KING EDWARD VI
HANDSWORTH GRAMMAR
SCHOOL FOR BOYS

KING EDWARD VI
ACADEMY TRUST
BIRMINGHAM

Year 8

2024 Mathematics 2025

Unit 8 Booklet

HGS Maths

Tasks

Dr Frost Course

Name: _____

Class: _____

Contents

1 Factorising to a Single Bracket

1.1 Highest Common Factor

Worked Example	Your Turn
Write the following as a product of factors: a) $3a$ b) $6a$ c) $6a^2$ d) $6a^2$b	Write the following as a product of factors: a) $2b$ b) $12b$ c) $12b^2$ d) $12a^2b^2$

Worked Example	Your Turn
Find the highest common factor of: a) $3a$ and $5a$ b) 6 and $6a$ c) $3a$ and $6a$ d) $4ab^2$ and $6a^2$b	Find the highest common factor of: a) $2b$ and $3b$ b) 6 and $12b$ c) $6b$ and $12b^2$ d) $8a^2b$ and $12a^2b^2$

1.2 Factorising to a Single Bracket

Factorising means to turn an expression into a product of factors.

Year 8 Factorisation

$2x^2 + 4xz$ → (Factorise) $2x(x+2z)$

Year 9 Factorisation

$x^2 + 3x + 2$ → (Factorise) $(x+1)(x+2)$

A Level Factorisation

$2x^3 + 3x^2 - 11x - 6$ → (Factorise) $(2x+1)(x-2)(x+3)$

Factorising is the reverse of expanding.
When you have a sum of terms, just identify the common factor.
i.e. Find the largest expression each of your terms is divisible by.

Worked Example	Your Turn
a) Factorise $12x + 18$ b) Factorise $12x + 18y$ c) Factorise $12x^2 + 18$	a) Factorise $12x - 20$ b) Factorise $12x - 20y$ c) Factorise $12x^3 - 20$

Worked Example	Your Turn
a) Factorise $12x^2 + 18\mathrm{x}$ b) Factorise $12x^2 + 18xy$ c) Factorise $12x^2y + 18xy$	a) Factorise $12x^2 - 20x$ b) Factorise $12x^2 - 20xy$ c) Factorise $12x^2y - 20xy^2$

1.3 Factorising to a Single Bracket with Index Laws

Worked Example	Your Turn
Factorise: a) $x^4y^2 - x^3y^5$ b) $10x^7y^4 - 25x^3y^2$	Factorise: a) $x^2y^5 - xy^3$ b) $20e^5f^2 - 12e^2f$

1.4 Finish Factorising

Worked Example	Your Turn
Finish factorising: a) $4(10x + 50)$ b) $4(30x + 50)$	Finish factorising: a) $4(5x + 15)$ b) $4(25x + 15)$

2 Solving Linear Equations 2

2.1 Brackets

To solve an equation means that we find the value of the variable(s).

Strategy: To get x on its own on one side of the equation, we gradually need to 'claw away' the things surrounding it.

Note: In algebra, we tend to give our answers as fractions rather than decimals (unless asked). And never recurring decimals. Don't round also (unless asked).

Worked Example	Your Turn
Solve the following equations: a) $4(x+8)=50$ b) $4(2x+8)=50$	Solve the following equations: a) $6(x-8)=50$ b) $6(3x-8)=50$

Worked Example	Your Turn
Solve the following equations: a) $-4(2x + 8) = 50$ b) $-4(2x - 8) = 50$	Solve the following equations: a) $-6(3x + 8) = 50$ b) $-6(3x - 8) = 50$

Worked Example	Your Turn
Solve the following equations: a) $8(x+3)+3(2x+6)=84$ b) $8(x+3)-3(2x-6)=84$	Solve the following equations: a) $3(x-3)+4(2x-6)=110$ b) $3(x-3)-4(2x-6)=110$

2.2 Both Sides

- Collect the variable terms (i.e. the terms involving x) on one side of the equation, and the 'constants' (i.e. the individual numbers) on the other side.

- Collect the variable terms on the side of the equation where there's more of them (and move constant terms to other side).

Balancing

- We eliminate the variable from the side with the smaller number of the variable.

- We eliminate the variable by applying the inverse to both sides.

Which side do you eliminate the variable from?
How would you balance both sides?

- $3x + 4 = 2x + 6$

- $2x + 4 = 3x + 6$

- $2x - 4 = 3x - 6$

- $4 - 2x = 3x - 6$

- $4 - 2x = 6 - 3x$

Worked Example	Your Turn
Solve the following equations: a) $5x + 7 = 2x + 31$ b) $2x - 23 = 7 - x$	Solve the following equations: a) $5x + 7 = 3x + 23$ b) $2x - 23 = 12 - 3x$

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Worked Example	Your Turn
Solve the following equations: a) $17x = 10x + 21$ b) $10x = 17x + 21$	Solve the following equations: a) $10x = 13x - 21$ b) $13x = 10x - 21$

Worked Example	Your Turn
Solve the following equations: a) $3(x+2)=2(x+3)$ b) $3(x+5)-7=2(x+2)$	Solve the following equations: a) $9(x-3)=4(x+7)$ b) $7(x+6)-7=4(x+2)$

Worked Example	Your Turn
Solve the following equation: $3(2w-1)-4=4(w+2)+1$	Solve the following equation: $2(2p-2)-4=2(p+3)-3$

Worked Example	Your Turn
Solve the following equation: $3(6x + 1) + 5(3 + x) = 2(3 - 5x) + 2(5 + 6x)$	Solve the following equation: $2(1 - 2x) + 2(4x + 1) = 3(3x + 5) + 4(5x + 1)$

Worked Example	Your Turn
Solve the following equation: $\frac{3x+6}{2} = x+3$	Solve the following equation: $\frac{9x-27}{4} = x+7$

2.3 Variable in the Denominator

Worked Example	Your Turn
Solve the following equation: a) $\frac{3}{x} + 2 = 6$ b) $\frac{3}{x+2} = 6$	Solve the following equation: a) $\frac{15}{x-2} = 6$ b) $\frac{15}{x} - 2 = 6$

Worked Example	Your Turn
Solve the following equation: $\frac{3x+6}{x+3}=2$	Solve the following equation: $\frac{7x-21}{x+7}=2$

2.4 Cross Multiplication

You can cross multiply to solve equations which are in the form:
$\frac{a}{b} = \frac{c}{d}$

Are the following equations ready to be cross multiplied?

- $\frac{2x}{3} = \frac{5}{9}$

- $\frac{2x}{3} + 1 = \frac{5}{9}$

- $\frac{2x}{3} + 1 = 5$

- $\frac{2x+1}{3} = 5$

- $\frac{3}{2x+1} = \frac{5}{x}$

Worked Example	Your Turn
Solve the following equations: a) $\frac{x}{5} = \frac{3}{2}$ b) $\frac{x+1}{5} = \frac{3}{2}$	Solve the following equations: a) $\frac{2x}{5} = \frac{3}{2}$ b) $\frac{2x+1}{5} = \frac{3}{2}$

Worked Example	Your Turn
Solve the following equations: a) $\frac{3x-4}{5} = \frac{x+4}{3}$ b) $\frac{4}{2-3x} = \frac{5}{6-2x}$	Solve the following equations: a) $\frac{x+4}{7} = \frac{x-4}{3}$ b) $\frac{4}{2+3x} = \frac{5}{6+2x}$

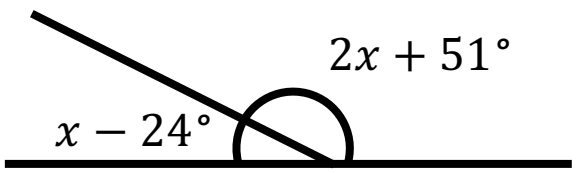
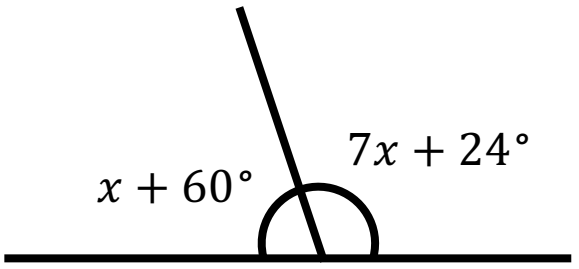
2.5 Forming and Solving Equations

Worked Example	Your Turn
I think of a number. I multiply the number by 6 then subtract 3. The result is 15. What was my original number?	I think of a number. I multiply the number by 4 then subtract 5. The result is 27. What was my original number?

Worked Example	Your Turn
$A = 7b + 5c$ Work out the value of b when $A = 29$ and $c = 3$	$A = 4b + 6c$ Work out the value of c when $A = 44$ and $b = 2$

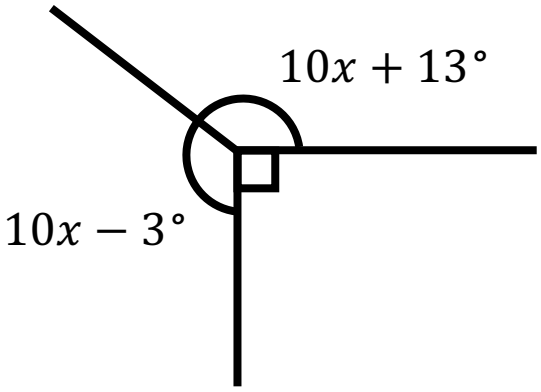
Worked Example	Your Turn
A is x years old. B is 3 years older than A. C is twice as old as A. The sum of the ages of A, B and C is 51. What are their ages?	A is x years old. B is 3 years younger than A. C is three times as old as A. The sum of the ages of A, B and C is 57. What are their ages?

Worked Example	Your Turn
A pizza costs £3.50. A lemonade costs £x. Ziana buys 3 pizzas and 5 lemonades and the total cost is £23. Find the cost of a lemonade.	A pizza costs £6.50. An iced tea costs £x. Jake buys 4 pizzas and 5 iced teas and the total cost is £38.50. Find the cost of an iced tea.

Worked Example	Your Turn
Find x 	Find x 

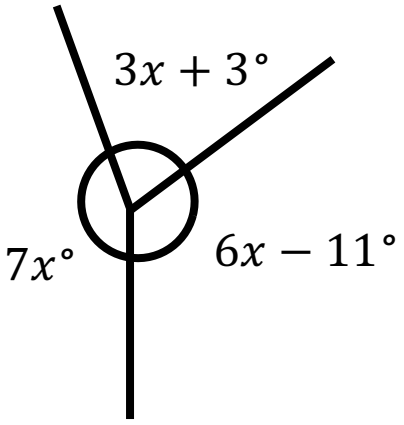
Worked Example

Find x



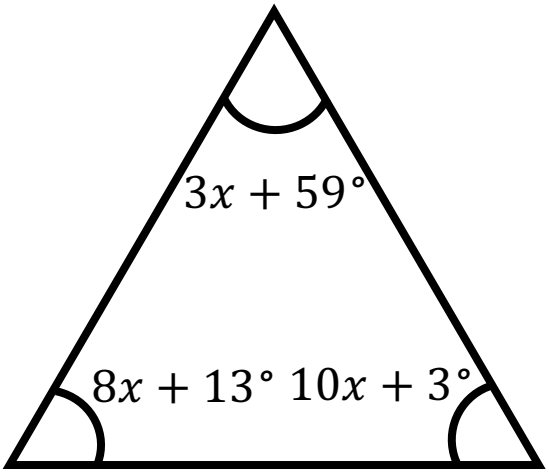
Your Turn

Find x



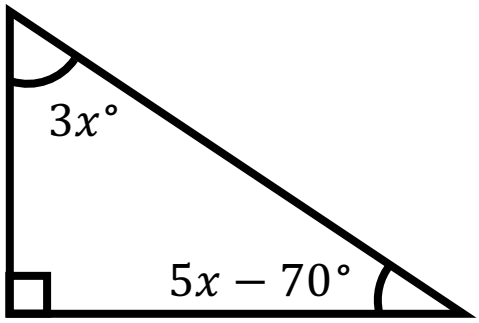
Worked Example

Find x



Your Turn

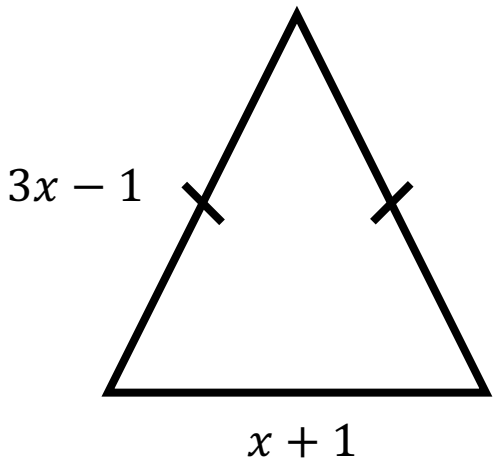
Find x



Worked Example	Your Turn
The perimeter of the rectangle is equal to 72 units. Find x. $2x + 3$  x	The perimeter of the rectangle is equal to 72 units. Find x. $4x + 6$  x

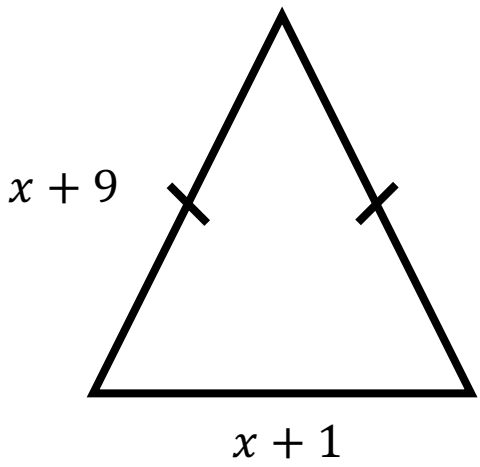
Worked Example

The perimeter of the isosceles triangle is equal to 34 units.
Find x.



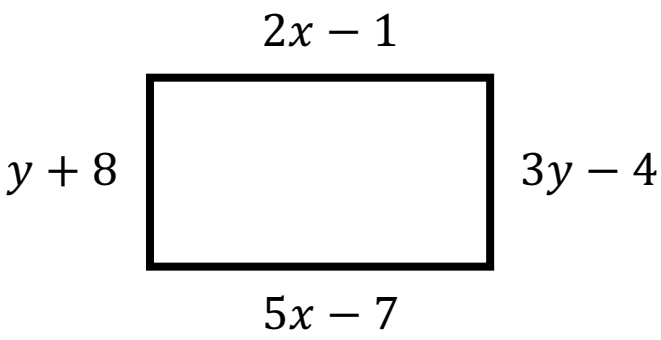
Your Turn

The perimeter of the isosceles triangle is equal to 34 units.
Find x.



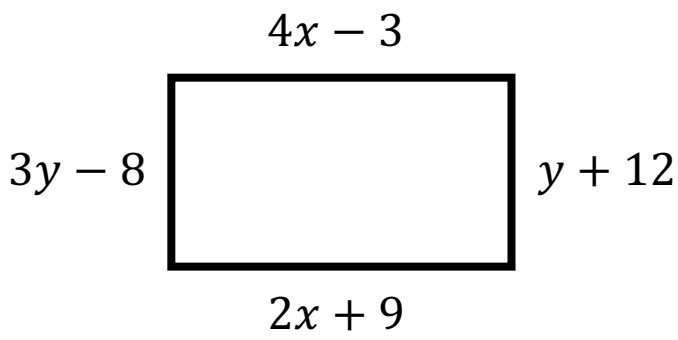
Worked Example

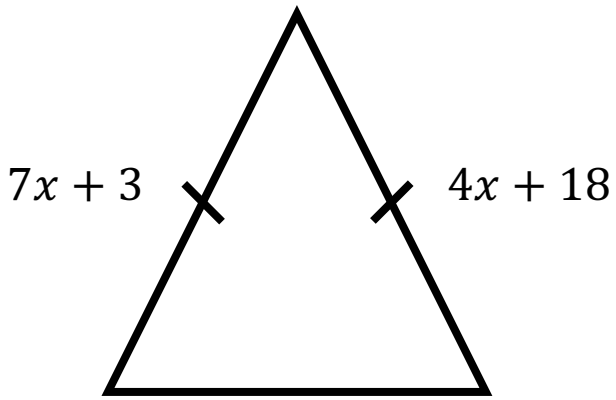
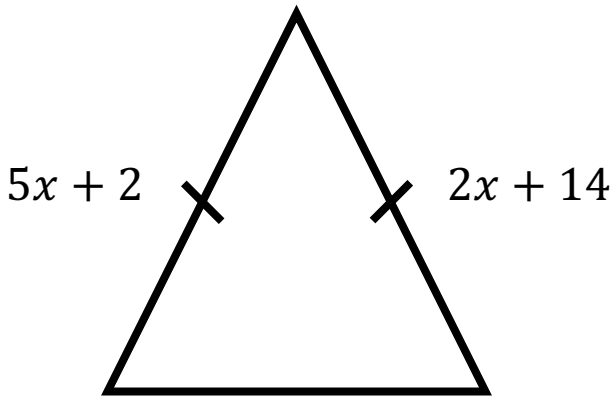
Find x and y



Your Turn

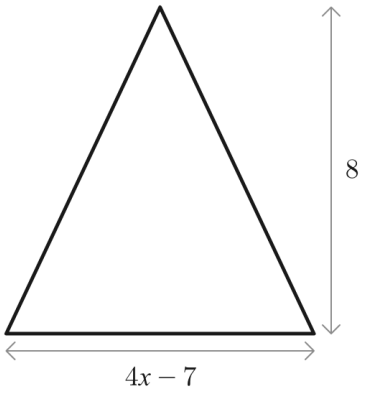
Find x and y



Worked Example	Your Turn
Find x 	Find x 

Worked Example

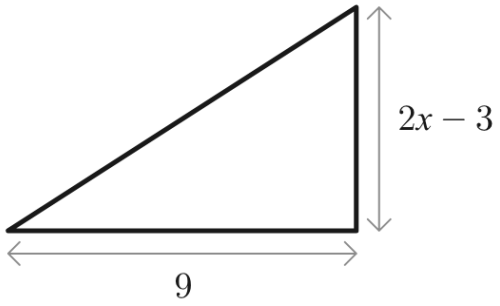
A triangle is shown in the diagram below.



All the measurements are in centimetres. The area of the triangle is 28 cm^2. Find the value of x.

Your Turn

The diagram below shows a triangle.



All the measurements are in centimetres. The area of the triangle is 9 cm^2. Find the value of x.

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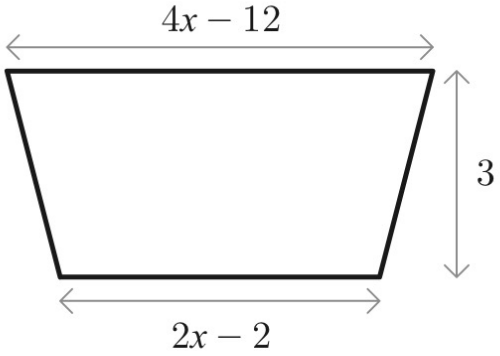
Worked Example

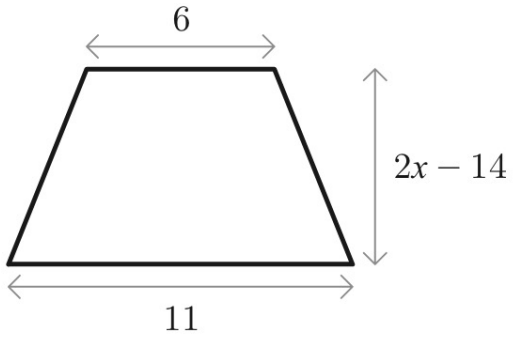
A trapezium is shown in the diagram below.



All the measurements are in centimetres. The area of the trapezium is 42 cm^2. Find the value of x.

Your Turn

The diagram below shows a trapezium.



All the measurements are in centimetres. The area of the trapezium is 34 cm^2. Find the value of x.

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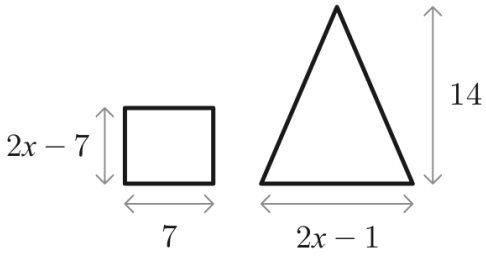
Worked Example

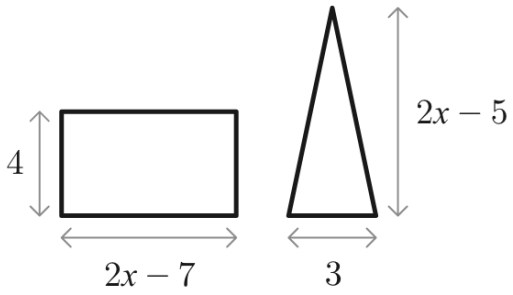
The diagram shows a rectangle and a triangle.



All the measurements are in centimetres.
The area of the rectangle is half the area of the triangle. Work out the value of x.

Your Turn

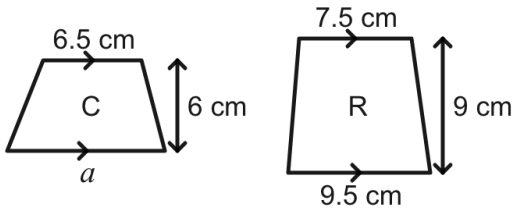
The diagram shows a rectangle and a triangle.



All the measurements are in centimetres.
The area of the rectangle is twice the area of the triangle. Work out the value of x.

Worked Example

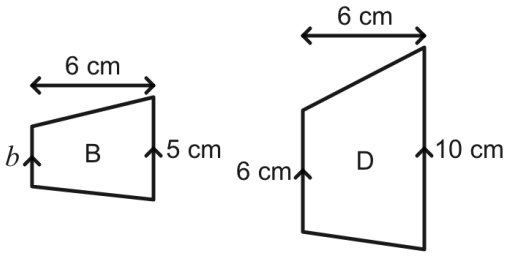
Shape C is a trapezium with parallel sides of length a cm and 6.5 cm and perpendicular height 6 cm. Shape R is a trapezium with parallel sides of length 9.5 cm and 7.5 cm and perpendicular height 9 cm. The area of R is 1.5 times the area of C.



Find the length a.

Your Turn

Shape B is a trapezium with parallel sides of length 5 cm and b cm and perpendicular height 6 cm. Shape D is a trapezium with parallel sides of length 10 cm and 6 cm and perpendicular height 6 cm. The area of R is twice the area of B.



Find the length b.

Worked Example

Different coloured counters are placed in a bag. The probabilities of each counter is given.

Colour	Red	Blue	Green	Purple
Probability	0.15	$6x$	$5x + 0.1$	0.2

a) Find the probability of selecting a green counter.

b) You are told there are 24 red counters in the bag. Find how many blue, green and purple counters there are?

Your Turn

Different coloured counters are placed in a bag. The probabilities of each counter is given.

Colour	Red	Blue	Green	Purple
Probability	$5x - 0.1$	0.1	$2x + 0.04$	$3x + 0.16$

a) Find the probability of selecting a red counter.

b) You are told there are 9 blue counters in the bag. Find how many red, green and purple counters there are?

3 Sequences

3.1 Finding the Next Term

Worked Example	Your Turn
a) A sequence starts with: $24, 29, 34, 39$ … Work out the next 3 terms. b) A sequence starts with: $2048, 512, 128, 32$ … Work out the next 3 terms.	a) A sequence starts with: $41, 36, 31, 26$ … Work out the next 3 terms. b) A sequence starts with: $7, 42, 252, 1512$ … Work out the next 3 terms.

Worked Example	Your Turn
a) A sequence starts with: $5, 9, 14, 23, 37$ … Work out the next 3 terms. b) A sequence starts with: $18, 23, 32, 45$ … Work out the next 3 terms.	a) A sequence starts with: $6, 10, 16, 26, 42$ … Work out the next 3 terms. b) A sequence starts with: $6, 14, 27, 45$ … Work out the next 3 terms.

3.2 Constant Differences

Worked Example	Your Turn
What is the constant difference in the sequence? a) The 10^{th} term is 52 and the 18^{th} term is 76 b) The 10^{th} term is 76 and the 18^{th} term is 52	What is the constant difference in the sequence? a) The 10^{th} term is 52 and the 22^{nd} term is 76 b) The 10^{th} term is 76 and the 22^{nd} term is 52

3.3 Term to Term Rule

Worked Example	Your Turn
a) The first five terms of a number sequence are shown below. $3, -1, -5, -9, -13$ Describe the term-to-term rule for this sequence.	a) The first five terms of a number sequence are shown below. $4, -2, -8, -14, -20$ Describe the term-to-term rule for this sequence.
b) The first five terms of a number sequence are shown below. $6, 30, 150, 750, 3750$ Describe the term-to-term rule for this sequence.	b) The first five terms of a number sequence are shown below. $5, 25, 125, 625, 3125$ Describe the term-to-term rule for this sequence.
c) The first five terms of a number sequence are shown below. $-4, 1, 10, 23, 40$ Describe the term-to-term rule for this sequence.	c) The first five terms of a number sequence are shown below. $5, 18, 36, 59, 87$ Describe the term-to-term rule for this sequence.

3.4 Types of Sequences

Arithmetic/Linear: The terms' first difference is constant.
e.g., $1, 3, 5, 7, \ldots$

Geometric: The terms found by multiplying by the same number each time.
e.g., $2, 4, 8, 16, \ldots$

Quadratic: The terms' second difference is constant.
e.g., $2, 5, 10, 17, \ldots$

Fibonacci-Type: The terms found by adding the previous two terms together.
e.g., $1, 3, 4, 7, 11, \ldots$

Frayer Model – Linear Sequences

Definition	**Characteristics**
Examples	**Non-Examples**

3.5 Position to Term Rule

Worked Example	Your Turn
Find the n^{th} term rule: a) $8, 15, 22, 29, 36, \ldots$ b) $-6, 1, 8, 15, 22, \ldots$ c) $36, 29, 22, 15, 8, \ldots$	Find the n^{th} term rule: a) $11, 18, 25, 32, 39, \ldots$ b) $-3, 4, 11, 18, 25, \ldots$ c) $39, 32, 25, 18, 11, \ldots$

Worked Example	Your Turn
The first five terms of a linear sequence are shown below. $9, 11, 13, 15, 17$ Find an expression for the $(n+1)^{th}$ term, in terms of n.	The first five terms of a linear sequence are shown below. $14, 16, 18, 20, 22$ Find an expression for the $(n-1)^{th}$ term, in terms of n.

Worked Example	Your Turn
Find the n^{th} term rule: $\frac{1}{2}, \frac{7}{10}, \frac{9}{10}, 1\frac{1}{10}, \ldots$	Find the n^{th} term rule: $\frac{1}{3}, \frac{7}{9}, 1\frac{2}{9}, 1\frac{2}{3}, \ldots$

Worked Example	Your Turn
Find the n^{th} term rule: $\frac{5}{12}, \frac{7}{19}, \frac{9}{26}, \frac{11}{33}, \ldots$	Find the n^{th} term rule: $\frac{6}{13}, \frac{8}{20}, \frac{10}{27}, \frac{12}{34}, \ldots$

3.6 Generating Linear Sequences

Worked Example	Your Turn
Generate the first 5 terms of a) $5n + 3$ b) $-3 - 5n$	Generate the first 5 terms of a) $6n - 3$ b) $3 - 6n$

Worked Example	Your Turn
a) The nth term of a sequence is $5(-6n+3)$ Work out the 50th term of the sequence.	a) The nth term of a sequence is $4(-3n-6)$ Work out the 50th term of the sequence.
b) The nth term of a sequence is $4n^2+6n-3$ Work out the 50th term of the sequence.	b) The nth term of a sequence is $2n^2-4n+1$ Work out the 50th term of the sequence.

3.7 Linear Sequences

Fill in the Gaps

First Five Terms	Term-to-Term Rule	10th Term	30th Term	nth Term	Sum of the First 5 Terms
3, 5, 7, 9, 11				$2n + 1$	
7, 10, 13, 16, 19					
8, ☐ ☐ ☐ ☐	$add\ 5$				
40, 36, 32, 28, 24				$44 - 4n$	
25, 22, 19, 16, 13					
☐ ☐ 7, ☐ ☐	$subtract\ 2$				
☐ ☐ ☐ 27, 31					
☐ ☐ ☐ ☐ ☐		35		$3n +$ ☐	
☐ ☐ ☐ ☐ ☐			20	☐ $- 6n$	
☐ ☐ ☐ ☐ ☐	$add\ 1$				35

Fill in the Gaps

Finding the nth term of a Linear Sequence

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	common difference	nth term
		11					21						
					27				43				
		4									31		
	11									65			
		14									−4		
	4						−38						
			−25										

5th	7th		4th	7th		6th	10th	
39	53		12	30		9	11	

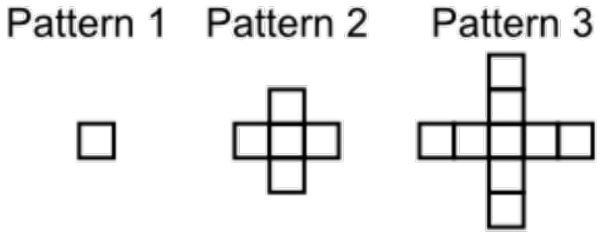
8th	15th		12th	20th		10th	15th	
−20	−48		−54	−102		17	15.5	

Fill in the Gaps

Q	First 4 terms	nth term rule	term to term rule	1st term	10th term	29th term
1	5, 9, 13, 17, …					
2		$4n + 3$				
3	8, 13, 18, 23, …					
4		$5n - 3$				
5			$+ 6$	2		
6			$+ 6$		52	
7				-1	26	
8					28	66
9		$8 - 2n$				
10	7, 6, 5, 4, …					
11				7	-20	
12					-20	-67.5

3.8 Patterns

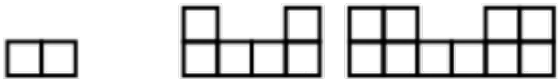
Worked Example



a) Draw the next pattern.
b) How many squares are in the n^{th} pattern?
c) How many squares in the 50^{th} pattern?
d) Which pattern will use 145 squares?

Your Turn

Pattern 1 Pattern 2 Pattern 3



a) Draw the next pattern.
b) How many squares are in the n^{th} pattern?
c) How many squares in the 50^{th} pattern?
d) Which pattern will use 154 squares?

3.9 Fibonacci-Type Sequences

Worked Example

Find the next three terms in these Fibonacci-type sequences:

a) $2, 7, 9, 16, \ldots$

b) $\frac{2}{3}, \frac{5}{6}, \frac{3}{2}, \frac{7}{3}, \ldots$

c) $3a + 4b, a + 7b, 4a + 11b, \ldots$

Your Turn

Find the next three terms in these Fibonacci-type sequences:

a) $3, 11, 14, 25, \ldots$

b) $\frac{3}{4}, \frac{5}{6}, \frac{19}{12}, \frac{29}{12}, \ldots$

c) $3a - 4b, 2a - 5b, 5a - 9b, \ldots$

3.10 Is a Term in the Sequence?

Worked Example	Your Turn
a) Is 100 in the sequence $16, 20, 24, 28, 32, \ldots$?	a) Is 100 in the sequence $26, 30, 34, 38, 42, \ldots$?
b) Is -100 in the sequence $42, 38, 34, 30, 26 \ \ldots$?	b) Is -100 in the sequence $32, 28, 24, 20, 16, \ldots$?

Worked Example

a) The first five terms of a linear sequence are shown below.
$19, 23, 27, 31, 35$
Find the greatest number in the sequence which is less than 68.

b) The first four terms of a sequence are shown below.
$13, 18, 23, 28$
Find the closest number in the sequence to 90.

Your Turn

a) The first four terms of a sequence are shown below.
$16, 20, 24, 28$
Find the first number in the sequence which is greater than 62.

b) The first four terms of a number sequence are shown below.
$6, 13, 20, 27$
Find the closest number in the sequence to 110.