &
Statistics

Product Rule for
Counting

16 There are three dials on a combination lock.

Each dial can be set to one of the numbers 1, 2, 3, 4, 5

The three digit number 553 is one way the dials can be set, as shown in the diagram.



(a) Work out the number of different three digit numbers that can be set for the combination lock.

(2 marks)

(b) How many of the possible three digit numbers have three different digits?

 **Video Solutions**

(2 marks)

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16	(a)	125	M1	for method to find the number of 3 digit combinations, eg 5^3 or $5^3 - 1$
			A1	for 125 or 124
	(b)	60	M1	for method to find the number of combinations with 3 different digits eg $5 \times 4 \times 3$ or finds there are 65 combinations that do not have 3 different digits
			A1	cao



14 Sadia is going to buy a new car.

For the car, she can choose one body colour, one roof colour and one wheel type.

She can choose from

19 different body colours

25 different wheel types

The total number of ways Sadia can choose the body colour and the roof colour and the wheel type is 3325

Work out the number of different roof colours that Sadia can choose from.

 **Video Solutions**

(2 marks)

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14	7	M1	method to find number of combinations, eg 19×25 oe (= 475) or for $3325 \div 19$ (= 175) or $3325 \div 25$ (= 133)
		A1	cao



11 Jack is in a restaurant.

There are 5 starters, 8 main courses and some desserts on the menu.

Jack is going to choose one starter, one main course and one dessert.

He says there are 240 ways that he can choose his starter, his main course and his dessert.

Could Jack be correct?

You must show how you get your answer.

 **Video Solutions**

(2 marks)

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HOME

11	Yes (supported)	P1	for process to find number of combinations, eg 5×8 oe (= 40) or for $240 \div 5$ (= 48) or $240 \div 8$ (= 30) or for $240 \div 5 \div 8$ (= 6) or $5 \times 8 \times x = 240$
		C1	Yes and 6



- 13 In a school there are 16 teachers and 220 students.
Of these students 120 are girls and 100 are boys.

One teacher, one girl and one boy are going to be chosen to represent the school.

Work out the number of different ways there are to choose one teacher, one girl and one boy.

 **Video Solutions**

(2 marks)

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13	192 000	M1	for $16 \times 120 \times 100$ oe
		A1	cao

 **Video Solutions**

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