



KING EDWARD VI
HANDSWORTH GRAMMAR
SCHOOL FOR BOYS



KING EDWARD VI
ACADEMY TRUST
BIRMINGHAM

Year 11

2026 Mathematics 2027

Unit 23 Tasks – Part 1

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Unit 23 Tasks – Part 2

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Year 11

2026 Mathematics 2027

Unit 23 Tasks – Part 3

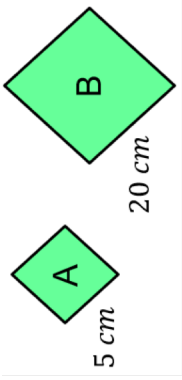
DO NOT WRITE INSIDE

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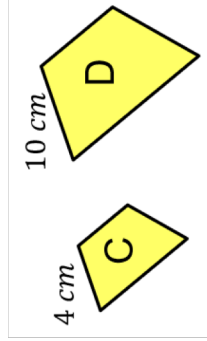
- 1 [Similarity with Area and Volume](#)
- 2 [Arcs, Sectors and Segments](#)
- 3 [Volume and Surface Area of Non-Prisms](#)
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1 Similarity with Area and Volume

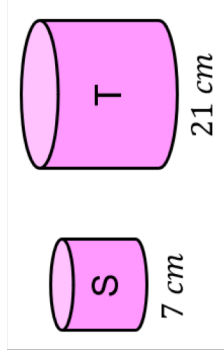
Fluency Practice



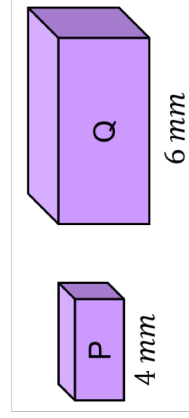
- (a) Find the linear scale factor.
- (b) Find the area scale factor.
- (c) The area of shape A is 15 cm^2 , find the area of shape B.
- (d) The area of shape B is 360 cm^2 , find the area of shape A.



- (a) The area of shape C is 12 cm^2 , find the area of shape D.
- (b) The area of shape D is 50 cm^2 , find the area of shape C.

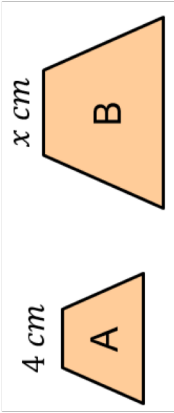


- (a) The volume of shape S is 70 cm^3 , find the volume of shape T.
- (b) The volume of shape T is 810 cm^3 , find the volume of shape S.

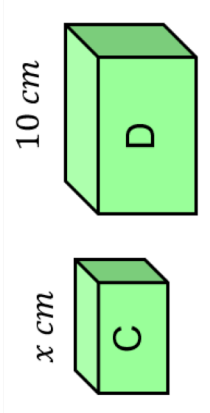


- (a) The volume of shape P is 24 cm^3 , find the volume of shape Q.
- (b) The volume of shape Q is 270 cm^3 , find the volume of shape P.
- (c) The surface area of shape P is 110 cm^2 , find the surface area of shape Q.
- (d) The surface area of shape Q is 180 cm^2 , find the surface area of shape P.

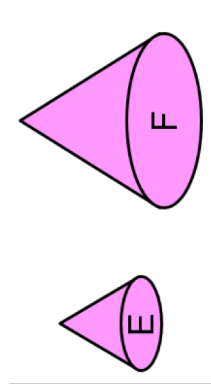
Fluency Practice



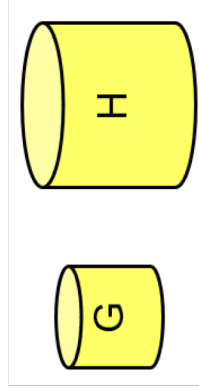
(a) The area of A is 20 cm^2 and the area of B is 180 cm^2 . Find x .



(b) The volume of C is 5 cm^3 and the volume of D is 320 cm^3 . Find x .



(c) The surface area of E is 15 cm^2 and the surface area of F is 60 cm^2 . If the volume of E is 27 cm^3 , find the volume of F.



(d) The volume of G is 4 cm^3 and the volume of H is 171.5 cm^3 . If the surface area of H is 122.5 cm^2 , find the surface area of G.

(e) If a painting with area of 220 cm^2 has a diagonal length of 21 cm, what will be the diagonal length of a similar painting with area 350 cm^2 ?

(f) It takes 5.6 litres of paint to paint a tower that is 3 m high. What is the tallest similar tower that can be painted with 8 litres of paint?

(g) A bronze statue has a mass of 300g and a height of 9 cm. A similar statue has a mass of 2 kg. What is its height?

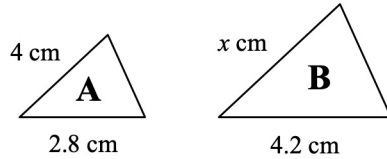
Purposeful Practice

Remember: If (between two similar shapes) a length is a and the equivalent length is b then the length scale factor k is given by $k = \frac{b}{a}$. Going from the first to the second: lengths get multiplied by k , areas get multiplied by k^2 , volumes get multiplied by k^3 .

1. Two boxes of cereal are similar in shape. The smaller one has a height of 15 cm. The larger one has a height of 20 cm.
 - (a) Find the length scale factor k going from the smaller to the larger.
 - (b) If the small box has volume 750 cm^3 , find the volume of the larger box.
 - (c) If the label on the front of the smaller box has area 20 cm^2 , find the area of the label on the larger box.
2. Two children's toys are similar in shape. The smaller one has a height of 20 cm. The larger one has a height of 25 cm.
 - (a) Find the length scale factor k going from the smaller to the larger.
 - (b) If the small toy has surface area 800 cm^2 , find the surface area of the larger toy.
 - (c) If the volume of the larger toy is 250 cm^3 , find the volume of the smaller toy.
3. Two cones are similar in shape. The height of the larger one is 10 cm. The height of the smaller one is 7 cm.
 - (a) Find the length scale factor k going from the larger to the smaller.
 - (b) If the larger cone has volume 100 cm^3 , find the volume of the smaller cone.
4. Two flasks are similar in shape. The surface area of the larger one is 100 cm^2 . The surface area of the smaller one is 64 cm^2 .
 - (a) Find the length scale factor k going from the larger to the smaller.
 - (b) If the volume of the larger one is 94 cm^3 find the volume of the smaller one.
5. Charlie has two similar sized rocks. The smaller has a volume of 2 cm^3 . The larger has a volume of 2.662 cm^3 .
 - (a) If the larger one has length 1.4 cm, find the length of the smaller one.
 - (b) If the smaller has a surface area of 4.2 cm^2 , find the surface area of the larger one.
6. Tiffany is similar in shape to her daughter Candy. Tiffany's back has surface area 1500 cm^2 . Candy's is 1215 cm^2 .
 - (a) If Candy is 130 cm tall, how tall is Tiffany?
 - (b) If Tiffany has a volume of 50000 cm^3 , what is Candy's volume?

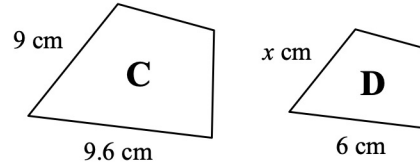
Fluency Practice

A1 Shape **A** is similar to shape **B**



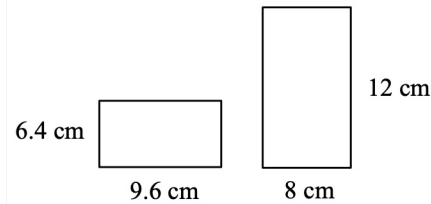
Work out the value of x .

A2 Shape **C** is similar to shape **D**

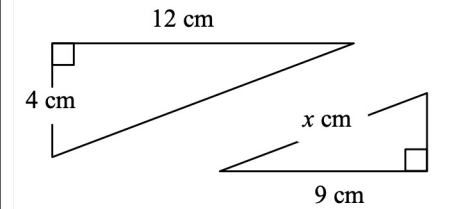


Work out the value of x .

A3 Do some calculations to work out if the rectangles are mathematically similar.

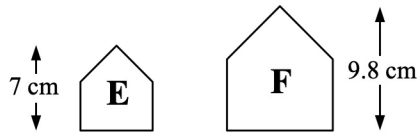


A4 The two triangles are similar



Work out the value of x .

B1 Shape **E** is similar to shape **F**
The area of **E** is 30 cm^2



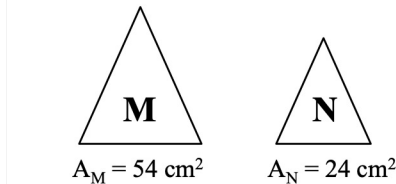
Calculate the area of **F**.

B2 Shape **G** is similar to shape **H**
The area of **G** is 210 cm^2



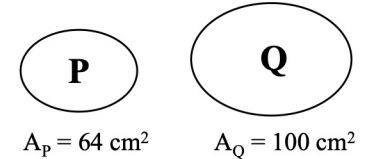
Calculate the area of **H**.

B3 Shape **M** is similar to shape **N**
The height of **M** is 12 cm.



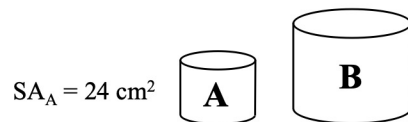
Calculate the height of **N**.

B4 Shape **P** is similar to shape **Q**
The width of **Q** is 14 cm.



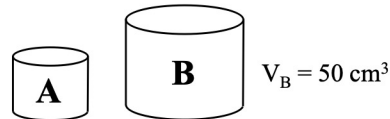
Find the width of **P**.

C1 Cylinders **A** and **B** are similar
Cylinder **B** is 1.6 times as high as cylinder **A**.



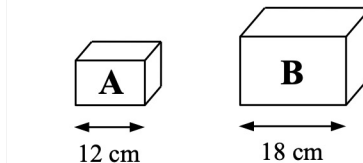
Calculate the surface area of **B**.

C2 Cylinders **A** and **B** are similar
Cylinder **B** is 1.4 times as high as cylinder **A**.



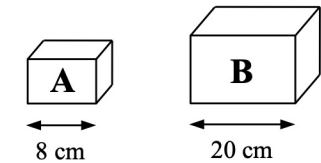
Calculate the volume of **A**.

C3 Cuboids **A** and **B** are similar
The volume of **A** is 250 cm^3 .



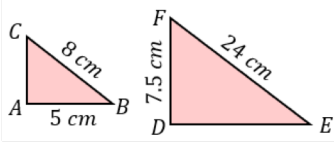
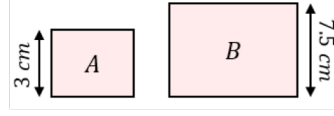
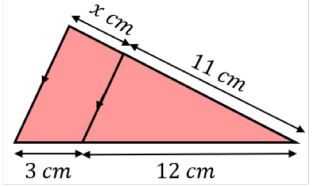
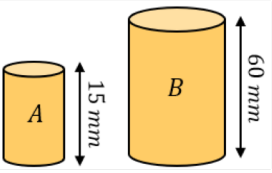
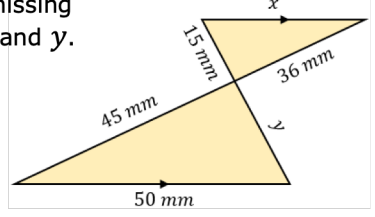
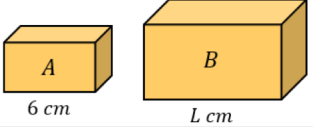
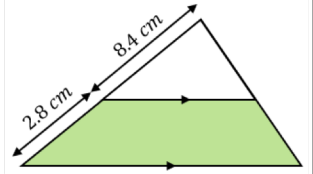
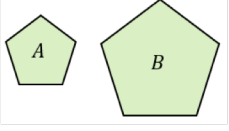
Calculate the volume of **B**.

C4 Cuboids **A** and **B** are similar
The surface area of **B** is 1000 cm^2 .

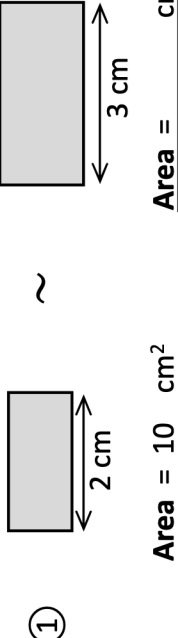
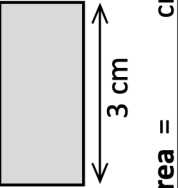
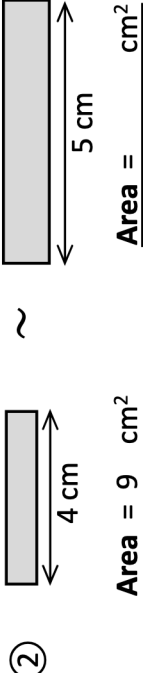
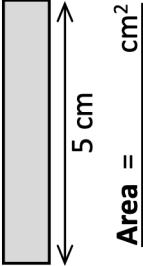
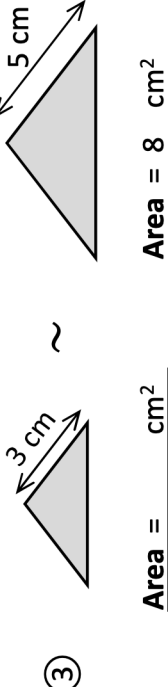
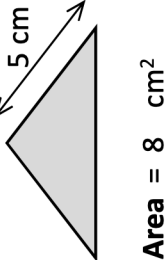
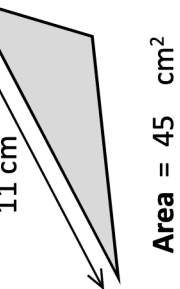
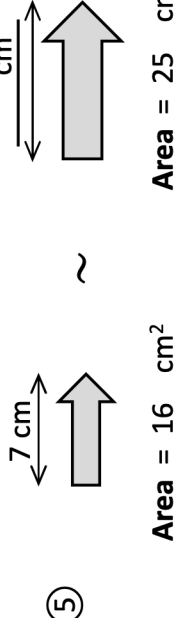
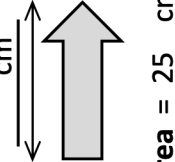
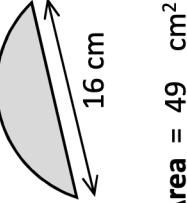


Calculate the surface area of **A**.

Purposeful Practice

Similar Shapes Revision		
(a) Triangles ABC and DEF are similar. Calculate the lengths of DE and AC. 	(b) Rectangles A and B are mathematically similar. The area of A is 40 cm^2. Work out the area of rectangle B. 	(c) Find the missing length x. 
(d) Cylinders A and B are similar. The volume of cylinder B is 2080 cm^3. Find the volume of cylinder A. 	(e) Find the missing lengths x and y. 	(f) Cuboids A and B are similar. A has a volume of 28 cm^3 and B has a volume of 437.5 cm^3. Find the length L. 
(g) Cones A and B are mathematically similar. Cone A has a volume of 857.5 cm^3 and a surface area of 73.5 cm^2. Cone B has a volume of 160 cm^3. Find its surface area.	(h) The area of the white triangle is 18 cm^2. Find the area of the shaded region. 	(i) Pentagons A and B are similar. The scale factor of their lengths is x. The area of A is 12 cm^2. If the area of B is $(16x + 3) \text{ cm}^2$, find the value of x. 

Fluency Practice

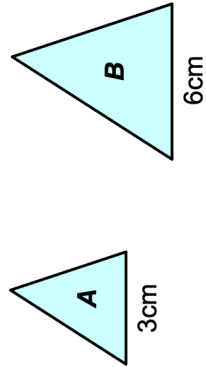
~ similar	Areas of Similar Shapes	Not drawn to scale
For each pair of similar shapes... 1) Express either the length or area ratio. 2) Use that to find the corresponding ratio. 3) Use the appropriate ratio to find missing areas or lengths (1dp).		
		
① 	~ 	Length Ratio = $\frac{2}{3}$ ↓ (Square) Area Ratio = $\frac{4}{9}$
② 	~ 	Length Ratio = $\frac{4}{5}$ Area Ratio = $\frac{16}{25}$
③ 	~ 	Length Ratio = $\frac{3}{5}$ Area Ratio = $\frac{9}{25}$
④ 	~ 	Length Ratio = $\frac{4}{11}$ Area Ratio = $\frac{16}{121}$
⑤ 	~ 	Length Ratio = $\frac{7}{\text{cm}}$ Area Ratio = $\frac{49}{\text{cm}^2}$
⑥ 	~ 	Length Ratio = $\frac{\text{cm}}{16}$ Area Ratio = $\frac{9}{256}$

Fluency Practice

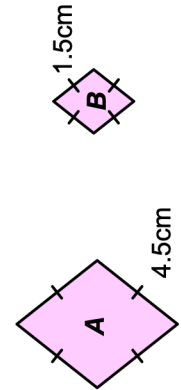
Exercise

1. Work out the ratio **area of shape A** : **area of shape B** for each pair of similar shapes.
Give your answers in the simplest form.

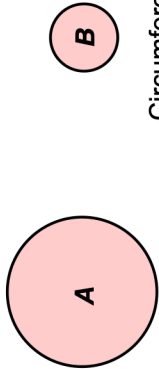
a)



b)



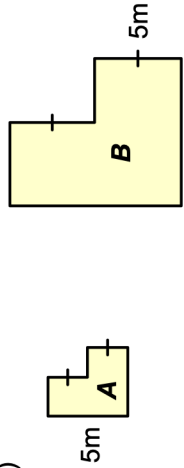
c)



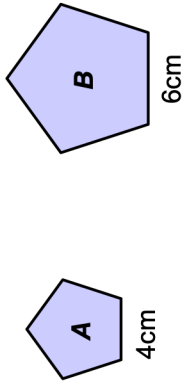
Circumference = 8π

Circumference = 4π

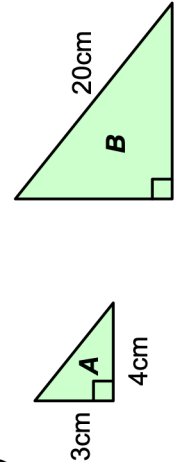
d)



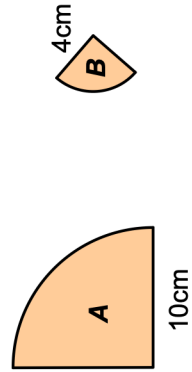
e)



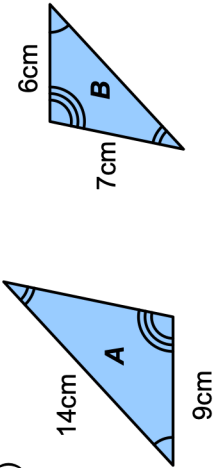
f)



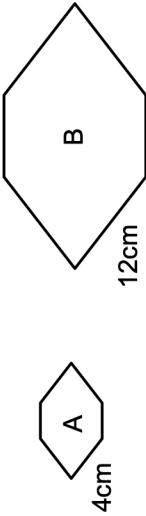
g)



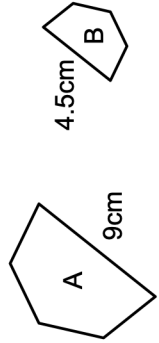
h)



i)



j)



2. Two similar hexagons are shown.
The area of hexagon A is 25cm^2 .

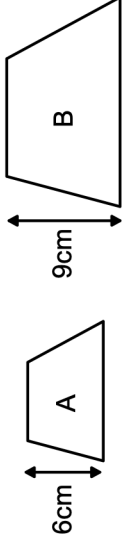
Work out the area of hexagon B.

3. Two similar shapes are shown.
The area of shape A is 54cm^2 .

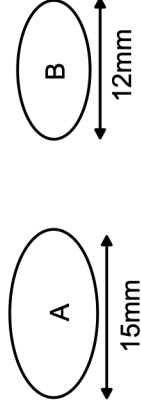
Work out the area of shape B.

Purposeful Practice

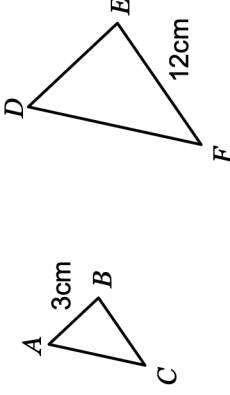
4. Two similar trapezia are shown.
The area of trapezium A is 48cm^2 .
Work out the area of trapezium B.



5. Two similar ellipses are shown.
The area of ellipse A is 40cm^2 .
Work out the area of ellipse B.

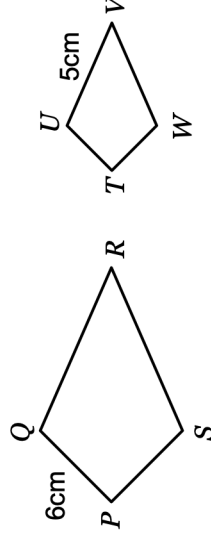


6. $\triangle ABC$ and $\triangle DEF$ are similar triangles
with areas 8cm^2 and 72cm^2 respectively.



- Work out the length of DE .
- Work out the length of BC .

7. $PQRS$ and $TUVW$ are similar kites
with areas 96cm^2 and 24cm^2
respectively.

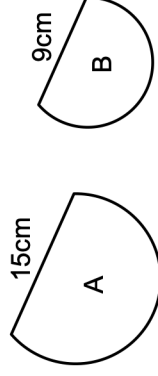


- Work out the length of TU .
- Work out the length of QR .

8. Two similar segments are shown.
Work out the ratio

Area of segment A : Area of segment B

Give your answer in the simplest form.



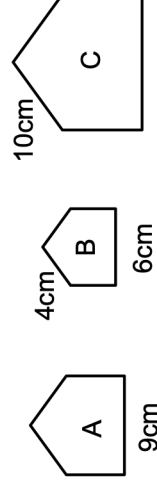
9. A and B are two similar rectangles. The area of B is 44% larger than the area of A.
Rectangle A has a width of 20cm.
Work out the width of rectangle B.

10. A and B are two similar squares, such that Area of A : Area of B = 1 : 8.
Square A has a diagonal length of $3\sqrt{2}\text{cm}$.
Work out the length of a diagonal of square B.

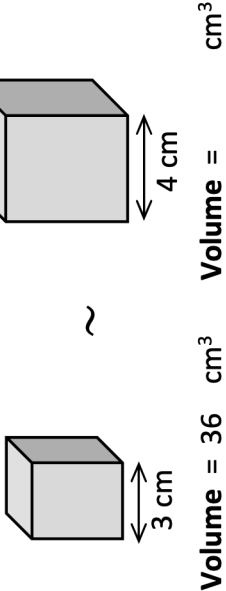
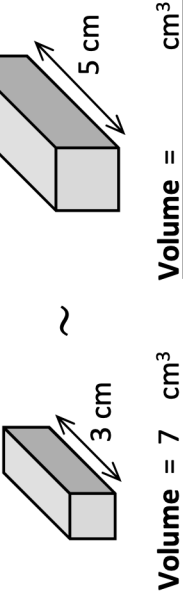
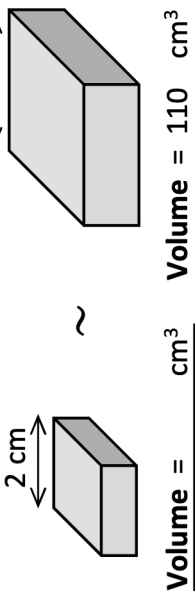
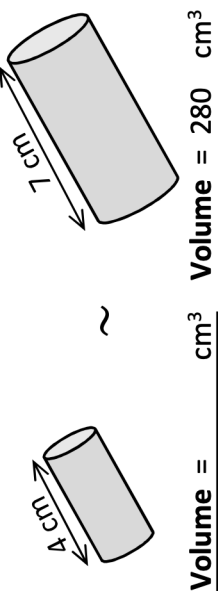
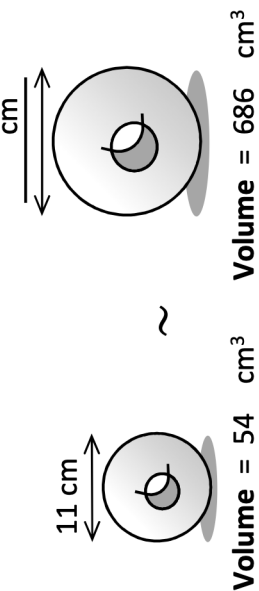
11. A, B and C are three similar shapes.
Work out the ratio

Area of shape A : Area of shape C

Give your answer in the simplest form.



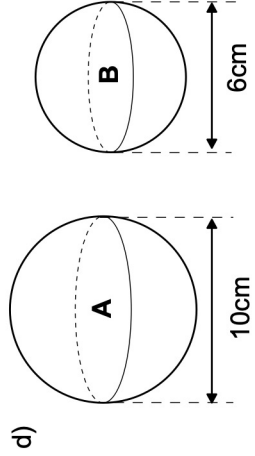
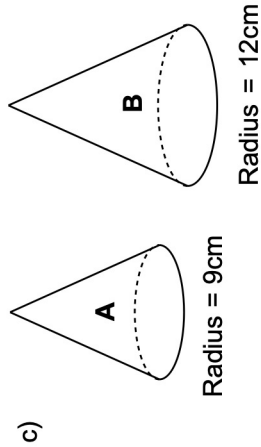
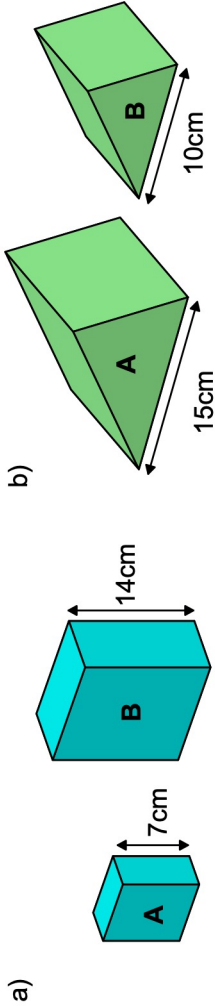
Fluency Practice

~ similar	Volumes of Similar Shapes	Not drawn to scale
For each pair of similar solids... 1) Express either the length or volume ratio. 2) Use that to find the corresponding ratio. 3) Use the appropriate ratio to find missing lengths or volumes (1dp). 		
①	 Volume = 36 cm³ Volume = _____ cm³	Length Ratio = $\frac{3}{4}$ ↓ (Cube) Volume Ratio = $\frac{27}{64}$
②	 Volume = 7 cm³ Volume = _____ cm³	Length Ratio = $\frac{\quad}{\quad}$ Volume Ratio = $\frac{\quad}{\quad}$
③	 Volume = _____ cm³ Volume = 110 cm³	Length Ratio = $\frac{\quad}{\quad}$ Volume Ratio = $\frac{\quad}{\quad}$
④	 Volume = _____ cm³ Volume = 280 cm³	Length Ratio = $\frac{\quad}{\quad}$ Volume Ratio = $\frac{\quad}{\quad}$
⑤	 Volume = 54 cm³ Volume = 686 cm³	

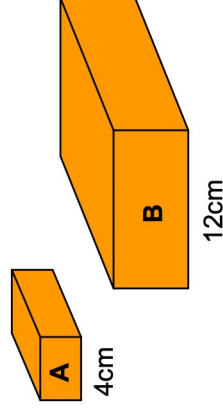
Purposeful Practice

Exercise

1. For each pair of similar shapes, work out **volume of A : volume of B**.
Give your answers in the simplest form.

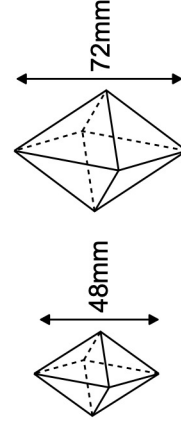


2. Two blocks are cut from the same piece of wood, as shown. The two blocks are similar cuboids.



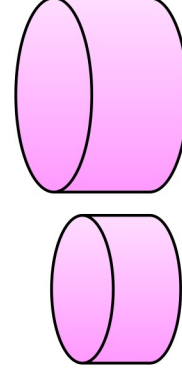
- a) The volume of block A is 50cm^3 .
Work out the volume of block B.
- b) The mass of block B is 5.4kg.
Work out the mass of block A.

3. Two similar octahedra are shown.
The smaller octahedron has a volume of 6.4cm^3 .



Work out the volume of the larger octahedron.

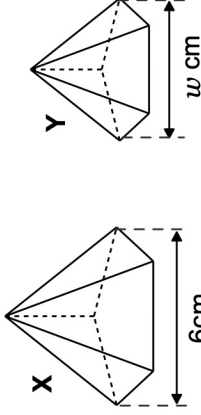
4. Two containers are in the shape of similar cylinders. The containers have diameters of 12cm and 16cm. The larger container has a capacity of 1.6 litres.



Work out the capacity of the smaller container.

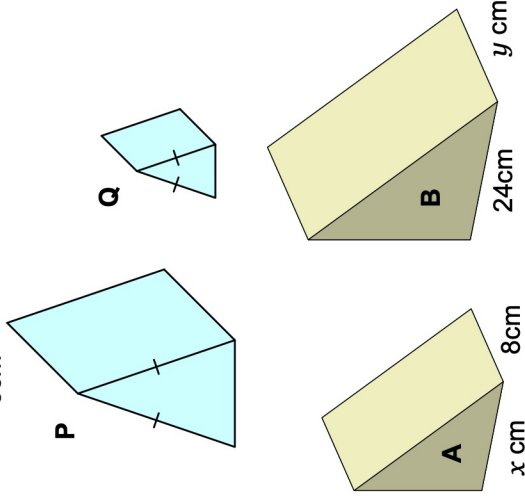
Purposeful Practice

5. X and Y are similar pyramids.
The volume of X is 135cm^3 .
The volume of Y is 40cm^3 .



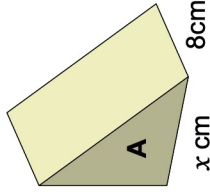
Work out the value of w .

6. P and Q are similar prisms.
The volume of P is 2000cm^3 .
The volume of Q is 686cm^3 .
The height of P is 20 cm.



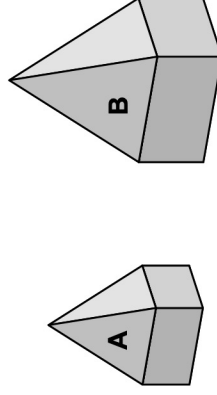
Work out the height of Q.

7. Shape B is an enlargement of shape A.
The volume of B is 72.8% larger than the volume of A.



Work out the values of x and y .

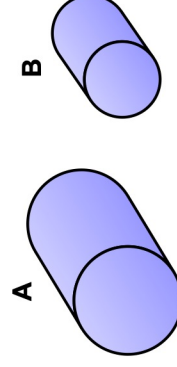
8. A and B are two similar 3D shapes.
Surface area of A : surface area of B = 4 : 9.



a) Work out the ratio of the volume of A to the volume of B in the simplest form.

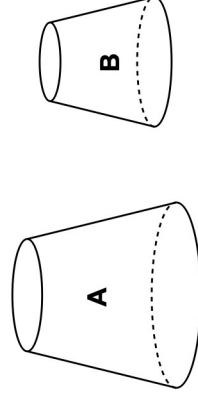
b) The volume of A is 76cm^3 .
Work out the volume of B.

9. A and B are two similar cylinders.
The surface area of A is $150\pi\text{ cm}^2$.
The surface area of B is $\frac{75}{2}\pi\text{ cm}^2$.
The volume of A is $250\pi\text{ cm}^3$.



Work out the volume of B in terms of π .

10. A and B are two similar frustums.
Volume of A : volume of B = 64 : 27.

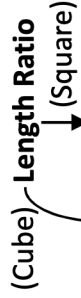


The surface area of A is $72\pi\text{ cm}^2$.
Work out the surface area of B.

Page 28

Not drawn to scale

- ①



$$= \frac{3}{5}$$

$$= 9 : 25$$

$$= 27 : 125$$

Surface Area = cm^2

- ②



• •

Volume = cm^3

- ③



1.

1.

• •

Surface Area = 49 cm²

- ④



.

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1

Surface Area = 72 cm^2
Volume = cm^3

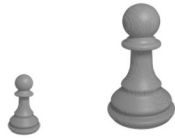
- 5

Surface Area = 140 cm^2
Volume = 1536 cm^3

Fluency Practice

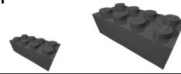
Similar Shapes: Length, Area & Volume Ratios

Here are pairs of shapes – a model & the real-life object (not shown to scale).
Complete each table with measurements & ratios.

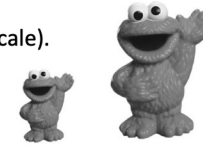


Answers to 1 dp
where necessary.

Shape A	Shape B	Ratios	
1 cm	3 cm	Length	
5 cm ²		Area	
3 cm ³		Volume	



Shape C	Shape D	Ratios	
2 cm		Length	
8 cm ²	18 cm ²	Area	
	108 cm ³	Volume	



Shape E	Shape F	Ratios	
6 cm		Length	
20 cm ²		Area	4:25
40 cm ³		Volume	



Shape G	Shape H	Ratios	
9 cm		Length	
	144 cm ²	Area	
3 cm ³		Volume	1:216



Shape I	Shape J	Ratios	
	12 cm	Length	
7 cm ²		Area	
15 cm ³		Volume	125:216



Shape K	Shape L	Ratios	
84 cm	120 cm	Length	
5 m ²		Area	
15 m ³		Volume	



Simplify these ratios first.

Shape M	Shape N	Ratios	
	2.5 cm	Length	
13 cm ²		Area	18:50
3 cm ³		Volume	



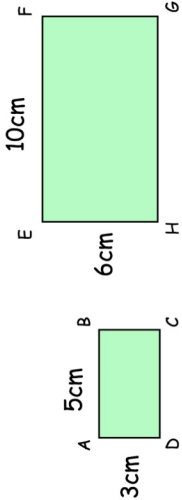
Shape O	Shape P	Ratios	
24 cm		Length	
45 cm ²		Area	
120 cm ³		Volume	250:686



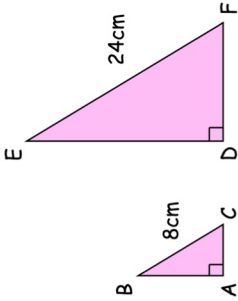
Shape Q	Shape R	Ratios	
25 cm		Length	
0.2 m ²		Area	128:242
13 cm ³		Volume	

Fluency Practice

Question 1: Rectangle EFGH is an enlargement of rectangle ABCD.



- (a) What is the scale factor of enlargement?
- (b) How many times larger is the area of EFGH than ABCD?



Question 2: Triangles ABC and DEF are similar.
How many times larger is the area of ABC than ABCD?

Question 3: Each pair of shapes below are similar.
Find the missing areas.

(a) Area = 5cm^2 Area = cm^2

(b) Area = 80cm^2 Area = cm^2

(c) Area = cm^2 Area = 240cm^2

(d) Area = 4cm^2 Area = cm^2

Fluency Practice

(e) Area = 216cm^2 Area = $\boxed{}\text{cm}^2$

(f)

Area = 99cm^2 Area = $\boxed{}\text{cm}^2$

Question 4: Each pair of shapes below are similar.
Find the missing lengths.

(a) Area = 15cm^2 Area = 60cm^2

(b) Area = 6cm^2 Area = 1350cm^2

(c) $\boxed{}\text{cm}$ 24cm

Area = 7cm^2 Area = 112cm^2

(d) Area = 60cm^2 Area = 735cm^2

Question 5: The solid shapes below are mathematically similar.
Find the missing surface areas.

(a) Surface area = 50cm^2 Surface area = $\boxed{}\text{cm}^2$

(b) Surface area = $\boxed{}\text{cm}^2$ Surface area = 506.25cm^2

Question 6: The solid shapes below are mathematically similar.
Find the missing lengths.

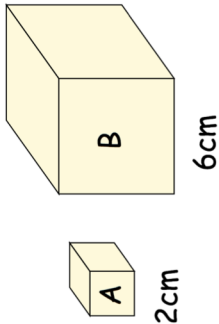
(a) Surface area = 16m^2 Surface area = 121m^2

(b) Surface area = 6cm^2 Surface area = 5400cm^2

Fluency Practice

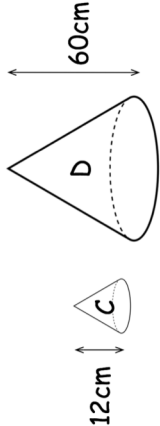
Question 1: Cube B is an enlargement of cube A.

- (a) What is the scale factor of enlargement?
- (b) How many times larger is the surface area of B than A?
- (c) How many times larger is the volume of cube B than A?



Question 2: Cones C and D are similar.

How many times larger is the volume of D than C?



Question 3: The solids below are mathematically similar. Find the missing volumes.

(a)

Volume = 20cm^3

3cm

Volume = cm^3

9cm

(b)

Volume = cm^3

5cm

Volume = 160000cm^3

40cm

(c)

Volume = cm^3

5cm

Volume = 138.24cm^3

6cm

(d)

Volume = 65mm^3

2.5mm

Volume = mm^3

1cm

Question 4: The solid shapes below are mathematically similar. Find the missing lengths.

(a)

Volume = 120cm^3

9cm

Volume = 960cm^3

cm

(b)

Volume = 6cm^3

cm

Volume = 750cm^3

15cm

Page 35



20cm



A diagram of a cube. A vertical double-headed arrow is drawn along the right edge of the front face, with the label "cm" next to it.

A 3D diagram of a rectangular prism. The height of the prism is indicated by a vertical double-headed arrow on the right side, labeled "12 cm".



Volume =


$$V_{\text{volume}} = 400 \text{ cm}^3$$
 cm^3 
$$\text{Volume} = 1920 \text{ cm}^3$$

cm³

$$\text{Volume} = 20\text{cm}^3$$

Surface area = $324\pi \text{ cm}^2$

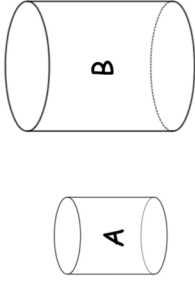


Fluency Practice

Question 1: A and B are mathematically similar.

The height of A : the height of B = 3 : 5

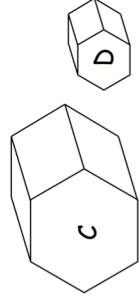
- (a) Find the surface area of A : the surface area of B
- (b) Find the volume of A : the volume of B



Question 2: Solids C and D are similar.

The length of C : the length of D = 9 : 2

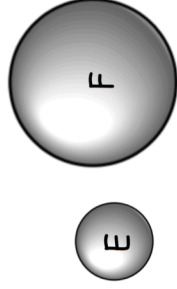
- (a) Find the surface area of C : the surface area of D
- (b) Find the volume of C : the volume of D



Question 3: Shown are spheres E and F.

The surface area of E : the surface area of F = 4 : 49

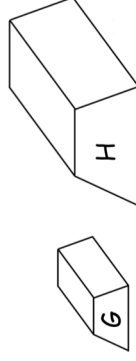
- (a) Find the diameter of E : the diameter of F
- (b) Find the volume of E : the volume of F



Question 4: Shown are similar solids G and H.

The volume of G : the volume of H = 27 : 1000

- (a) Find the height of G : the height of H
- (b) Find the surface area of G : the surface area of H



Question 5: The surface areas of two similar shapes are in the ratio 25 : 81
The length of the smaller shape is 30cm.

Work out the length of the larger shape.

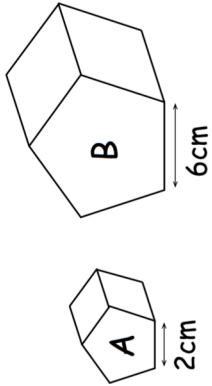
Question 6: The volumes of two similar shapes are in the ratio 1000 : 27
The surface area of the larger shape is 250cm²

Work out the surface area of the smaller shape.

Purposeful Practice

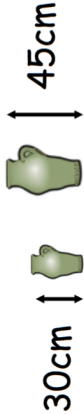
Apply

Question 1: Myles says that the surface area of B is three times larger than the surface area of A.



Explain why Myles is incorrect.

Question 2: Two vases are similar. The smaller vase holds 800ml.

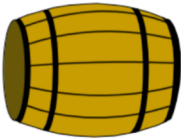


How much does the larger vase hold?

Question 3: Two barrels are mathematically similar. It takes 90ml of paint to paint the smaller barrel.



4 Litres



108 Litres

How much paint is needed for the larger barrel?

Question 4: A large bottle of cola is 16cm tall. A small bottle of cola is 12cm tall.

The bottles are mathematically similar.

Fernando claims the small bottle contains three-quarters of the amount of cola than the large bottle.

Show Fernando is wrong.

Question 5: Nina bought a toy that grows when placed in water. Before placing the toy in water, it was 4cm tall. After placing the toy in water it grew to a similarly shaped toy that was 11cm tall.



Grows 20 times larger

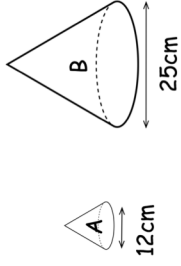
Is the claim that it will “grow 20 times larger” reasonable?

Question 6: Alec makes two solid mathematically similar models of the Titanic.

- The smaller model had a length of 10cm
 - The larger model had a length of 45cm
 - The mass of the larger model is 7.29kg
- Work out the mass of the smaller model.

Purposeful Practice

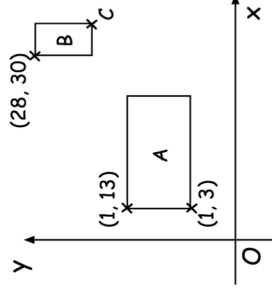
Question 7: Below are two similar cones.



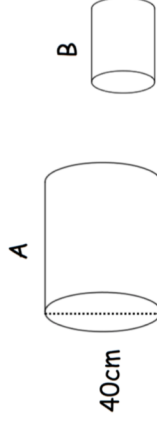
Anna says the volume of A is approximately 11% of the volume of B. Is Anna correct? Explain your answer.

Question 8: Rectangles A and B are similar.
The area of rectangle A is 240
The area of rectangle B is 15.

Find the coordinates of the point C.



Question 9: Cylinders A and B are similar.



$$\text{Volume B} \times \frac{512}{27} = \text{Volume A}$$

Find the radius of cylinder B.

Question 10: A, B and C are similar.

The volume of A is 729cm^3 and the volume of B is 64cm^3 .
The surface area of B is 25cm^2 and the surface area of C is 121cm^2 .

Find the ratio length of A : length of B : length of C

Question 11: Shapes A, B and C are similar.

The height of shape A is 8cm.
The height of shape C is 4cm.
The ratio of the surface area of shape B to the surface area of shape C is 25:9

Work out the ratio of the volume of shape A to shape B.

Purposeful Practice

Question 12: Two solid toys, C and D, are similar.

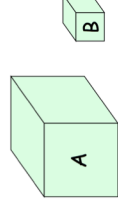
The volume of toy C is 40cm^3

The surface area of C : surface area of D = 2 : 9

Work out the volume of toy D.

Question 13: Washing powder is sold in two different sizes, a large box A and a smaller box B. Cuboid boxes A and B are similar.

Surface area of A : Surface area of B = 81 : 4



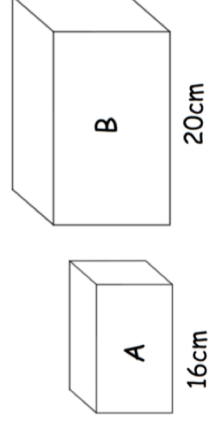
How many smaller boxes, B, can be completely filled using the contents of a full box A?

Question 14: Pyramid A and pyramid B are similar.

The surface area of B is 42.25 times larger than the surface area of A.

Find the ratio of the volume of A to the volume of B.

Question 15: Cuboids A and B are similar but made from different materials. Both cuboids are placed on a table.



The pressure on the table due to cuboid A is 3.5 newtons/ cm^2

Cuboid A exerts a force of 420N on the table.

The pressure on the table due to cuboid B is 4 times larger than cuboid A.

Work out the force exerted by cuboid B on the table.

Purposeful Practice

Question 16: Ornament A and B are mathematically similar.
They are solid and both made from copper and zinc in the ratio 3:2

Ornament A has a height of 5cm and volume of 30cm^3
Ornament B has a height of 18cm.

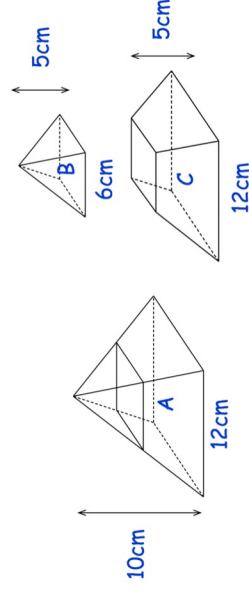
The density of copper is 8.96g/cm^3
The density of zinc is 7.13g/cm^3

Work out the difference in mass between ornament A and ornament B.

Question 17: Cylinders A and B are similar.
The height of A is 6cm.
The volume of A is 240cm^3 to 2 significant figures.
The height of B is 15cm and the volume of B is y .

Work out the error interval of y .

Question 18: The square based pyramid A is divided into Pyramid B and Frustum C.



- (a) Express the volume of Pyramid B as a fraction of the volume of Pyramid A.
- (b) Express the volume of Frustum C as a fraction of the volume of Pyramid A.

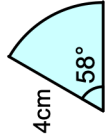
2 Arcs, Sectors and Segments

Fluency Practice

learn by heart+ example

$$\text{Length of an arc:} \\ \frac{\theta}{360} \times 2\pi r$$

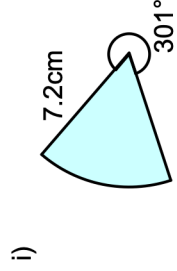
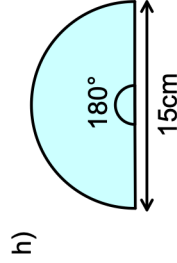
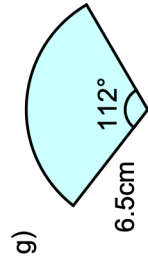
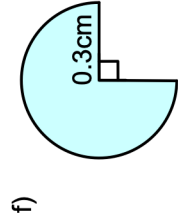
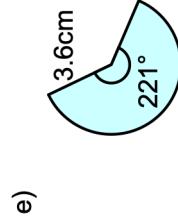
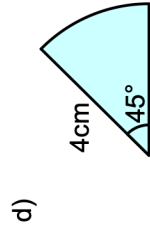
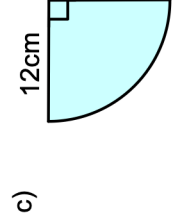
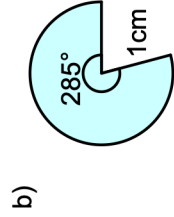
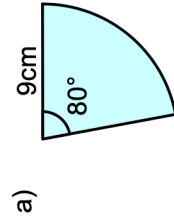
Calculate the arc length of the sector, correct to the nearest 0.01cm.



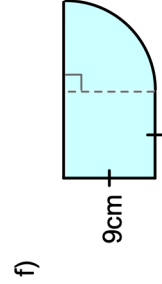
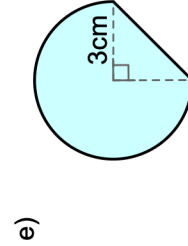
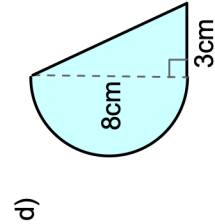
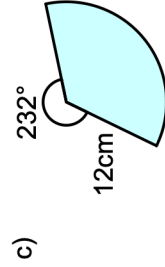
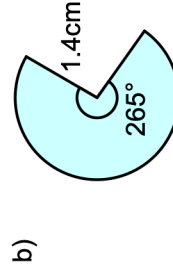
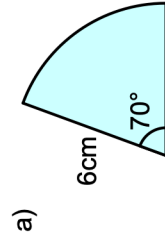
$$\text{Arc length} = \frac{58}{360} \times 2 \times \pi \times 4 \\ = 4.05\text{cm (nearest 0.01cm)}$$

exercise

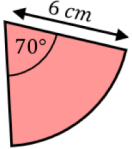
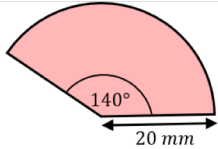
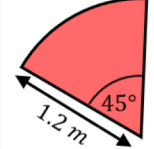
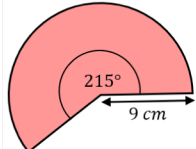
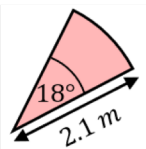
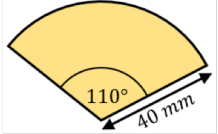
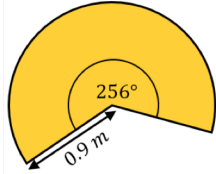
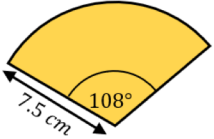
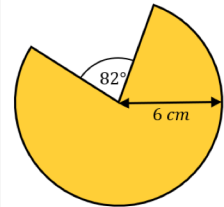
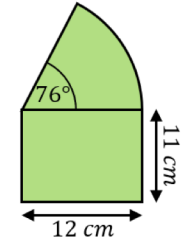
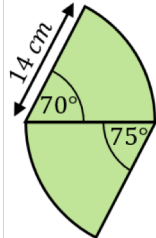
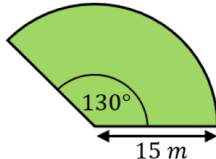
1. Calculate the arc length of each sector, correct to the nearest 0.01cm.



2. Calculate the **perimeter** of these shapes, correct to the nearest 0.01cm.



Purposeful Practice

Arc Length and Perimeter of a Sector				
(a) Find the arc length. 	(b) Find the arc length. 	(c) Find the arc length. 	(d) Find the arc length. 	(e) Find the arc length. 
(f) Find the perimeter. 	(g) Find the perimeter. 	(h) Find the perimeter. 	(i) Find the perimeter. 	(j) Find the perimeter. 
(k) Find the perimeter. 	(l) Find the perimeter. 	(m) Farmer Jo wants to put a fence around his sector-shaped field. Fencing costs £18.99 per metre. How much will it cost Farmer Jo? 	(n) The pendulum of a clock is 48 cm long and swings through an angle of 15° . The pendulum swings back and forth every two seconds. How far does the end of the pendulum swing in a minute?	

Fluency Practice

CIRCUMFERENCE: MATCH THREE!

Each of these pictures contains circles or parts of circles. Calculate the total perimeter of each shape. Find your answer in terms of Pi and as a decimal in the list below.

A

B

C

D

E

F

G

H

I

J

K

Perimeter in terms of π

$4.5\pi + 6$

$2\pi^2$

$10\pi + 12$

$3\pi + 12$

6π

5π

$3\pi + 9$

$5\pi + 10$

$1.5\pi + 6$

$4\pi + 24$

$3\pi + 6$

Perimeter (2 d.p.)

18.42

19.74

18.85

20.14

36.57

10.71

25.71

15.71

43.42

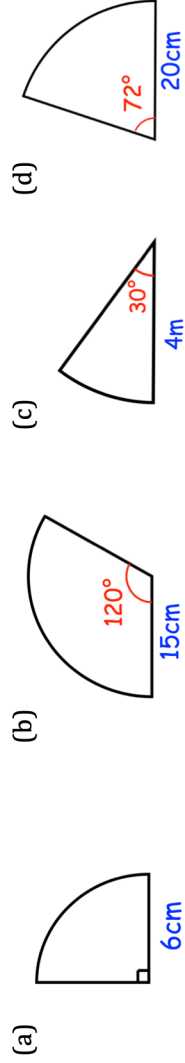
21.42

15.42

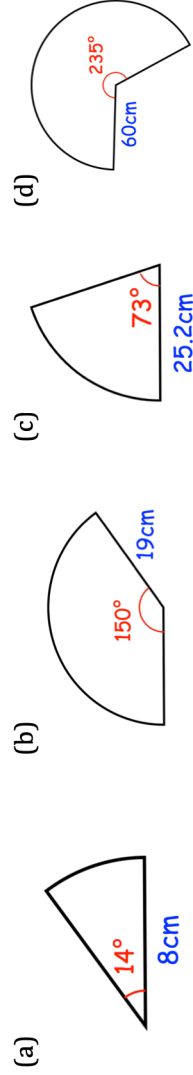
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		
K		

Fluency Practice

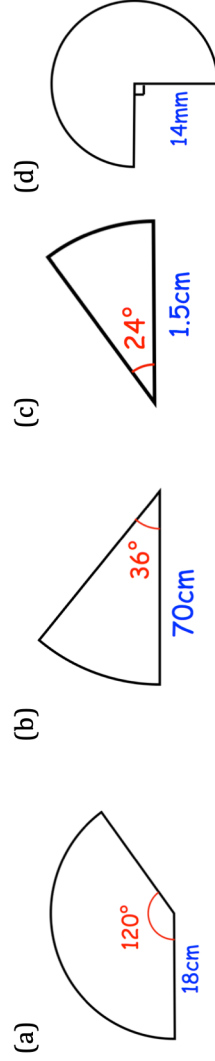
Question 1: For each sector below, calculate the length of the arc.
Give your answers to one decimal place and include suitable units.



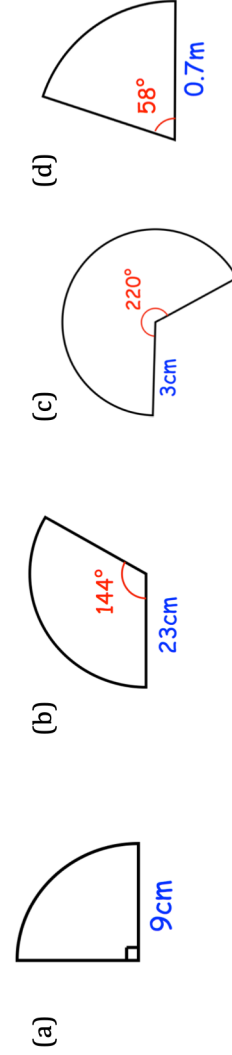
Question 2: For each sector below, calculate the length of the arc.
Give your answers to one decimal place and include suitable units.



Question 3: For each sector below, calculate the length of the arc.
Leave your answer in terms of π

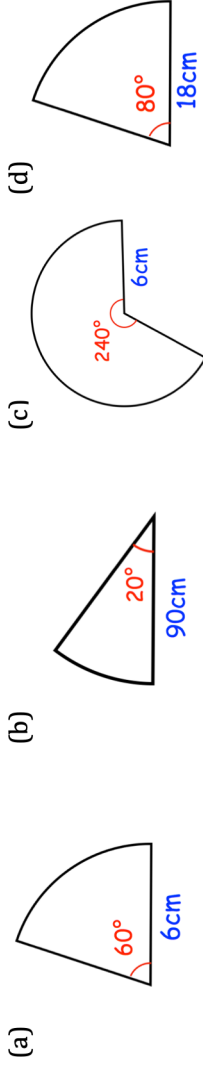


Question 4: Calculate the perimeter of each sector below
Give your answers to one decimal place and include suitable units.



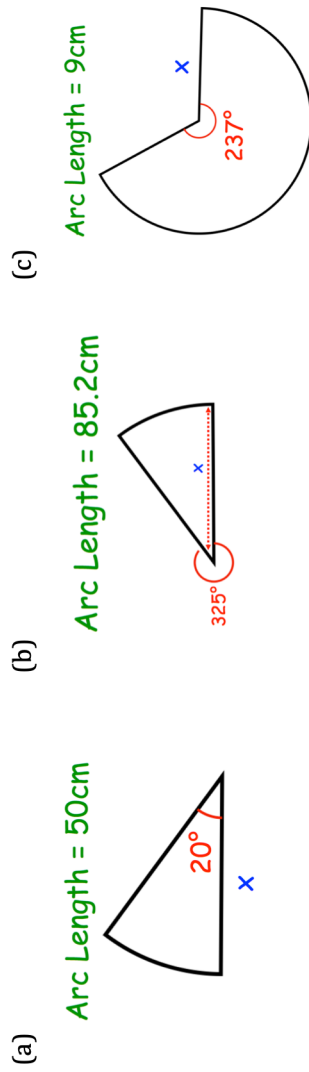
Fluency Practice

Question 5: Calculate the perimeter of each sector below
Leave your answer in terms of π

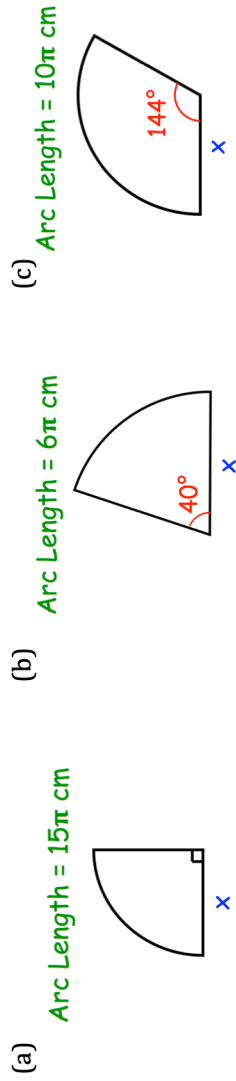


Question 6: The arc length of each sector has been given.
Calculate x

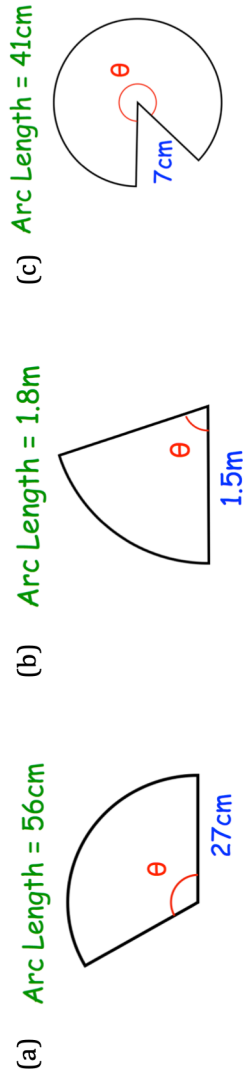
Give your answers to one decimal place and include suitable units.



Question 7: The arc length of each sector has been given.
Calculate x

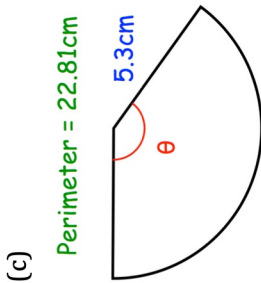
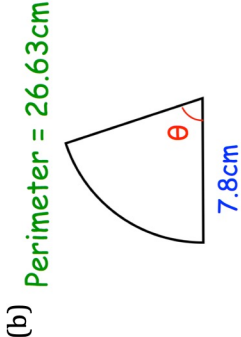
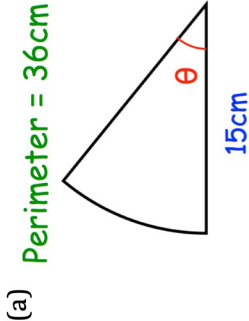


Question 8: The arc length of each sector has been given.
Calculate the size of the angle
Give your answers to one decimal place.

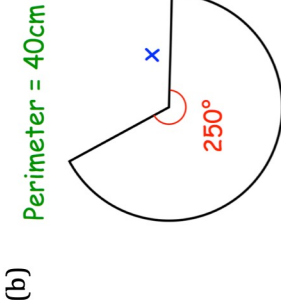
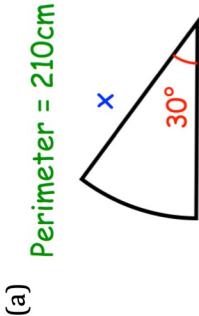


Purposeful Practice

Question 9: The perimeter of each sector has been given.
Calculate the size of the angle
Give your answers to one decimal place.

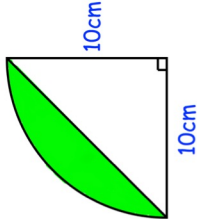


Question 10: The perimeter of each sector has been given.
Calculate x
Give your answers to one decimal place.

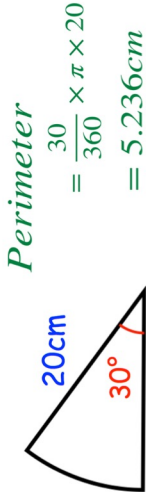


Apply

Question 1: Calculate the perimeter of the segment.



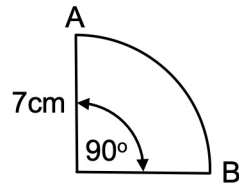
Question 2: James is calculating the perimeter of the sector.
Can you spot any mistakes?



Purposeful Practice

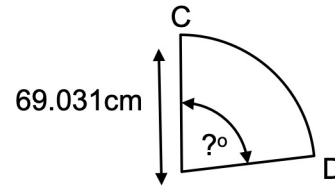
lengths of arcs (i)

(1)



what is the length of arc AB ?

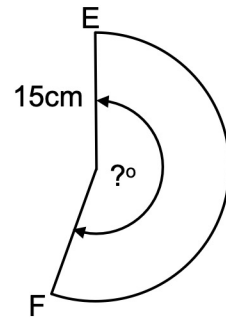
(2)



the length of the arc CD is 100cm

what is the angle?

(3)



the arc EF is to have an length of 50cm

what is the angle?

(4)

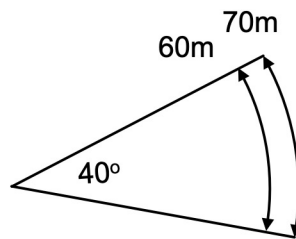
the radius of the London Eye is 60m

there are 32 equally spaced capsules

how far is it between two adjacent capsules?



(5)



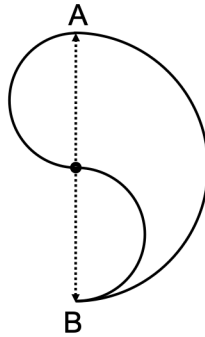
in a 40° (college) discus throwing area

what is the difference in arc lengths for the 60m and 70m arcs?

Purposeful Practice

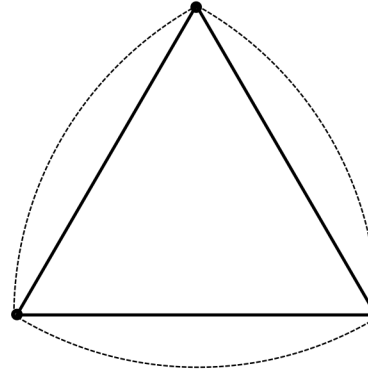
lengths of arcs (ii)

(1)



what is the perimeter of the shape if AB is a diameter of the larger circle, of length 20cm?

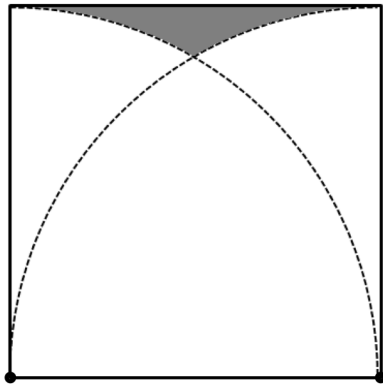
(2)



the length of a side of the equilateral triangle is 8cm

what is the total distance around the three arcs (drawn with centres on the corners of the triangle)?

(3)

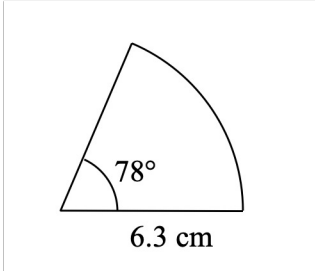


what is the perimeter of the shaded shape if a square has a length of 4cm?

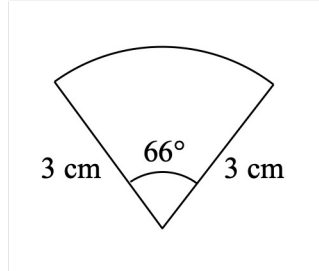
the arcs are drawn with centres on the corners of the square

Purposeful Practice

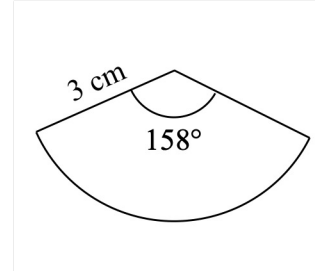
A1 Find the length of the arc



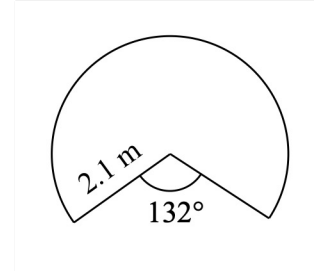
A2 Work out the perimeter



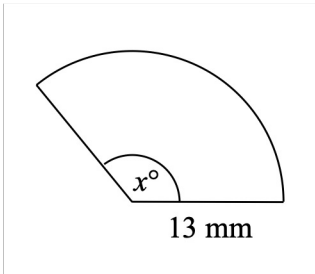
A3 Find the length of the arc



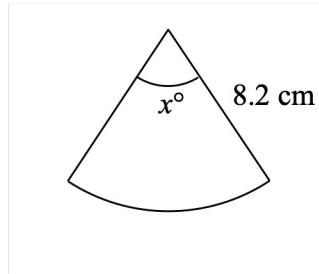
A4 Work out the perimeter



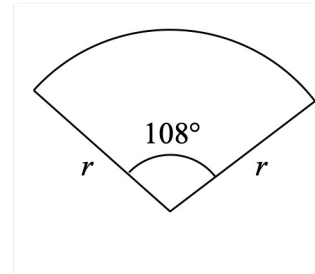
B1 Arc length is 32 mm, find x



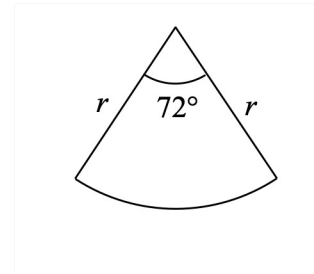
B2 Perimeter is 25 cm, find x



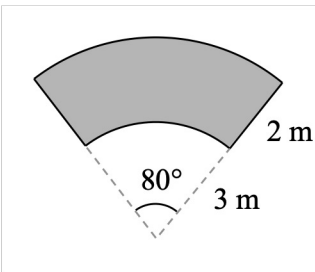
B3 Arc length is 9 cm, find r



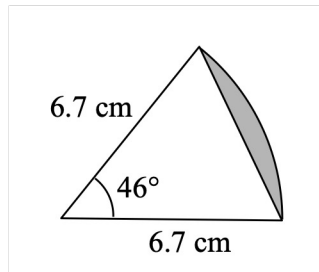
B4 Perimeter is 40 cm, find r



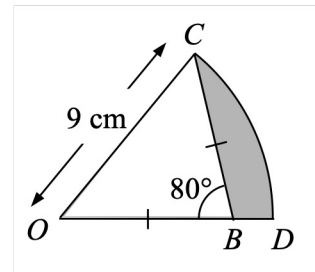
C1 Find the perimeter of the shaded shape.



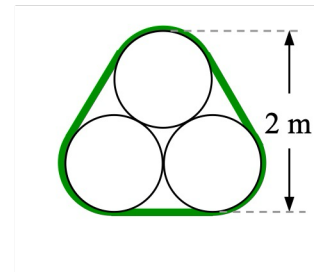
C2 Find the perimeter of the shaded segment.



C3 $OB = BC$. Find the perimeter of the shaded shape.



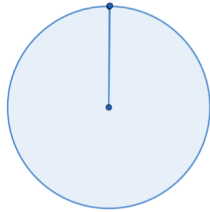
C4 Find length of the band that goes around the circles.



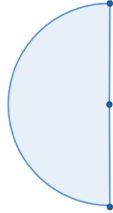
Fluency Practice

The radius is 5cm in every diagram. Find the area of each of the sectors.

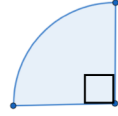
1



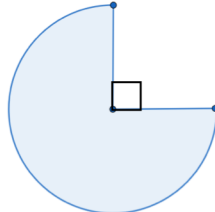
2



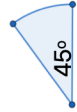
3



4



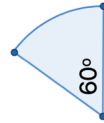
5



6



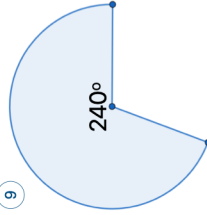
7



8



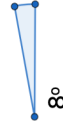
9



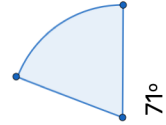
10



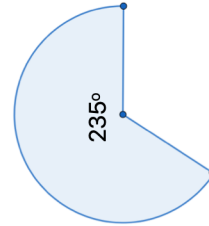
11



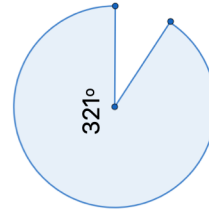
12



13



14



15

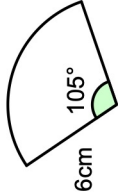


Fluency Practice

learn by heart example

$$\text{Area of a sector} = \frac{\theta}{360} \times \pi r^2$$

Calculate the area of the sector, correct to the nearest 0.01cm^2 .

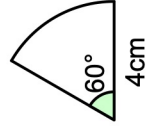


$$\begin{aligned} \text{Area} &= \frac{105}{360} \times \pi \times 6^2 \\ &= 32.99\text{cm}^2 \text{ (nearest } 0.01\text{cm}^2) \end{aligned}$$

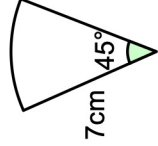
exercise

1. Calculate the area of these shapes, correct to the nearest 0.01cm^2 .

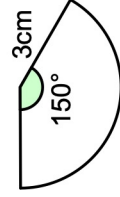
a)



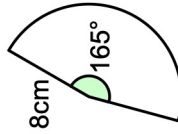
b)



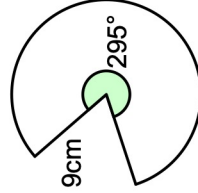
c)



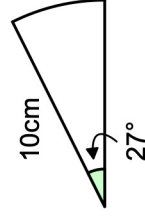
d)



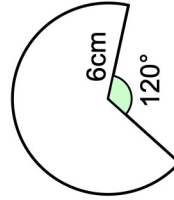
e)



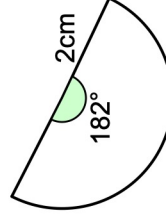
f)



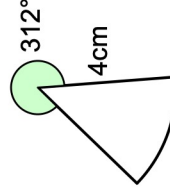
g)



h)

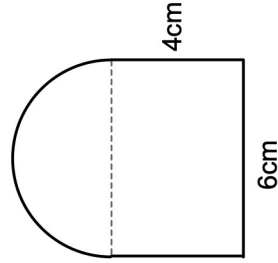


i)

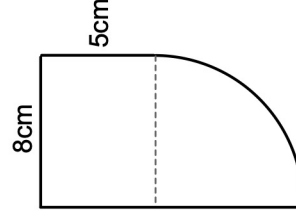


2. Calculate the area of these shapes, correct to the nearest 0.01cm^2 .

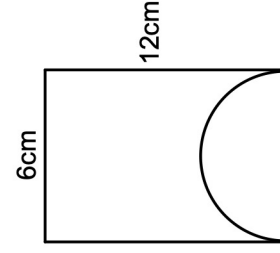
a)



b)



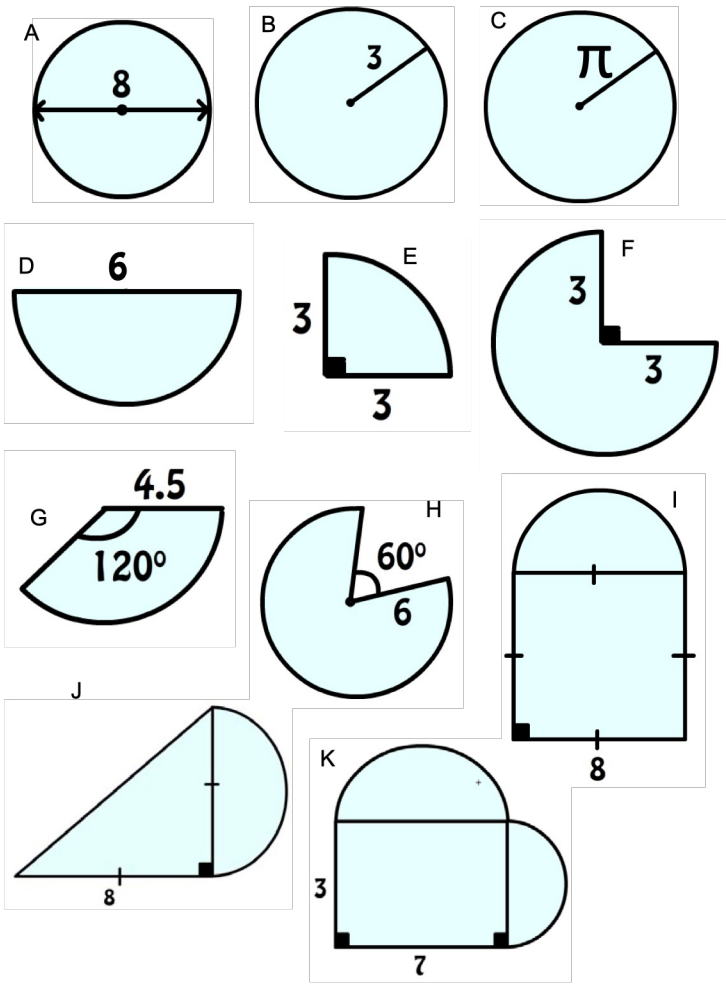
c)



Fluency Practice

area: match three!

Each of these pictures contains circles or parts of circles. Calculate the total area of each shape. Find your answer in terms of Pi and as a decimal in the list below.



Area in terms
of π

4.5π

6.75π

30π

π^3

$32 + 8\pi$

9π

$64 + 8\pi$

16π

$21 + 7.25\pi$

6.75π

2.25π

Area
(2 d.p.)

14.14

43.78

94.25

28.27

89.13

21.21

31.01

57.13

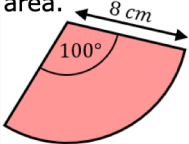
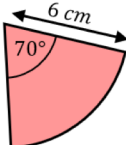
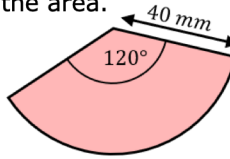
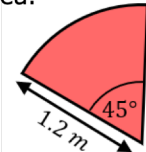
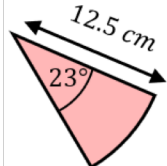
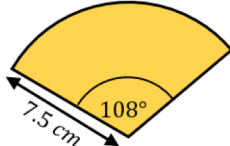
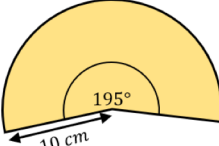
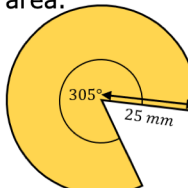
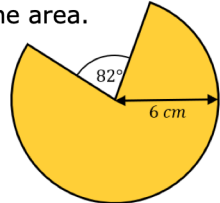
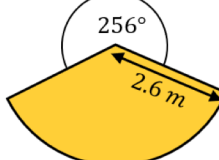
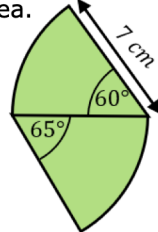
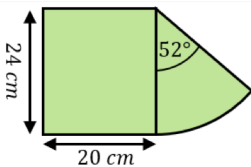
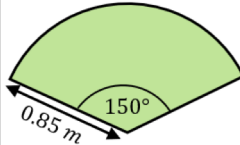
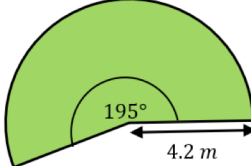
21.21

7.07

50.27

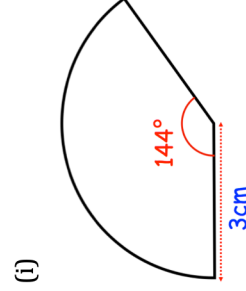
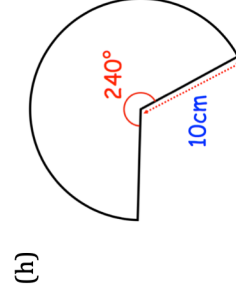
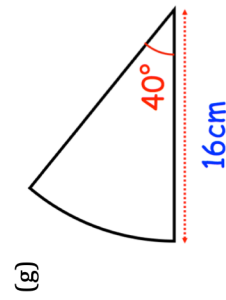
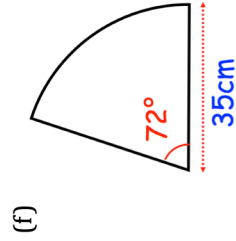
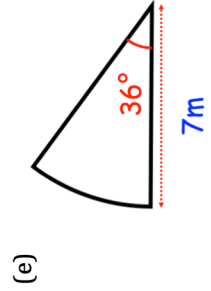
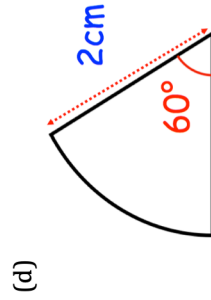
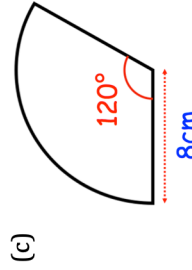
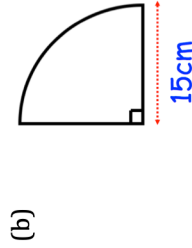
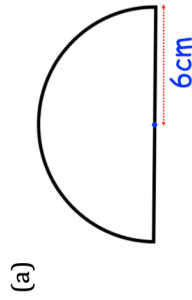
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		
K		

Purposeful Practice

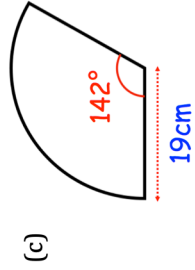
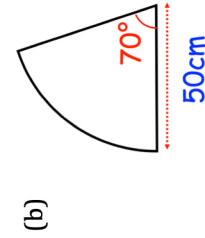
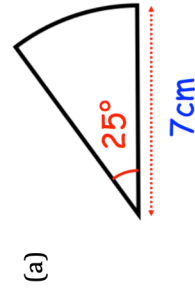
Area of a Sector				
(a) Find the area. 	(b) Find the area. 	(c) Find the area. 	(d) Find the area. 	(e) Find the area. 
(f) Find the area. 	(g) Find the area. 	(h) Find the area. 	(i) Find the area. 	(j) Find the area. 
(k) Find the area. 	(l) Find the area. 	(m) Tia wants a fan-shaped mirror, as shown in the diagram. Mirrored glass costs £82.50 per m^2 . How much will Tia's mirror cost to make? 	(n) Pablo has a sector-shaped swimming pool with dimensions shown. He wants to fill his pool to a depth of 1.8 m. How many litres of water will he need? 	

Fluency Practice

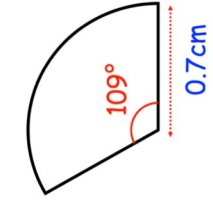
Question 1: Calculate the area of each of the following sectors.
Give each answer to one decimal place and include units.



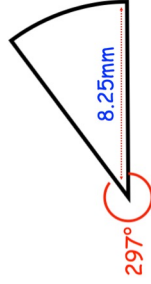
Question 2: Calculate the area of each of these sectors.
Give each answer to 2 decimal places and include suitable units.



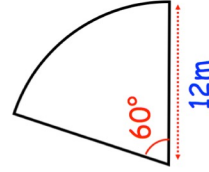
Fluency Practice



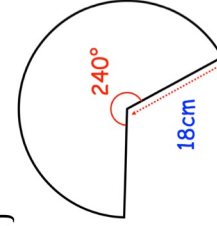
(f)



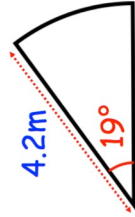
(i)



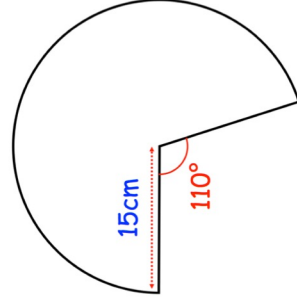
(c)



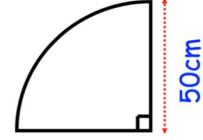
(f)



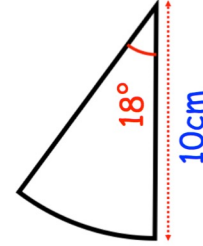
(e)



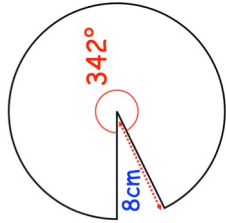
(h)



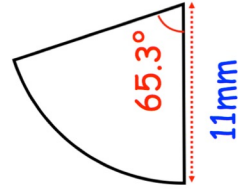
(b)



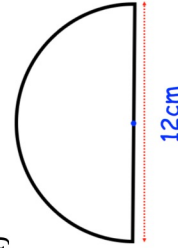
(e)



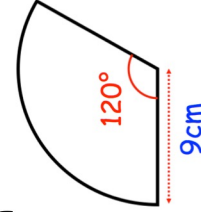
(d)



(g)



(a)

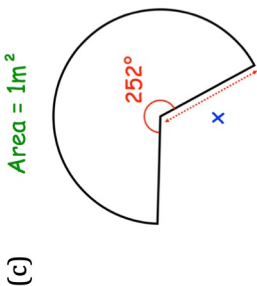
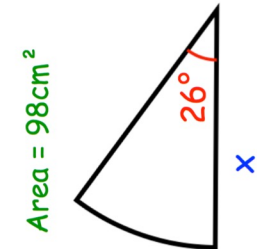
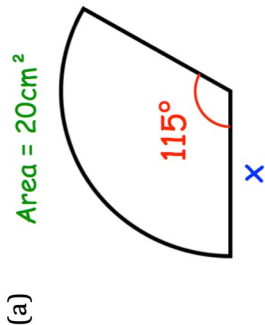


(d)

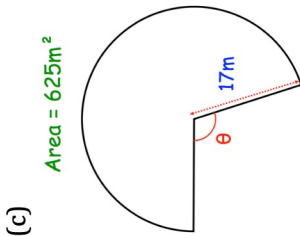
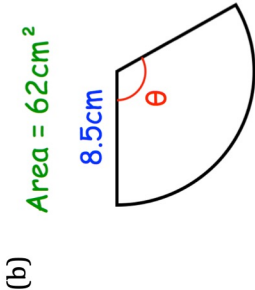
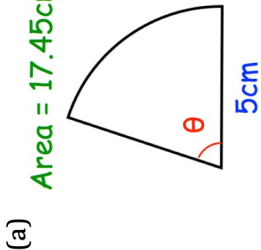
Question 3: Find the area of these sectors.
Leave your answer in terms of π

Purposeful Practice

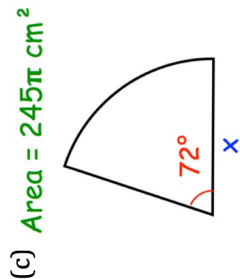
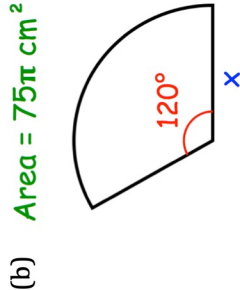
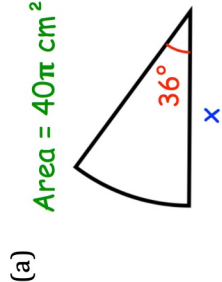
Question 4: The areas of these sectors have been given.
Calculate x .



Question 5: The areas of these sectors have been given.
Calculate the missing angles.

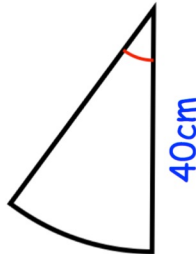


Question 6: The areas these sectors have been given in terms of π .
Work out x



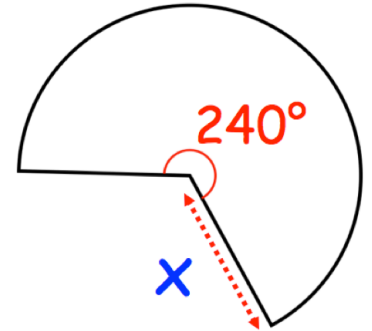
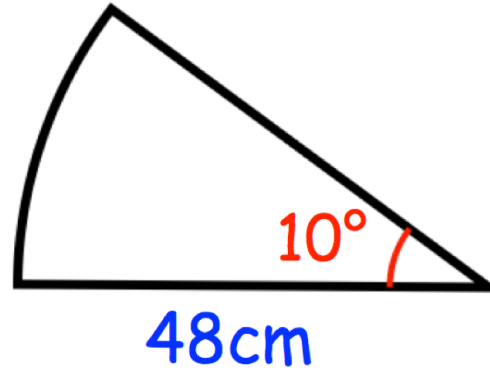
Apply

Question 1: The perimeter of the sector below is 103 cm
Find the area of the sector



Purposeful Practice

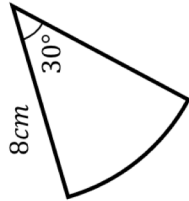
Question 2: These two sectors have the same area.
James says x is 2cm.
Is he correct?



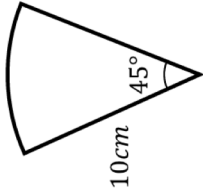
Fluency Practice

Find the area of the following shapes/shaded areas:

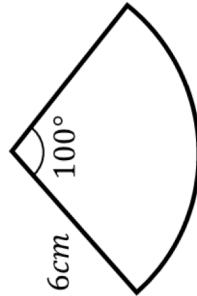
① Leave to 2 d.p.



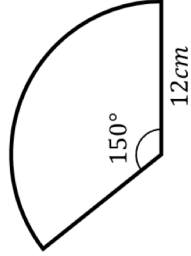
② Leave in terms of π



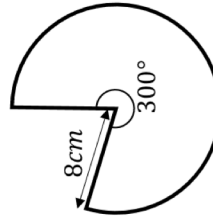
③ Leave to 3 s.f.



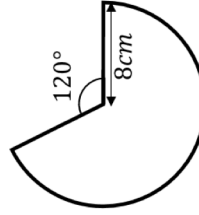
④ Leave in terms of π



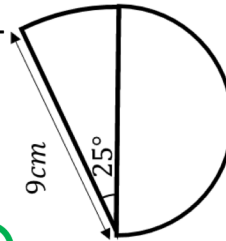
⑤ Leave to 1 d.p.



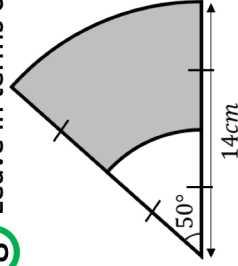
⑥ Leave in terms of π



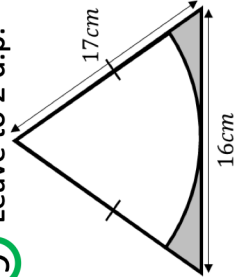
⑦ Leave to 2 d.p.



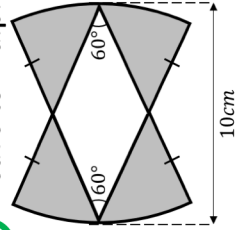
⑧ Leave in terms of π



⑨ Leave to 2 d.p.



⑩ Leave to 2 d.p.



Fluency Practice

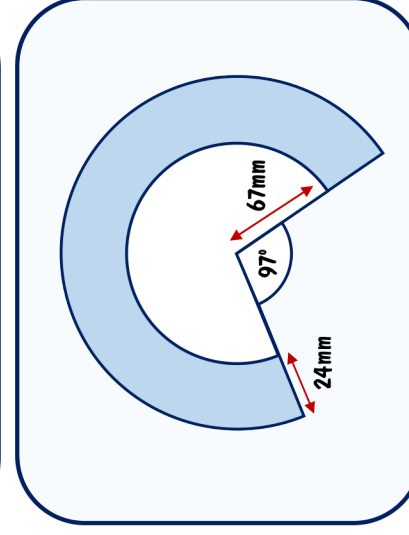
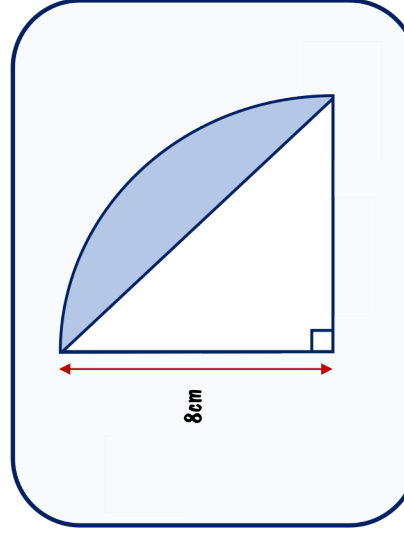
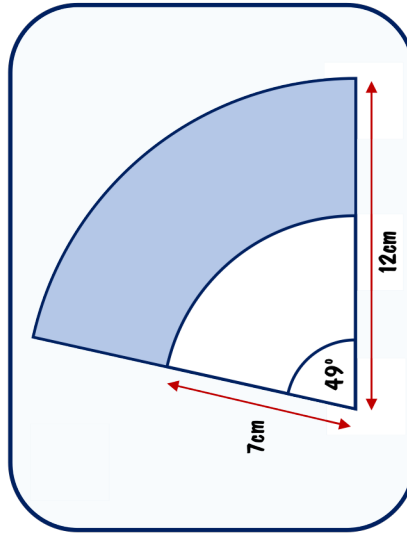
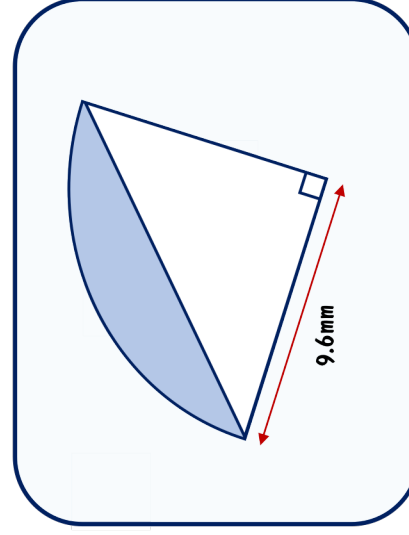
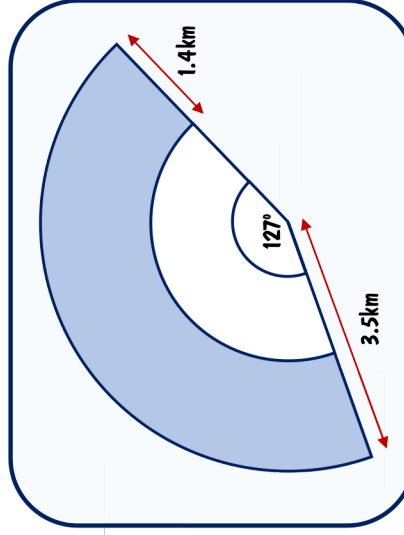
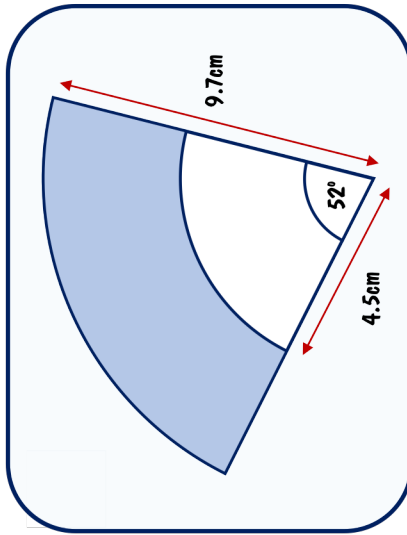
Q	Find, to two decimal places, the:	Answers
1	area of a circle with radius 10 <i>cm</i>	
2	circumference of a circle with radius 10 <i>cm</i>	
3	area of a circle with diameter 8 <i>cm</i>	
4	circumference of a circle with diameter 8 <i>cm</i>	
5	area of a half-circle with radius 6 <i>cm</i>	
6	perimeter of a half-circle with radius 6 <i>cm</i>	
7	area of a quarter-circle with diameter 4 <i>cm</i>	
8	perimeter of a quarter-circle with diameter 4 <i>cm</i>	
9	area of a sector of a circle with diameter 12 <i>m</i> and an angle of 60° subtended at the centre	
10	perimeter of a sector of a circle with diameter 12 <i>m</i> and an angle of 60° subtended at the centre	
11	radius of a circle where the numerical value of the area and circumference of a circle are equal	
12	algebraic expression for the difference between the magnitude of the area and circumference of a circle of radius <i>r</i>	

Fluency Practice

Q	Find, leaving your answer in terms of π , the:	Answers
1	Area of a sector with a radius of 6 <i>cm</i> and an angle of 120° subtended at the centre	
2	Arc length of a sector with a radius of 6 <i>cm</i> and an angle of 120° subtended at the centre	
3	Area of a sector with a diameter of 6 <i>cm</i> and an angle of 60° subtended at the centre	
4	Arc length of a sector with a diameter of 6 <i>cm</i> and an angle of 60° subtended at the centre	
5	Area of a sector with a radius of 8 <i>cm</i> and an angle of 90° subtended at the centre	
6	Arc length of a sector with a radius of 8 <i>cm</i> and an angle of 90° subtended at the centre	
7	Area of a sector with a diameter of 8 <i>cm</i> and an angle of 90° subtended at the centre	
8	Arc length of a sector with a diameter of 8 <i>cm</i> and an angle of 90° subtended at the centre	
9	Area of a sector with a radius of 12 <i>cm</i> and an angle of 30° subtended at the centre	
10	Perimeter of a sector with a radius of 12 <i>cm</i> and an angle of 30° subtended at the centre	
11	Area of a sector with a diameter of 16 <i>cm</i> and an angle of 45° subtended at the centre	
12	Perimeter of a sector with a diameter of 16 <i>cm</i> and an angle of 45° subtended at the centre	

Fluency Practice

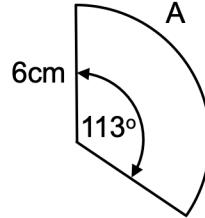
Find the area and the perimeter of the shaded section in each sector.



Purposeful Practice

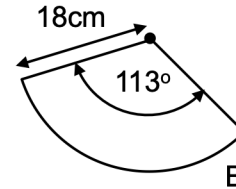
areas of sectors (i)

(1)



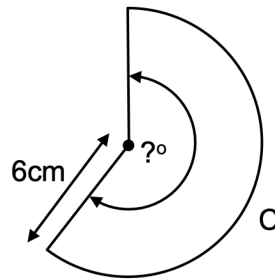
what is the area of sector A ?

(2)



what is the area of sector B ?

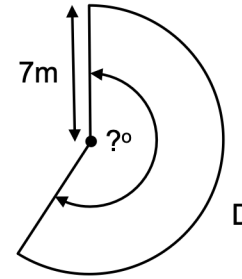
(3)



sector C is to have an area of 60.0044cm^2

what angle must it have?

(4)



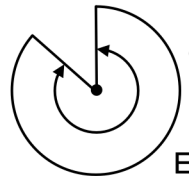
sector D is to have an area of 91.08m^2

what angle must it have?

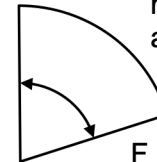
(5)

which sector (E or F) has a bigger area?

explain your answer



radius = 23cm
angle = 305°

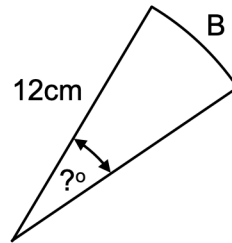
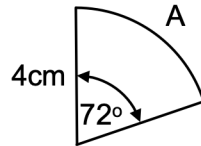


radius = 46cm
angle = 76.25°

Purposeful Practice

areas of sectors (ii)

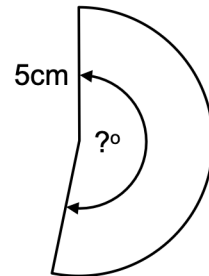
(1)



the two sectors A and B are to have exactly the same area

what angle must sector B have?

(2)



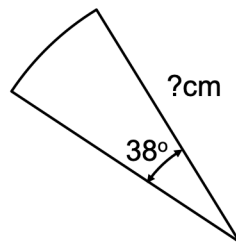
the sector (with a radius of 5cm) is to have an area of 40cm^2

(a) what angle must the sector have?

what angle do you need for an area of 40cm^2 for a sector with radius (b) 4cm (c) 6cm ?

(give your answers correct to the nearest 0.1°)

(3)

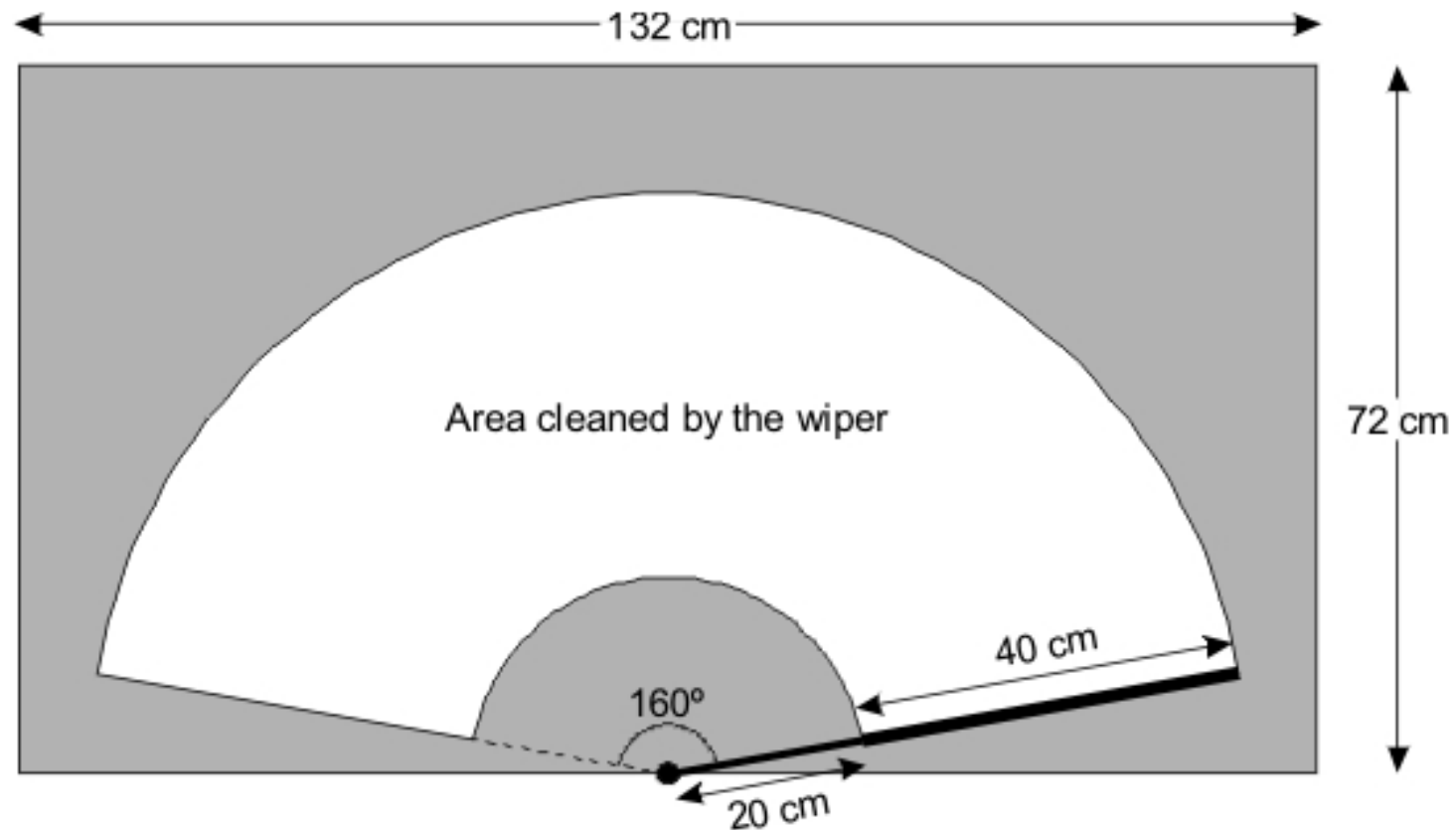


what radius must the sector have so that the area of the sector is 65cm^2 ?

Exam Question

The diagram models a rectangular rear windscreen of a car.

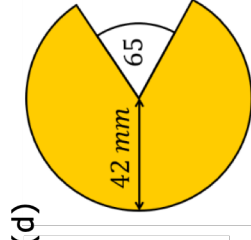
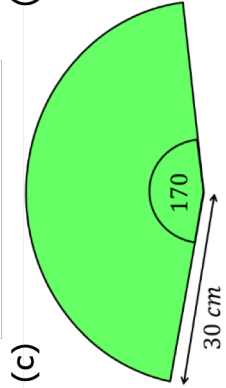
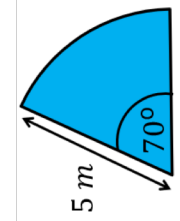
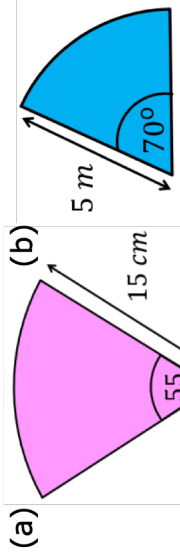
The windscreen wiper can rotate through 160°



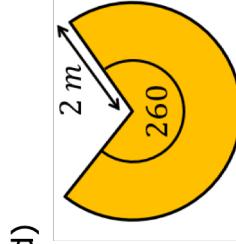
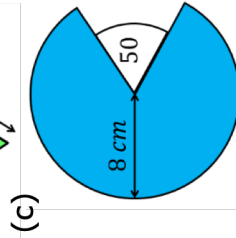
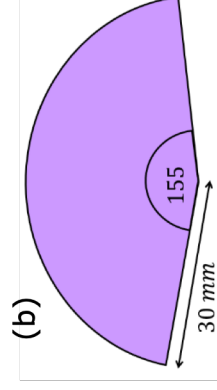
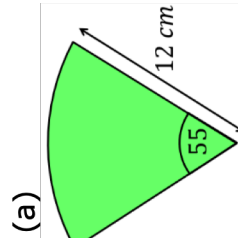
What percentage of the rear windscreen is cleaned by the wiper?

Purposeful Practice

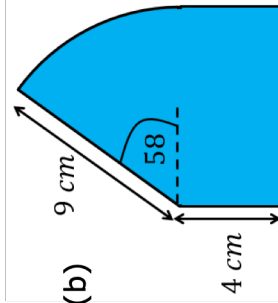
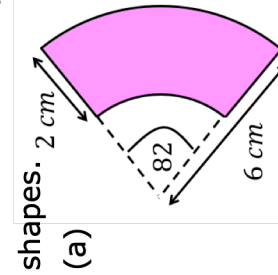
Find the area of each of these sectors.



Find the arc length and perimeter of each of these sectors.



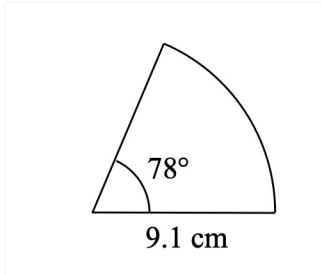
Find the area and perimeter of these shapes.



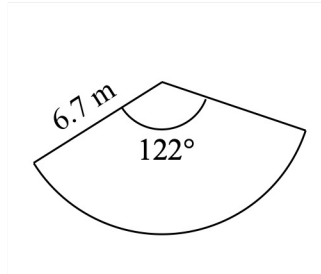
- (a) A sector has an area of 70 cm^2 and a radius of 8 cm . Find its angle.
- (b) A sector with angle 75° has an area of 30 cm^2 . Find the radius of the sector.
- (c) A sector has a perimeter of 35 cm and a radius of 7 cm . Find its angle.

Purposeful Practice

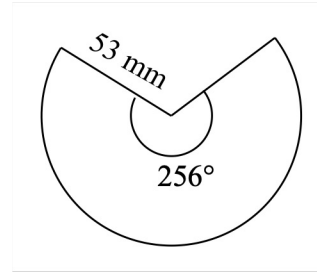
A1 Find the area.



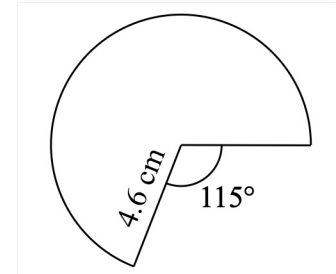
A2 Find the area.



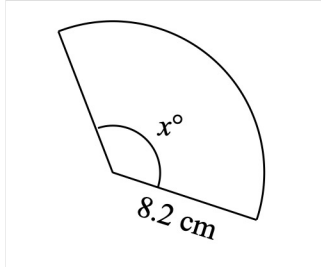
A3 Find the area.



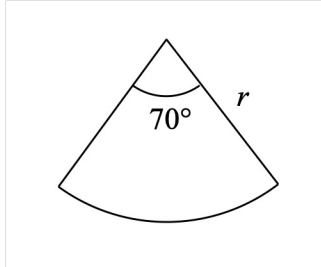
A4 Find the area.



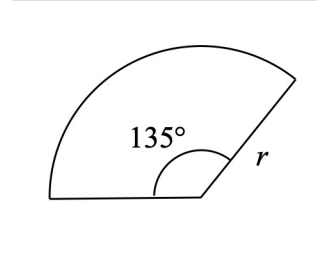
B1 The area is 75 cm^2 , find x



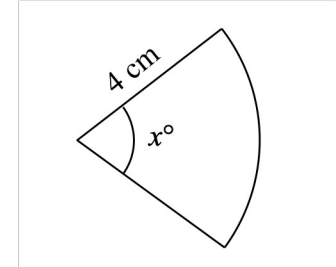
B2 The area is 20 cm^2 , Find r



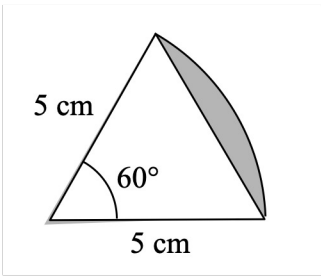
B3 The area is 65 cm^2 , Find r



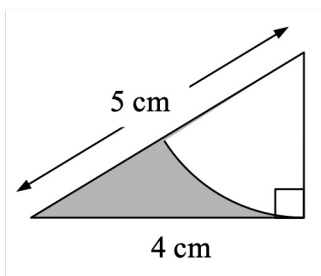
B4 The area is 8 cm^2 , find x



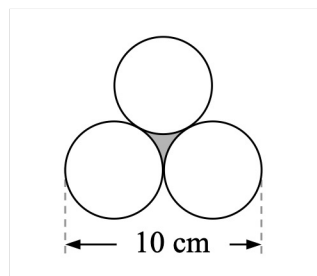
C1 Find the shaded area.



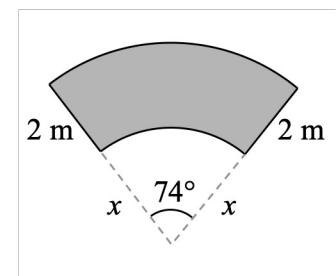
C2 Find the shaded area.



C3 Find the shaded area.

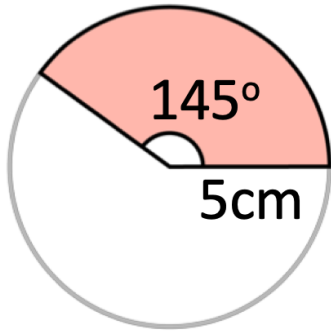


C4 The area of the shaded shape is 12 cm^2 . Find the value of x .

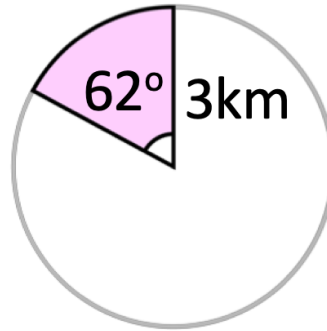


1 Work out the area and perimeter of each sector, correct to one decimal place.

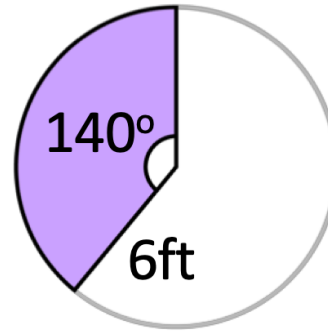
(a)



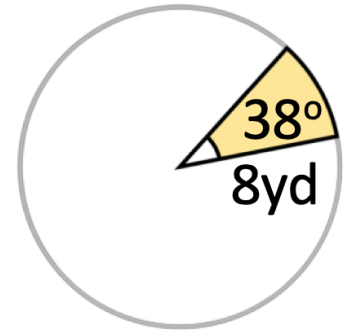
(b)



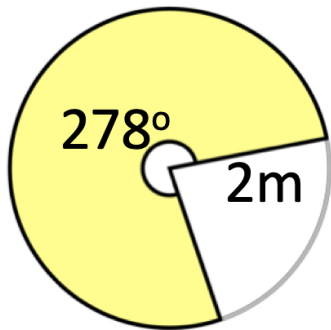
(c)



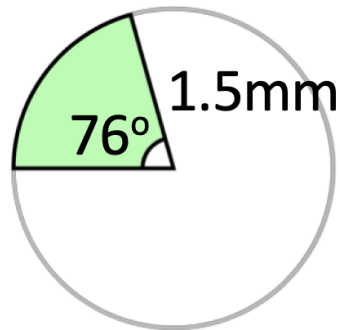
(d)



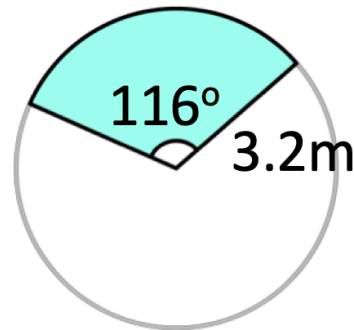
(e)



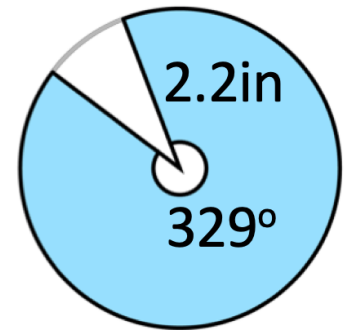
(f)



(g)



(h)



Purposeful Practice

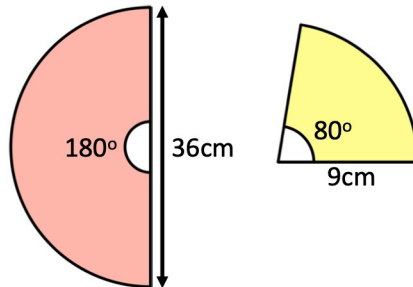
- 2 Use $\pi = 3.14$ to work out the **area** of a sector, to two decimal places, with radius, r and angle, θ given as:

- (a) $r = 11\text{m}$, $\theta = 82^\circ$ (b) $r = 4\text{km}$, $\theta = 20^\circ$
 (c) $r = 18\text{yd}$, $\theta = 18^\circ$ (d) $r = 9\text{in}$, $\theta = 30^\circ$
 (e) $r = 10\text{cm}$, $\theta = 45^\circ$

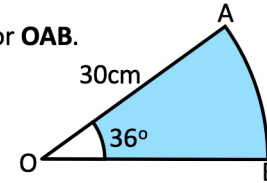
- 3 Use your calculator to work out the **perimeter** of a sector leaving your answer in terms of π , with radius, r and angle, θ given as:

- (a) $r = 6\text{ft}$, $\theta = 60^\circ$ (b) $r = 9\text{km}$, $\theta = 160^\circ$
 (c) $r = 15\text{m}$, $\theta = 45^\circ$ (d) $r = 18\text{mm}$, $\theta = 210^\circ$
 (e) $r = 12\text{cm}$, $\theta = 330^\circ$

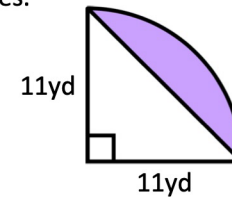
- 4 Express the **area** of the red sector to the area of the yellow sector as a ratio in its simplest form.



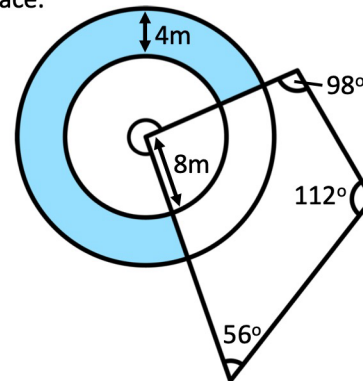
- 5 OAB is a sector of a circle, centre O. The **radius** of the circle is **30cm**. The **angle** of the sector is **36°** . Calculate the **perimeter** of the sector OAB. Leave your answer in terms of π .



- 6 Calculate the perimeter of the shaded region, correct to three significant figures.

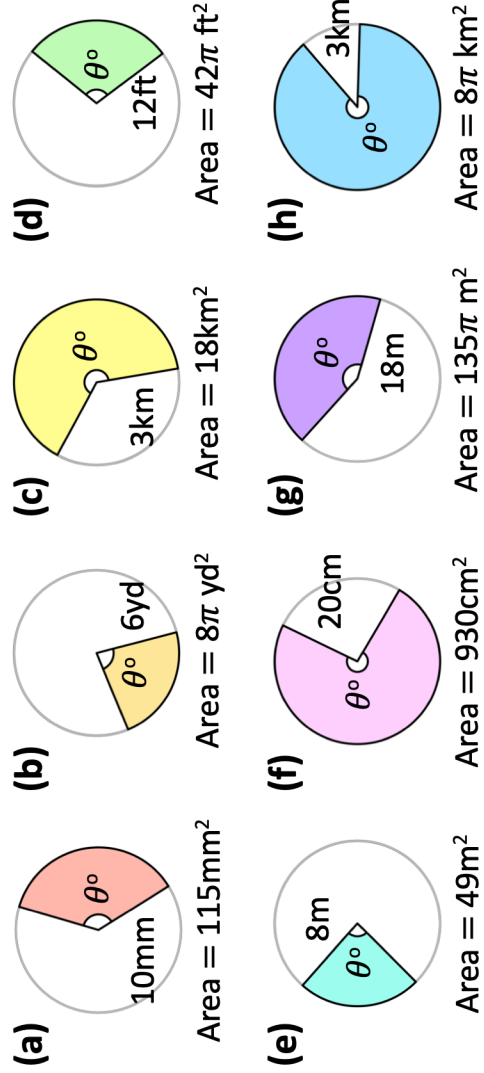


- 7 Find the area of the shaded region below, correct to one decimal place.

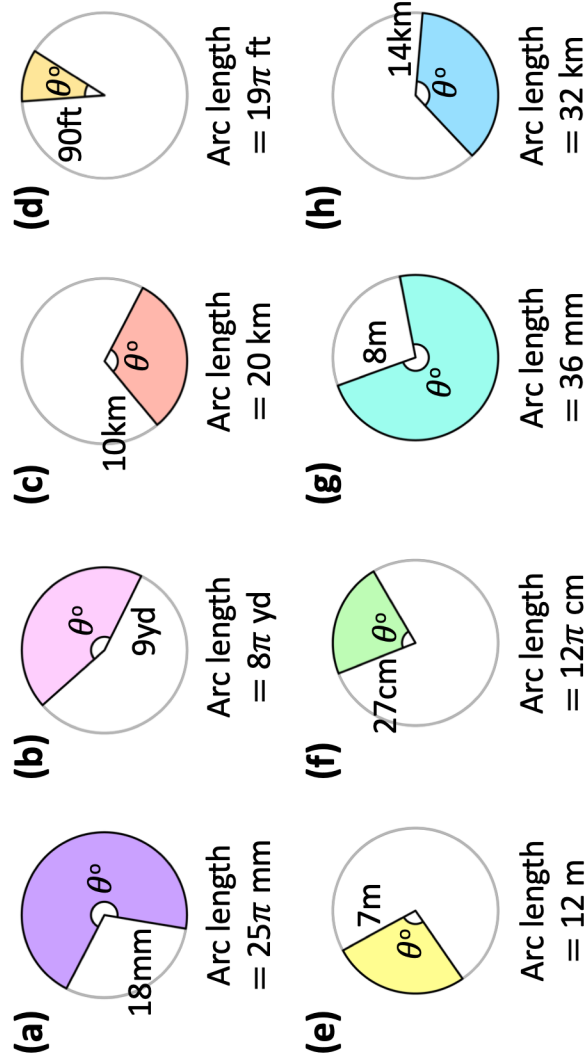


Fluency Practice

1 Work out the angle of each sector, correct to the nearest whole number, given its **area** and radius.



2 Work out the **angle** of each sector, correct to the nearest whole number, given its **arc length** and radius.



Fluency Practice

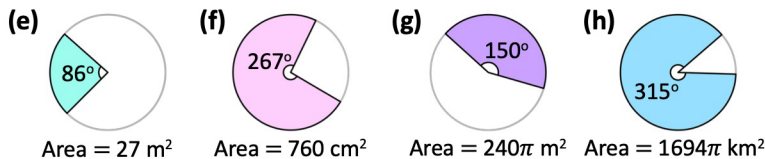
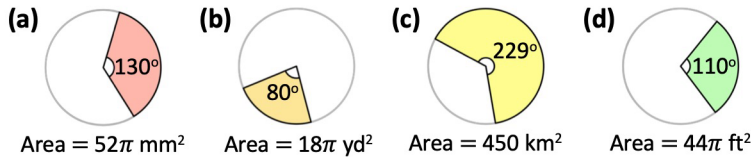
- 3** Use $\pi = 3.14$ to work out the **angle** of a sector, correct to one decimal place, with **area**, A and **radius**, r given as:

- (a) $A = 6\text{m}^2$, $r = 6\text{m}$ (b) $A = 150\text{km}^2$, $r = 12\text{km}$
 (c) $A = 54\text{yd}^2$, $r = 8\text{yd}$ (d) $A = 85\text{in}^2$, $r = 10\text{in}$
 (e) $A = 12\text{cm}^2$, $r = 2.5\text{cm}$

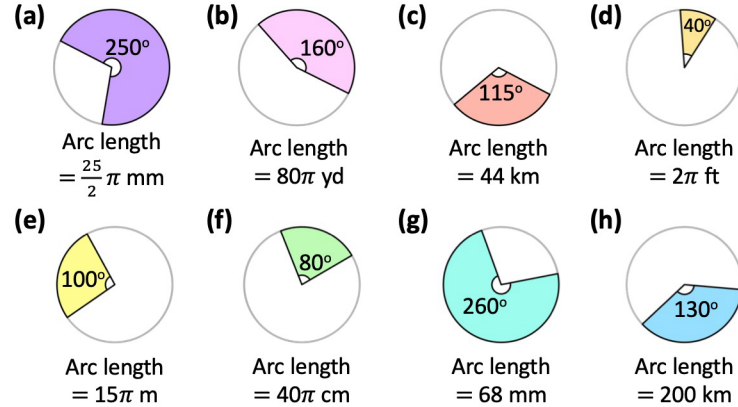
- 4** Use your calculator to work out the **angle** of a sector, correct to one decimal place, with **arc length**, L and **radius**, r given as:

- (a) $L = 6\pi\text{ft}$, $r = 12\text{m}$ (b) $L = 10\pi\text{km}$, $r = 6\text{m}$
 (c) $L = 75\text{m}$, $r = 15\text{m}$ (d) $L = 12.5\text{mm}$, $r = 4.5\text{m}$
 (e) $L = 31.2\text{cm}$, $r = 10\text{m}$

- 5** Work out the angle of each sector, correct to the nearest whole number, given its **area** and **radius**.



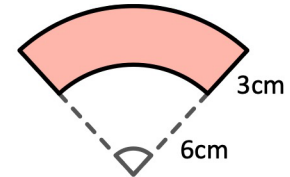
- 6** Work out the **radius** of each sector, correct to the nearest whole number, given its **arc length** and **angle**.



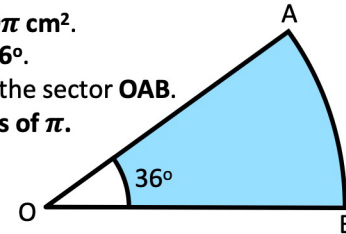
- 7** The perimeter of shaded section the sector below is,

$$6 + \frac{20}{3}\pi\text{ cm}$$

Find the angle, θ , in the sector.

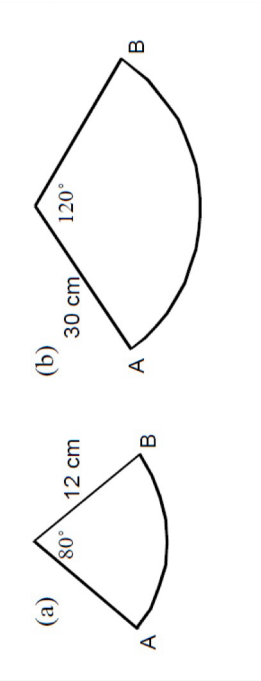


- 8** OAB is a sector of a circle, centre O. The **area** of the sector is $10\pi\text{ cm}^2$. The **angle** of the sector is 36° . Calculate the **perimeter** of the sector OAB. Leave your answer in terms of π .

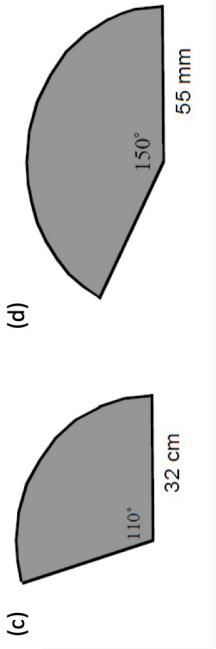


Purposeful Practice

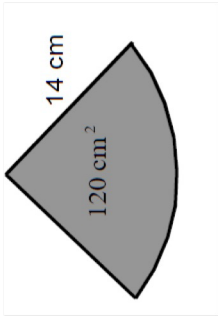
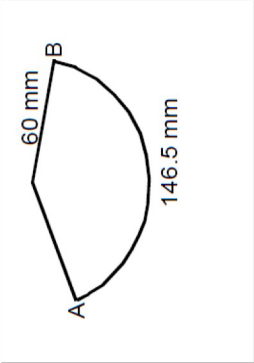
1. Calculate the length of arc AB in each question below:



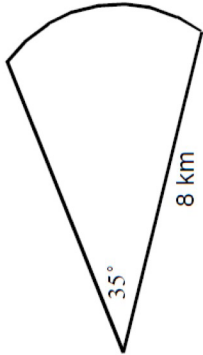
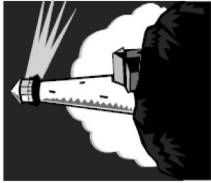
Calculate the area of each sector below:



2. The length of arc AB is given. Calculate the size of the angle at the centre of the sector.
3. The area of the sector is given. Calculate the size of the angle at the centre of the sector.



4. The beam from a lighthouse reaches a distance of 8 kilometres and spreads to an angle of 35° .



Calculate the area covered by the beam from the lighthouse.

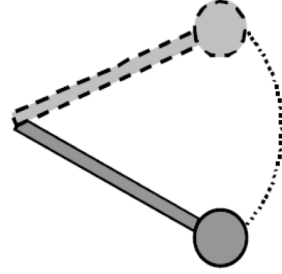
Purposeful Practice

5. The curved part on an anchor is in the shape of an arc of a circle which has radius 1.2 metres.



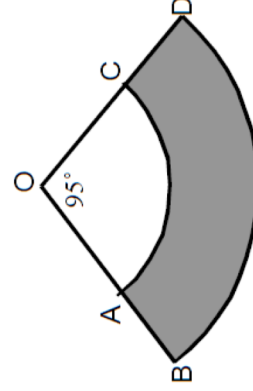
Calculate the length of this arc.

6. A pendulum is 45 centimetres long. When the pendulum swings it travels along the arc of a circle and covers a distance of 27.5 centimetres.



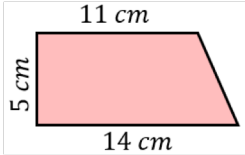
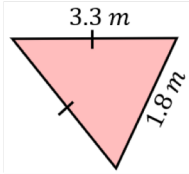
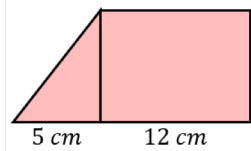
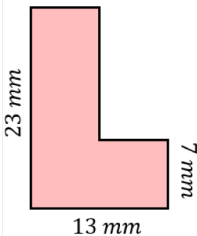
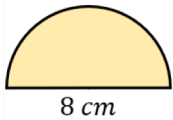
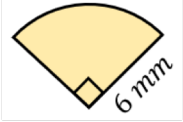
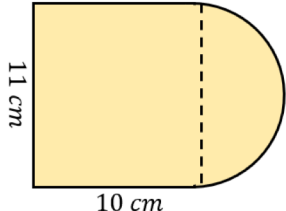
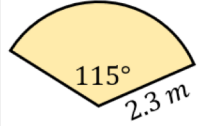
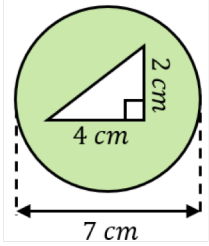
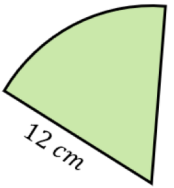
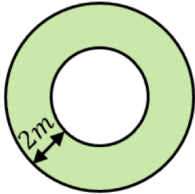
Calculate the size of the angle through which the pendulum travels.

7. In the diagram below AC and BD are arcs of circles with centres at O. The radius, OA, is 10 centimetres and the radius, OB, is 16 centimetres.



Find the shaded area.

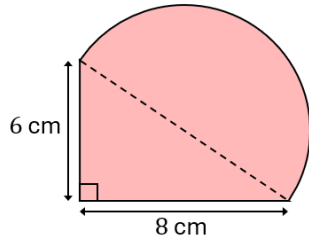
Purposeful Practice

Area and Perimeter Revision			
(a) Find the area. 	(b) Find the perimeter of the triangle. 	(c) The area of the triangle is 20 cm^2 . Find the area of the rectangle. 	(d) Find the perimeter. 
(e) Find the area of the semi-circle to 1 decimal place. 	(f) Find the perimeter to 3 significant figures. 	(g) Find the perimeter to 1 decimal place. 	(h) Find the area, giving your answer to 1 decimal place. 
(i) 	(j) The area of the sector is $24\pi \text{ cm}^2$. Find the perimeter of the sector in terms of π . 		(k) A circular lawn is surrounded by a path of constant width 2 m. The area of the path is $30\pi \text{ m}^2$. Find the area of the lawn in terms of π . 

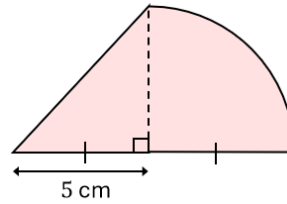
Purposeful Practice

Calculate the area and perimeter of each shape, giving your answers correct to 1 decimal place.

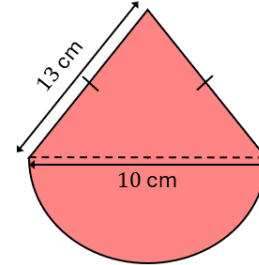
(a)



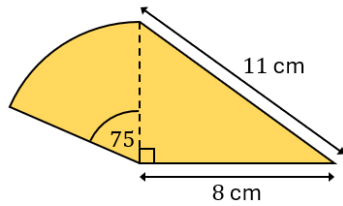
(b)



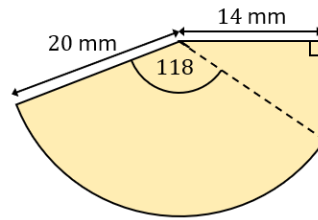
(c)



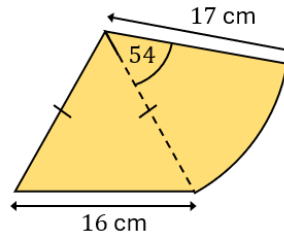
(d)



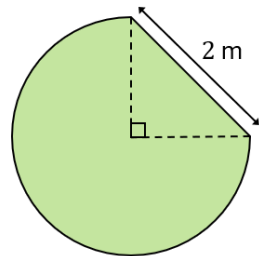
(e)



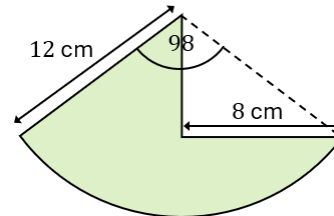
(f)



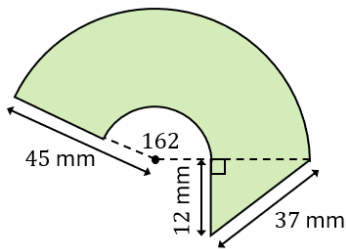
(f)



(g)



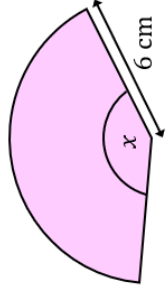
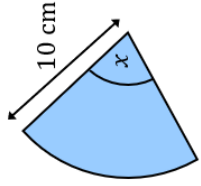
(h)



Fluency Practice

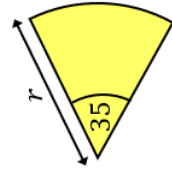
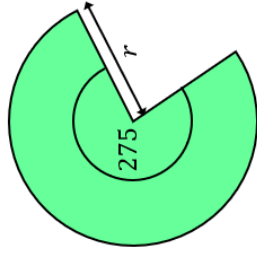
Find the missing angle, giving your answer correct to 1 decimal place.

(a) Area = 70 cm^2 (b) Area = 40 cm^2



Find the missing radius, giving your answers correct to 1 decimal place.

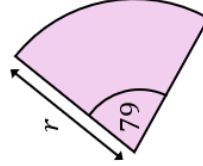
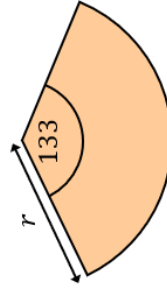
(a) Area = 135 cm^2 (b) Area = 44 cm^2



Find the missing radius, giving your answers correct to 1 decimal place.

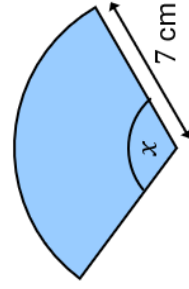
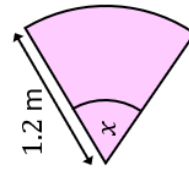
(a) Arc = 30 cm

(b) Arc = 15 mm



Find the missing angle, giving your answer correct to 1 decimal place.

(a) Arc = 1.4 m (b) Perimeter = 29 cm



A sector with an angle of 40° and radius of 11 cm has an area which is twice that of a sector with angle 65° and radius r . Find r to 1 decimal place.

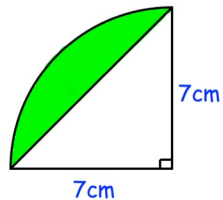
Problem Solving

The radius of a circle is half the length of the diameter	Always True	Sometimes True	Never True
The diameter of a circle is longer than the circumference	Always True	Sometimes True	Never True
An arc is longer than the diameter	Always True	Sometimes True	Never True
A chord is longer than the diameter	Always True	Sometimes True	Never True
A chord is longer than the radius	Always True	Sometimes True	Never True
A tangent touches a circle at exactly one point.	Always True	Sometimes True	Never True
A chord is half the length of a diameter	Always True	Sometimes True	Never True
A sector has a larger area than a segment	Always True	Sometimes True	Never True
The area of each side of a diameter is the same	Always True	Sometimes True	Never True
A tangent crosses the diameter	Always True	Sometimes True	Never True
The area of each side of a chord is the same	Always True	Sometimes True	Never True
A chord is longer than an arc	Always True	Sometimes True	Never True

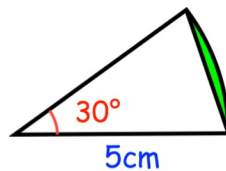
Fluency Practice

Question 1: Calculate the area of each segment.
Give each answer to 3 decimal places.

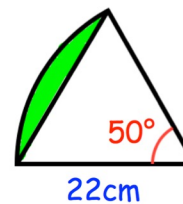
(a)



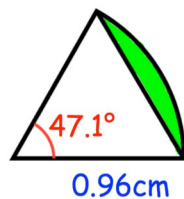
(b)



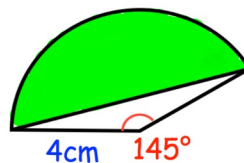
(c)



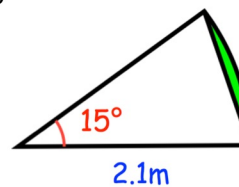
(d)



(e)

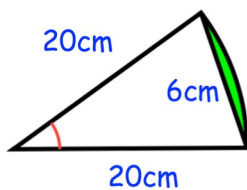


(f)

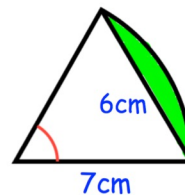


Question 2: Calculate the area of each segment.
Give each answer to 3 decimal places.

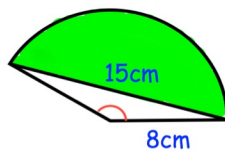
(a)



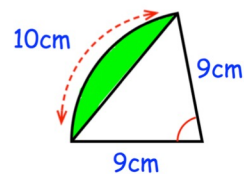
(b)



(c)



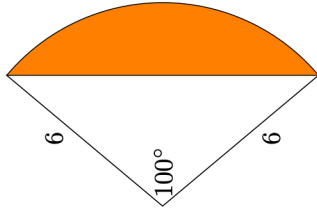
(d)



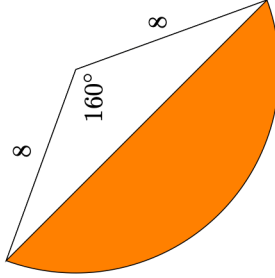
Fluency Practice

All units are in centimetres. Give all answers to three significant figures.

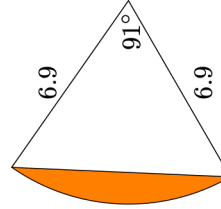
1. Find the area of the orange segment in the diagram below.



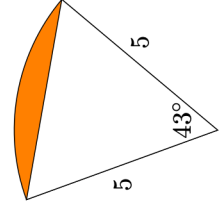
2. Find the area of the orange segment in the diagram below.



3. Find the area of the orange segment in the diagram below.

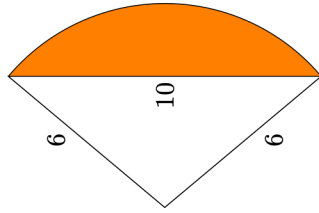


4. Find the area of the orange segment in the diagram below.

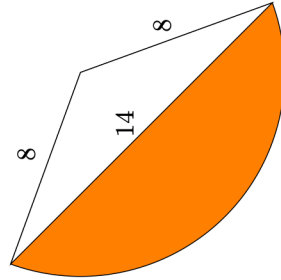


Fluency Practice

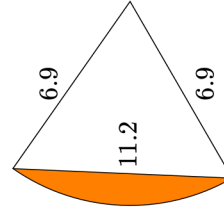
5. Find the area of the orange segment in the diagram below.



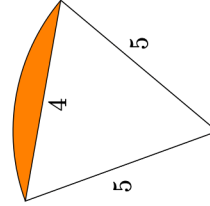
6. Find the area of the orange segment in the diagram below.



7. Find the area of the orange segment in the diagram below.

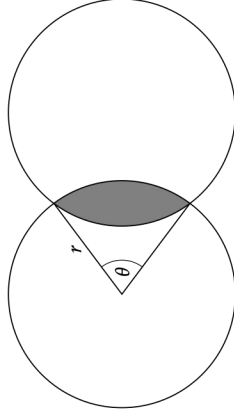


8. Find the area of the orange segment in the diagram below.

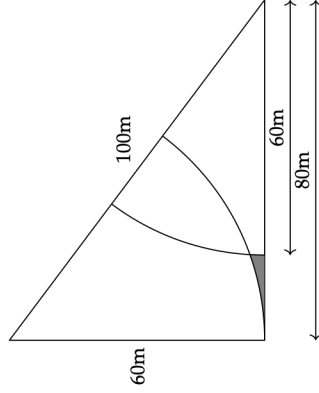


Purposeful Practice

1. Shown are two circles, both with radius r . The angle subtended from the centre of each circle to the points of intersection of the circles is θ . Find the perimeter and area of region of intersection of the two circles, shown shaded in the diagram.

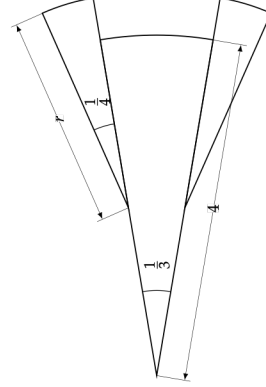


2. A sector of a circle has fixed area A , but the radius and angle may vary. Show that the minimum possible perimeter of the sector is $4\sqrt{A}$, and find the angle of the sector when this occurs.
3. A farmer has a field in the shape of a right angled triangle with sides 60m, 80m, and 100m. A goat is tethered to each of the two angles which are not the right angle by a rope of length 60m. Find, to three significant figures, the area of the field that cannot be reached by either goat.



4. The logo of a company is made up of three sectors, as shown in the diagram. The larger sector has radius 4 units and angle $\frac{1}{3}$ radians. The two smaller sectors both have radius r and angle $\frac{1}{4}$ radians.

The area of the logo is $\frac{203}{48}$ units². Find the perimeter of the logo.



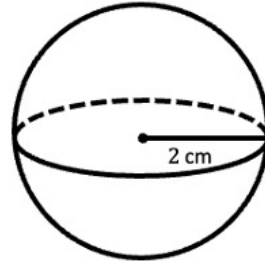
5. Three circles are drawn such that the centre of each circle lies on the circumference of the other two. What fraction of the total area inside this shape lies inside all three of the circles?

3 Volume and Surface Area of Non-Prisms

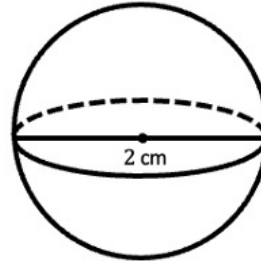
Intelligent Practice

Calculate the volume. Give your answers in terms of π and to 1 decimal place.

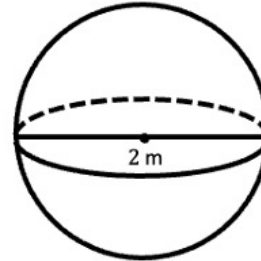
Question 1



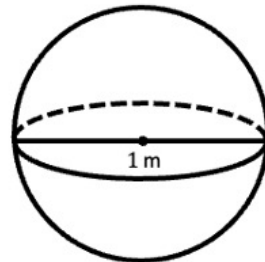
Question 2



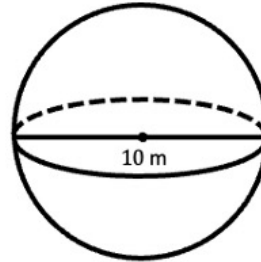
Question 3



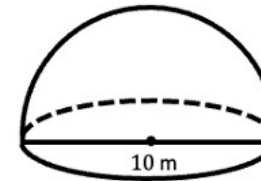
Question 4



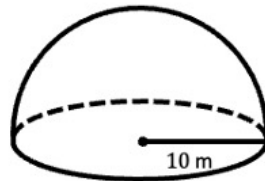
Question 5



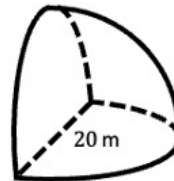
Question 6



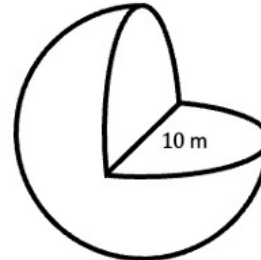
Question 7



Question 8



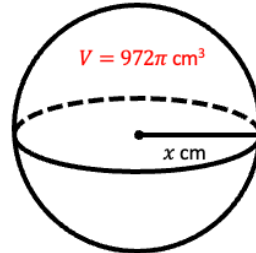
Question 9



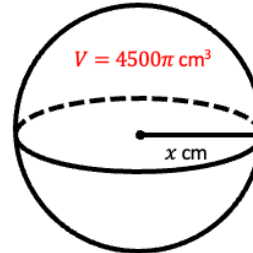
Intelligent Practice

Find x given the volume. Give your answers to 1 decimal place if required.

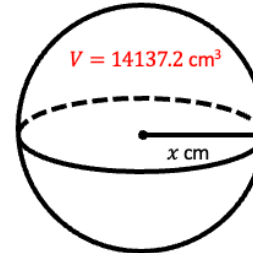
Question 1



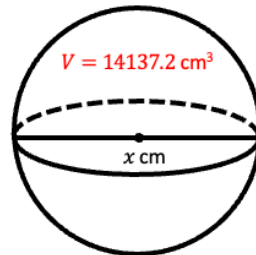
Question 2



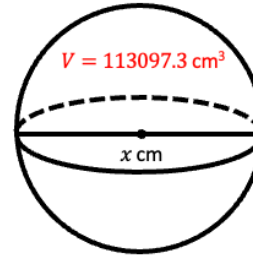
Question 3



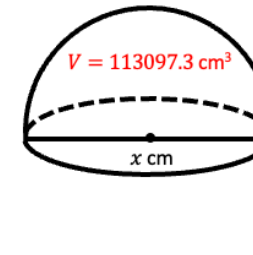
Question 4



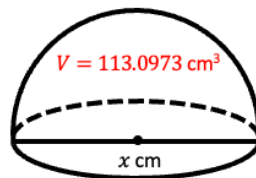
Question 5



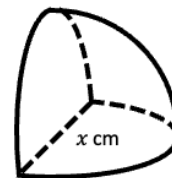
Question 6



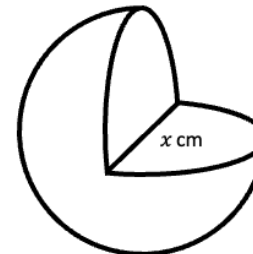
Question 7



Question 8



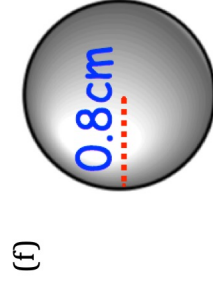
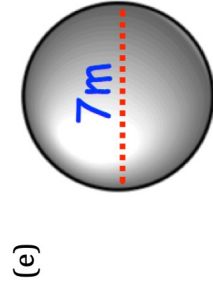
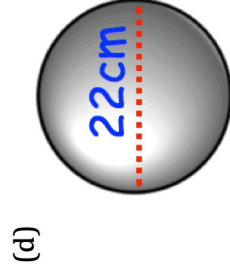
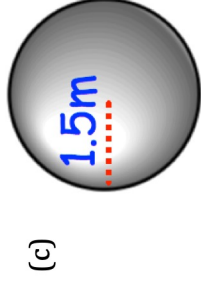
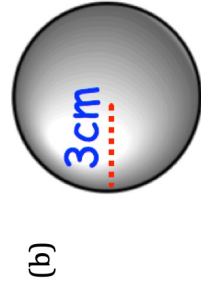
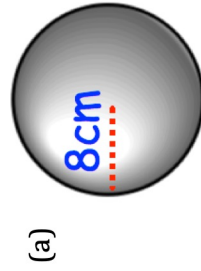
Question 9



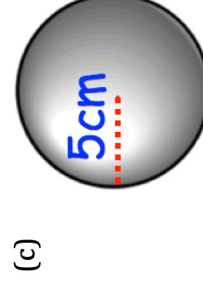
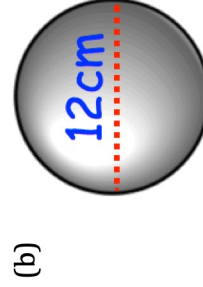
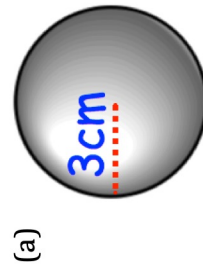
$$V = 339.2920 \text{ cm}^3$$

Fluency Practice

Question 1: Find the volume of each of these spheres.
Give each answer to one decimal place (you may use a calculator)



Question 2: Find the volume of each of these spheres.
Give each answer in terms of π (you may not use a calculator)



Question 3: Find the volume of each of these spheres.
Give your answers to three significant figures (you may use a calculator)

(a) A sphere with radius 9cm

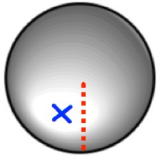
(b) A sphere with diameter 38cm

(c) A sphere with diameter 6.7cm

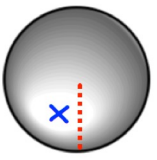
(d) A sphere with radius 1.25 inches.

Fluency Practice

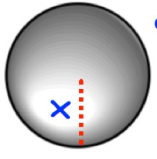
Question 4: Find the size of the radius in each of the spheres below.
Give your answers to one decimal place (you may use a calculator)

(a) 

Volume = 200cm^3

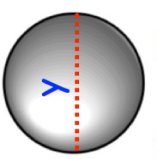
(b) 

Volume = 1950cm^3

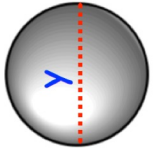
(c) 

Volume = 1m^3

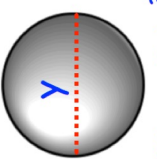
Question 5: Find the size of the diameter in each of the spheres below.
Give your answers to one decimal place (you may use a calculator)

(a) 

Volume = 50cm^3

(b) 

Volume = 2360cm^3

(c) 

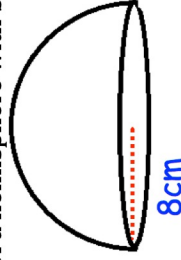
Volume = 0.4m^3

Apply

Question 1: A metal cuboid measuring 4cm by 5cm by 12cm is melted down and a sphere is made.

Calculate the radius of the sphere.

Question 2: Calculate the volume of a hemisphere with base of radius 8cm.



Question 3: A solid sphere fits perfectly inside of a cube box of side length 10cm.
What percentage of the box is empty?

Question 4: A ball of gold has a radius of 9cm.
The density of gold is 19.3g/cm^3 .
Work out the mass of the ball.

Purposeful Practice

volume of a sphere

$$\text{volume of a sphere} = \frac{4}{3}\pi r^3$$

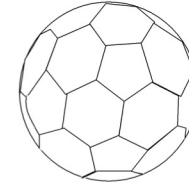
(1)



a standard tennis ball has a diameter of 6.7 cm

what is the volume of the tennis ball?

(2)



a regulation football must have a circumference of between 68 cm and 70 cm

what are the limits of the football's volumes?

(3)



how much larger (approximately) is the volume of a 14" (diameter) balloon to an 11" balloon?

(4)



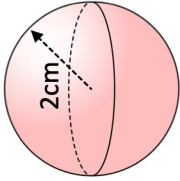
the Earth has a volume of 1,083,206,916,846 km³

how wide is a time zone if there are 24 of them around the circumference?

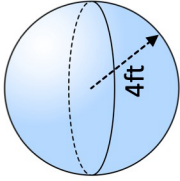
Fluency Practice

Q1 Work out the volume of each of the following spheres.

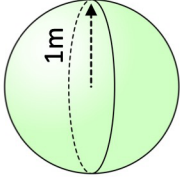
[a]



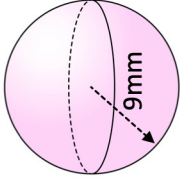
[b]



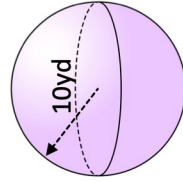
[c]



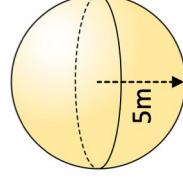
[d]



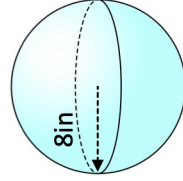
[e]



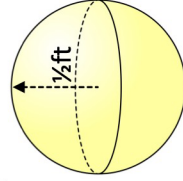
[f]



[g]

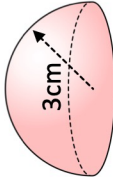


[h]

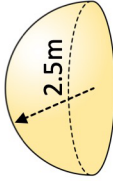


Q2 Work out the volume of each of the following hemispheres to three significant figures.

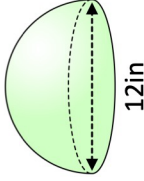
[a]



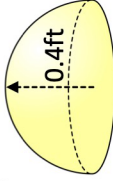
[b]



[c]



[d]



Q3 Work out, correct to four significant figures, the volume of a sphere with:

[a] Radius = 7 cm

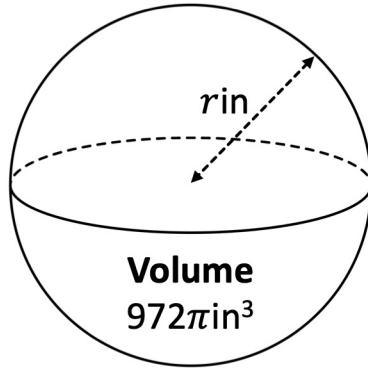
[b] Radius = 1.5 mm

[c] Diameter = 4.2 yd

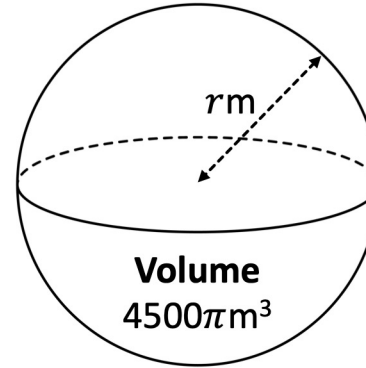
Q4 Given that the radius of Mars is approximately 3.4×10^3 kilometres. Find its volume to three significant figures.

Fluency Practice

Ex3 The following sphere has a volume of $972\pi\text{in}^3$. Find the length of its radius, $r\text{in}$.

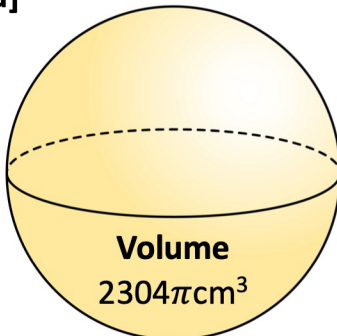


Q5 The following sphere has a volume of $4500\pi\text{m}^3$. Find the length of its radius, $r\text{m}$.

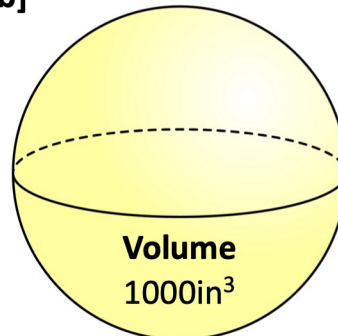


Q6 Work out the radius of the following spheres given their volume.

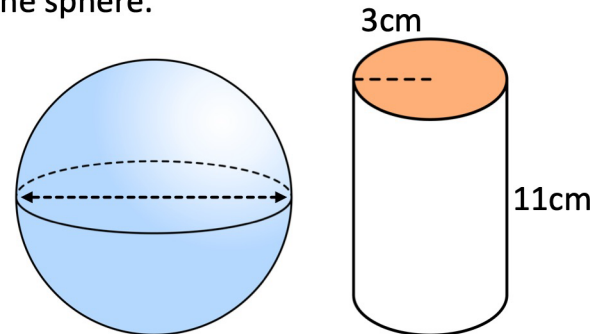
[a]



[b]

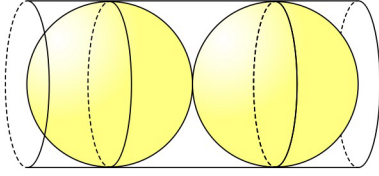


Q7 The following cylinder and sphere have the same volume. Find the diameter of the sphere.

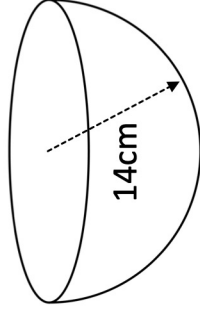


Purposeful Practice

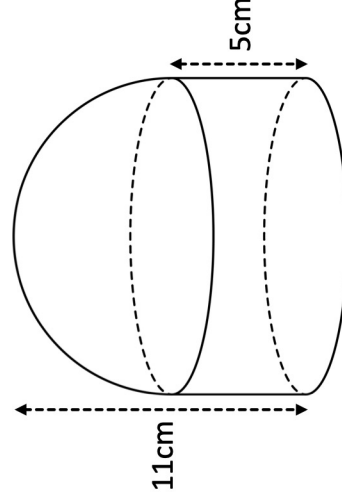
Q1 Craig buys two tennis balls which fit inside a cylindrical container of the same diameter. The tennis ball's diameter is 6cm. What fraction of the container's volume do the tennis balls take up?



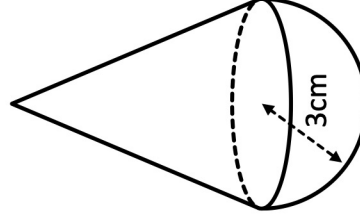
Q2 Marie has some hanging flower baskets in the shape of hemispheres with radius 14cm. Marie is going to fill the flower baskets completely with soil. She has 50 litres of compost. **1 litre = 1000cm^3** . Work out how many flower baskets Marie can fill completely with compost.



Q3 The following composite solid is made by joining a cylinder and hemisphere. Calculate the volume of the solid leaving your answer in terms of π .



Q4 A child's toy is made from joining a cone and a hemisphere. The cone and the hemisphere both have a radius of 3cm. The ratio of the height of the toy to the radius of the hemisphere is 3:1. Calculate the volume of the toy in terms of π .



Purposeful Practice



Gold facts:

Gold has a density of 19.3 g/cm^3 .

The price of gold is currently around **£35 per gram**.

The entire gold reserves of the world currently total around **165,000 tonnes**.

Task 1

What is the value of one cubic centimetre of gold?

Task 2a

How heavy would a lump of gold worth £1 million be?

Task 2b

What would the volume of this lump of gold be?

Task 2c

If this lump of gold were made into a sphere, what would its diameter be?

Hint: The volume of a sphere is $V = \frac{4}{3}\pi r^3$. Remember the diameter is twice the radius.

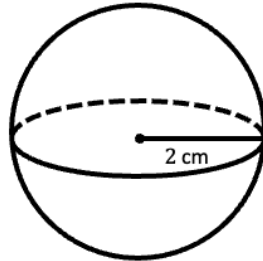
Task 3

If the entire gold reserves of the world were melted down to form a huge sphere, what would its diameter be?

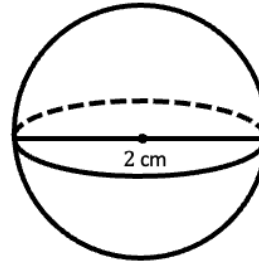
Intelligent Practice

Calculate the total surface area. Give your answers in terms of π and to 1 decimal place.

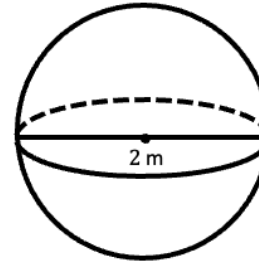
Question 1



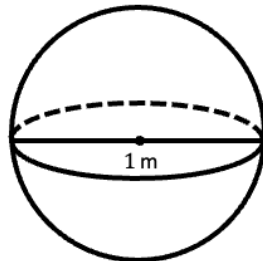
Question 2



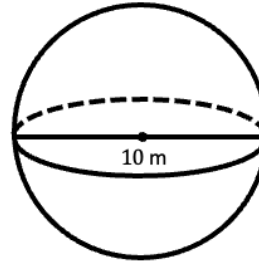
Question 3



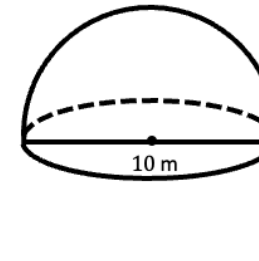
Question 4



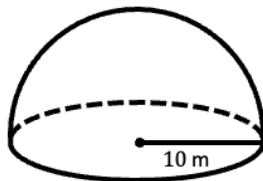
Question 5



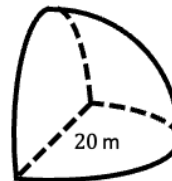
Question 6



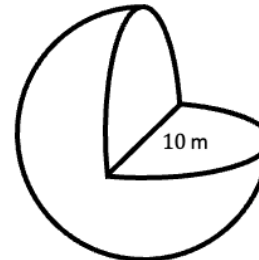
Question 7



Question 8



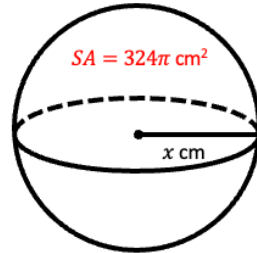
Question 9



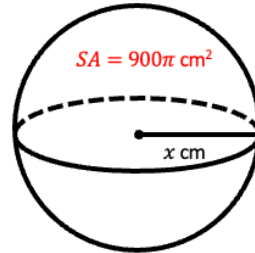
Intelligent Practice

Find x given the total surface area. Give your answers to 1 decimal place if required.

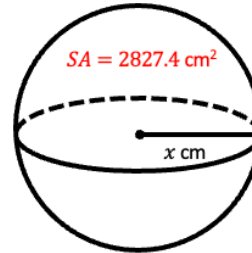
Question 1



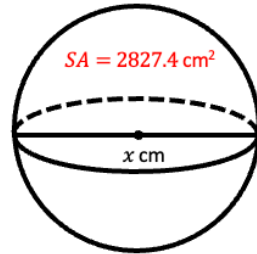
Question 2



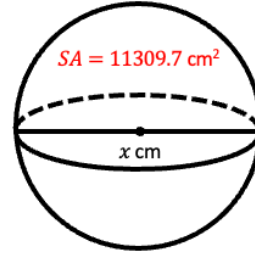
Question 3



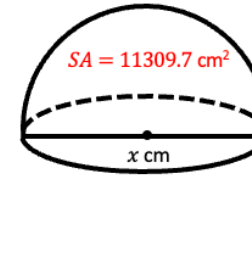
Question 4



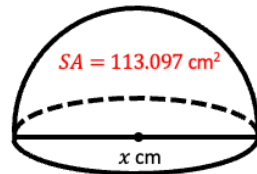
Question 5



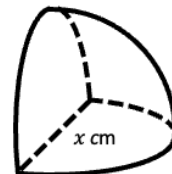
Question 6



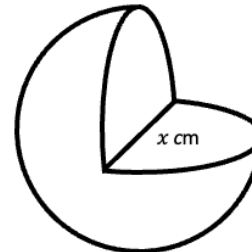
Question 7



Question 8

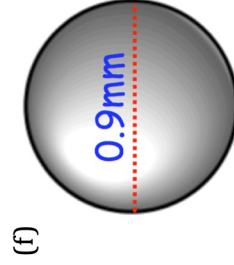
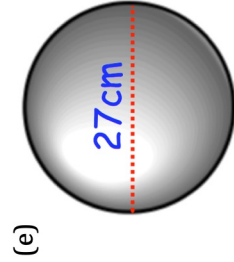
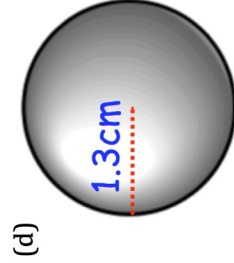
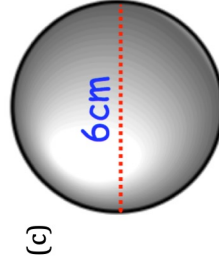
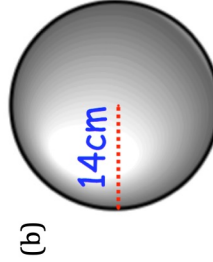
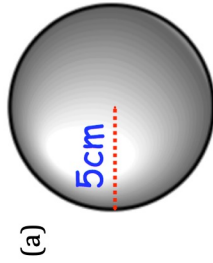


Question 9

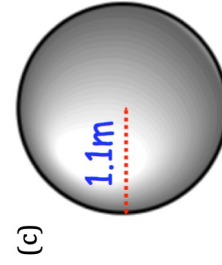
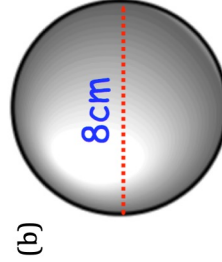
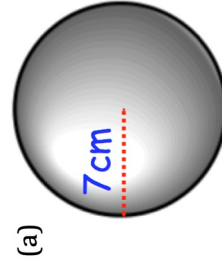


Fluency Practice

Question 1: Find the surface area of each of these spheres.
Give each answer to 2 decimal places (you may use a calculator)



Question 2: Find the surface area of each of these spheres.
Give each answer in terms of π (you may not use a calculator)



Question 3: Find the surface area of each of these spheres.

Give your answer to 3 significant figures (you may use a calculator)

(a) A sphere with diameter 2 cm

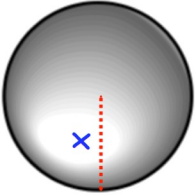
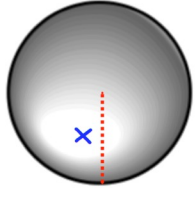
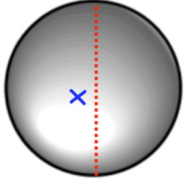
(b) A sphere with radius 36 mm

(c) A sphere with radius 0.4 m

(d) A sphere with diameter 2.07 inches

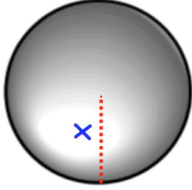
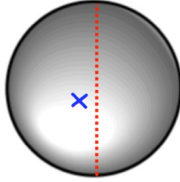
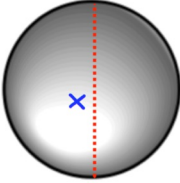
Fluency Practice

Question 4: Find the size of x in each of the sphere below.
Give your answers to two decimal places (you may use a calculator)

(a)  (b)  (c) 

$\text{Surface area} = 50\text{cm}^2$ $\text{Surface area} = 940\text{cm}^2$ $\text{Surface area} = 4800\text{cm}^2$

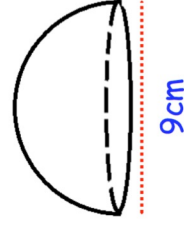
Question 5: Find the size of x in each of the sphere below.
You may not use a calculator

(a)  (b)  (c) 

$\text{Surface area} = 16\pi \text{ cm}^2$ $\text{Surface area} = 100\pi \text{ cm}^2$ $\text{Surface area} = 3600\pi \text{ cm}^2$

Apply

Question 1: A glass paperweight is shown below.
The paperweight is a hemisphere with diameter 9cm.
Find the surface area of the paperweight

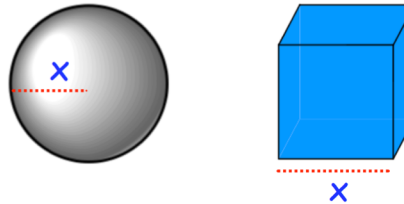


Question 2: Show the surface area of a sphere with radius 6cm is four times larger than the surface area of a sphere with radius 3cm.

Purposeful Practice

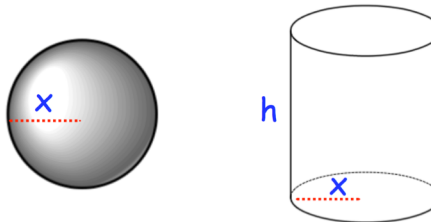
Question 3: The formula for the surface area of a sphere is $A = 4\pi r^2$
Make r the subject of the formula

Question 4: The diameter of a sphere is equal to the side length of a cube.



Peter says the surface area of the sphere is double the surface area of the cube.
Is Peter correct?

Question 5: A sphere has a radius of x .
A cylinder has a radius of x and height h .

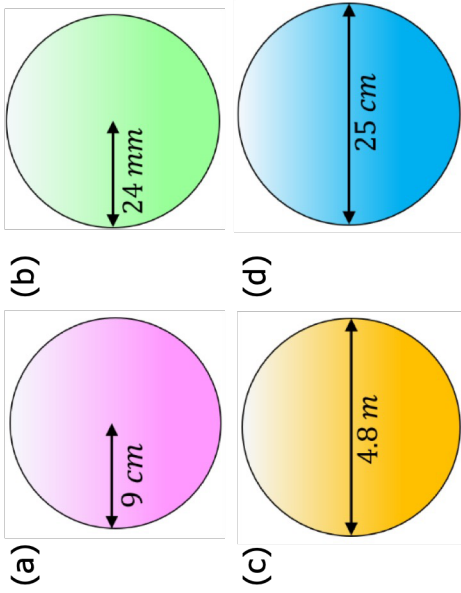


The surface area of the sphere and cylinder are equal.

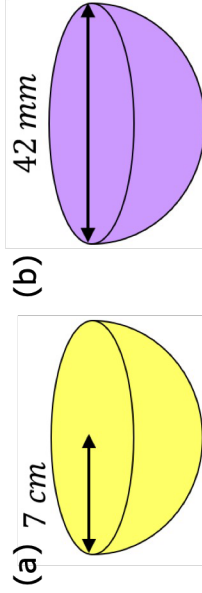
Show $h = x$

Fluency Practice

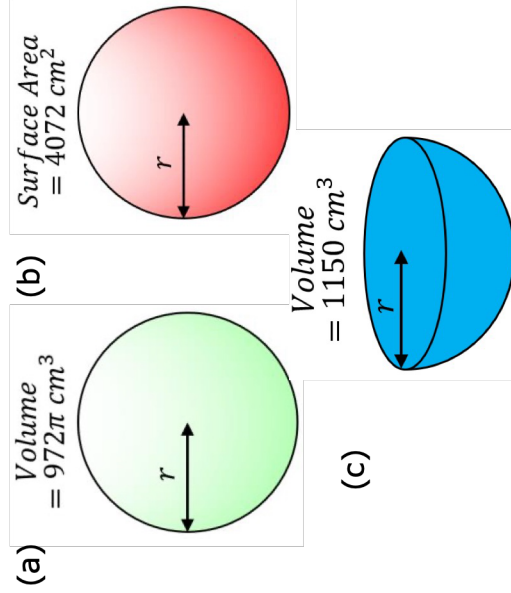
Find the volume and surface area of these spheres.



Find the volume and total surface area of these hemispheres.

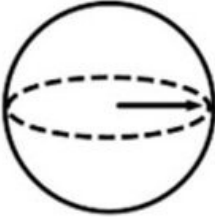
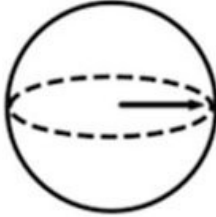
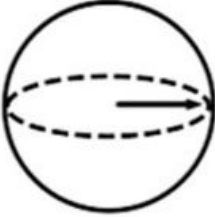
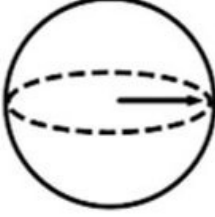


Find the missing lengths.



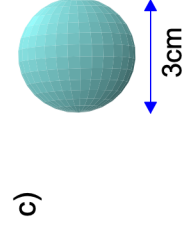
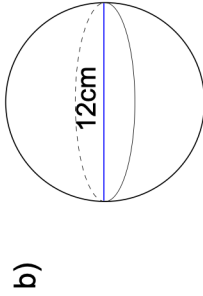
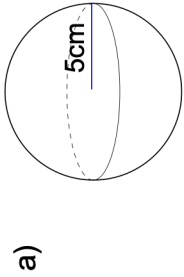
A container is made up of a hemisphere on top of a cylinder, both with the radius 26 cm. The total volume of the container is $230\,000 \text{ cm}^3$. Find the height of the cylinder.

Fluency Practice

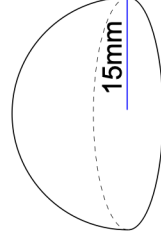
<u>Sphere A</u>  Radius = 3 Surface area = 36π Volume = 36π	<u>Sphere B</u> Radius is three times sphere A  Radius = Surface area = Volume =						
<u>Sphere C</u> Surface area is four times sphere A  Radius = Surface area = Volume =	<u>Sphere D</u> Volume is sixty-four times sphere A  Radius = Surface area = Volume =						
<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; border-bottom: 1px solid black;"><u>Radius</u></th> <th style="text-align: center; border-bottom: 1px solid black;"><u>Surface area</u></th> <th style="text-align: center; border-bottom: 1px solid black;"><u>Volume</u></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">A : B : C : D</td> <td style="text-align: center;">A : B : C : D</td> <td style="text-align: center;">A : B : C : D</td> </tr> </tbody> </table>		<u>Radius</u>	<u>Surface area</u>	<u>Volume</u>	A : B : C : D	A : B : C : D	A : B : C : D
<u>Radius</u>	<u>Surface area</u>	<u>Volume</u>					
A : B : C : D	A : B : C : D	A : B : C : D					

Purposeful Practice

1. Work out the volume and surface area of each sphere. Give your answers both in terms of π , and correct to 3 significant figures.

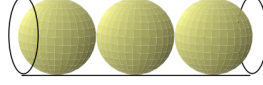


2. A hemisphere has a radius of 15mm.



Work out the volume and surface area of the hemisphere, giving your answers in terms of π .

3. A plastic tube in the shape of a cylinder contains three tennis balls.



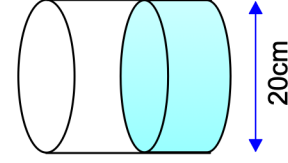
The tube and each ball have a diameter of 6.7cm and the balls fit snugly into the tube, such that none of them are able to move.

Work out the volume of free space within the tube.

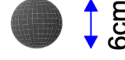
4. The moon has a radius of approximately $(1.7 \times 10^3)\text{km}$.

- a) Work out the volume of the moon.
b) Work out the surface area of the moon.

5. A cylindrical container with diameter 20cm is partially filled with water.



A metal sphere with diameter 6cm is dropped into the water and is completely submerged.

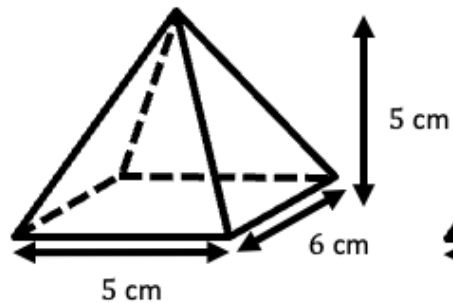


Work out by how much the water level rises.

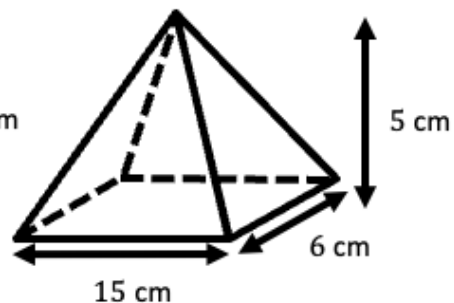
Intelligent Practice

Calculate the volume.

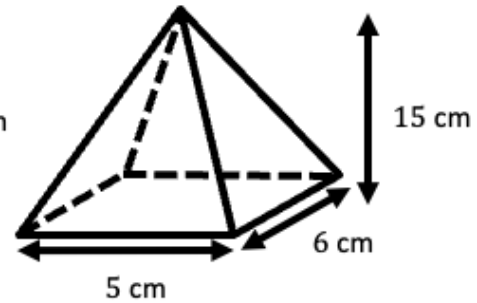
Question 1



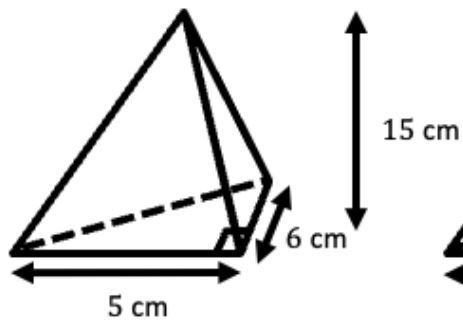
Question 2



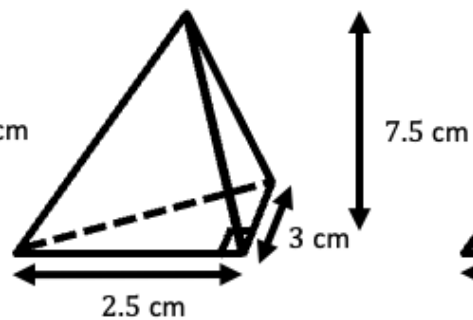
Question 3



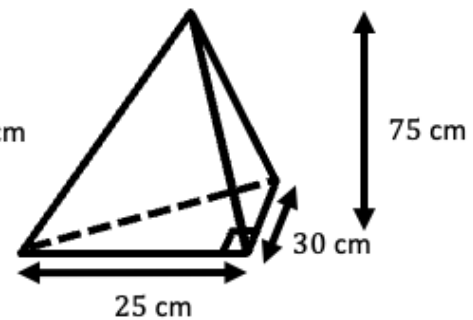
Question 4



Question 5



Question 6

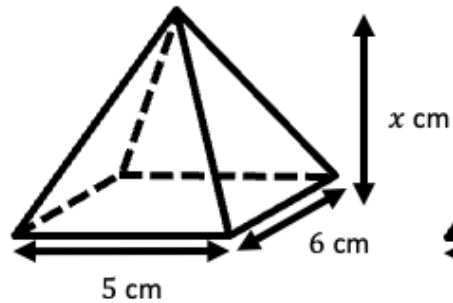


Intelligent Practice

Find x given the volume.

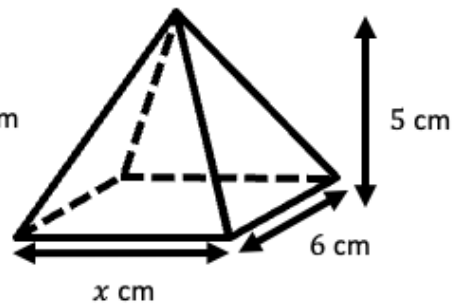
Question 1

$$V = 50 \text{ cm}^3$$



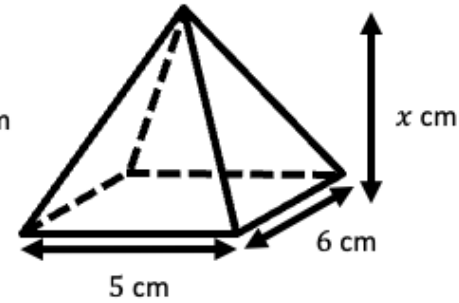
Question 2

$$V = 150 \text{ cm}^3$$



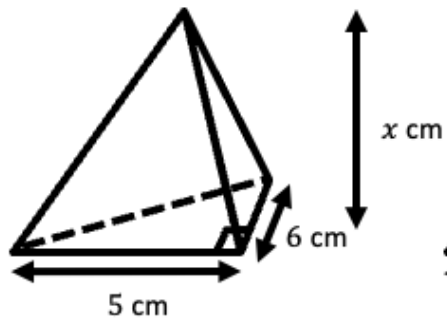
Question 3

$$V = 150 \text{ cm}^3$$



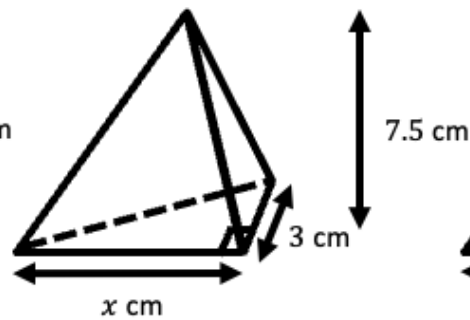
Question 4

$$V = 75 \text{ cm}^3$$



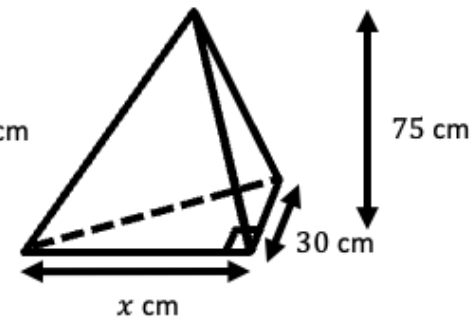
Question 5

$$V = 9.375 \text{ cm}^3$$



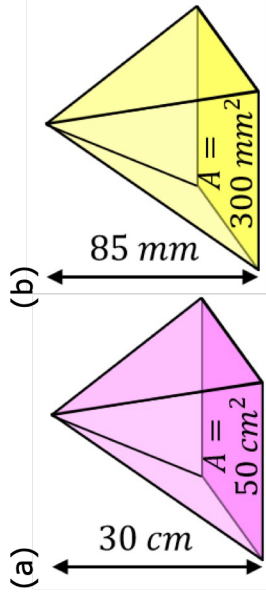
Question 6

$$V = 9375 \text{ cm}^3$$

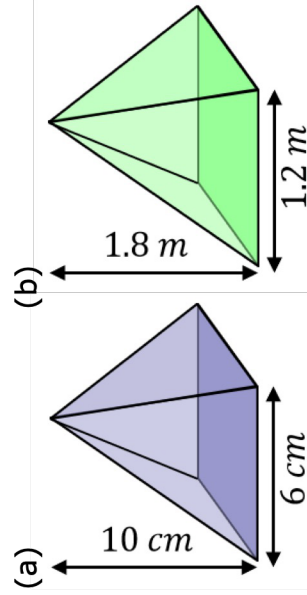


Fluency Practice

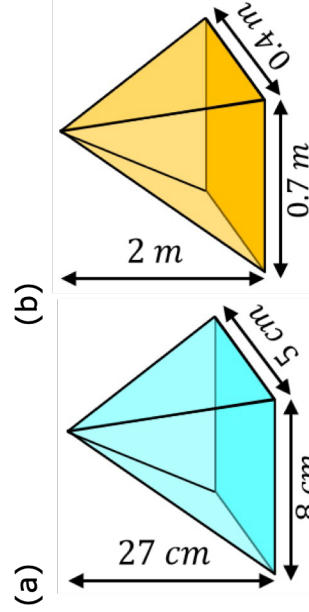
Find the volume of each of these pyramids.



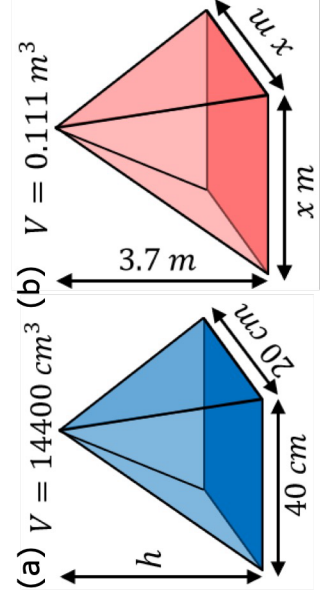
Find the volume of each of these square-based pyramids.



Find the volumes of each of these pyramids.

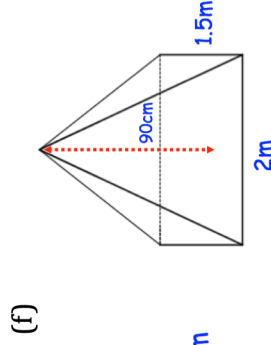
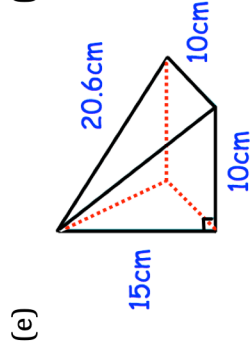
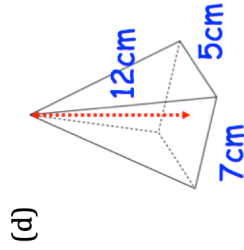
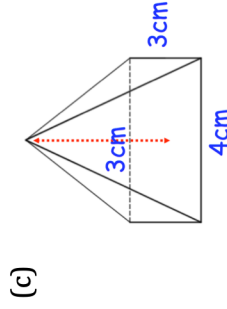
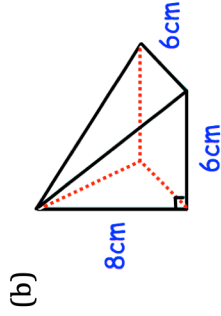
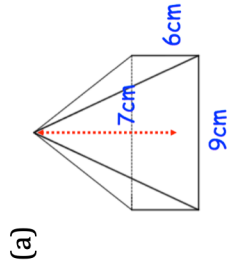


Find the missing measurements from each of these pyramids when given their volumes.



Fluency Practice

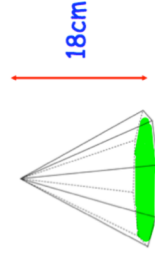
Question 1: Find the volume of each of these pyramids.
Give each answer to one decimal place (you may use a calculator)



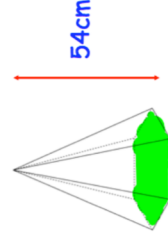
Question 2: A square-based pyramid has a base with side length 8 cm.
The height of the pyramid is 11 cm.
Calculate the volume of the pyramid.

Question 3: A rectangular-based pyramid has a base with length 12 cm and width 6 cm.
The height of the pyramid is 8 cm.
Calculate the volume of the pyramid.

Question 4: An octagon-based pyramid has a height of 18 cm.
The area of the octagon base is 20 cm^2 .
Calculate the volume of the pyramid

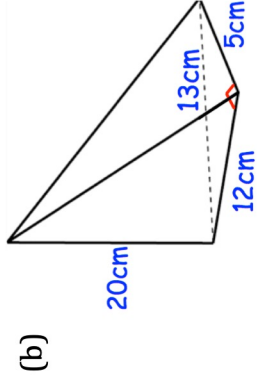
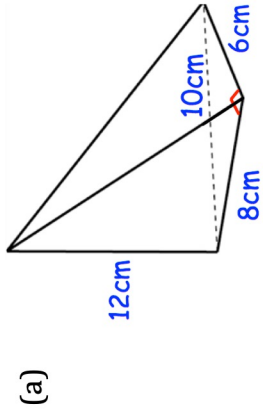


Question 5: A hexagon-based pyramid has a height of 54 cm.
The volume of the pyramid is 1080 cm^3 .
Calculate the area of the base of the pyramid.

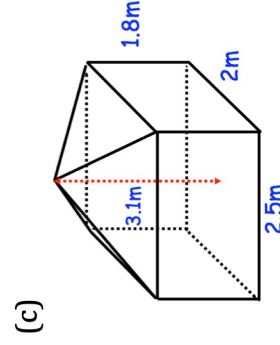
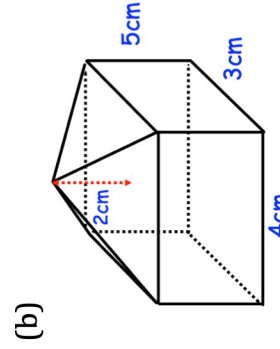
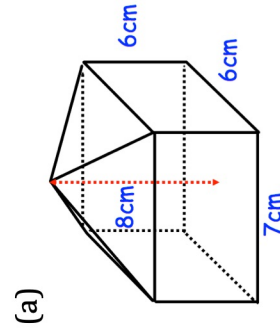


Fluency Practice

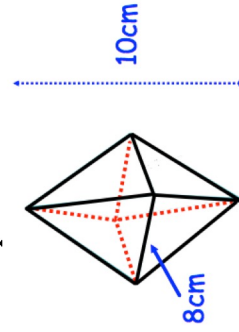
Question 6: Shown below are two triangular-based pyramids.
Find the volume of each.



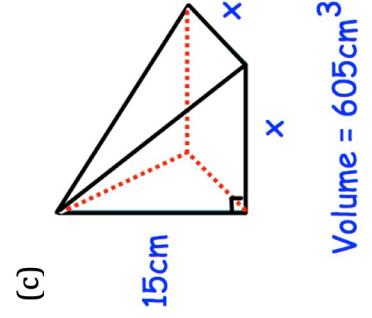
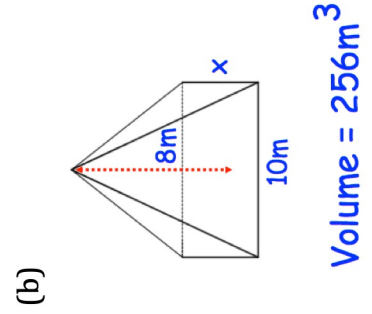
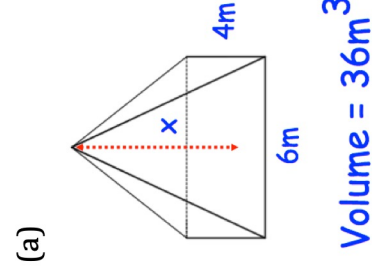
Question 7: Find the volume of each of composite solids.



Question 8: A solid shape is created by joining two square based pyramids.
Find the volume of the shape.



Question 9: Find x for each of these pyramids.
The volume of each is given.



Purposeful Practice

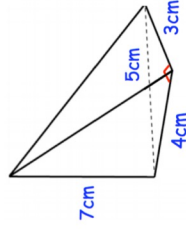
Apply



Question 1: The Great Pyramid of Giza is a square based pyramid.
The base has a side length of 440 cubits.
The height of the pyramid is 280 cubits.
Calculate the volume of the Great Pyramid of Giza.

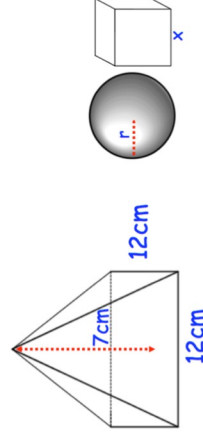
Question 2: A solid rectangular based pyramid has a base with length 28cm and width 20cm.
The height of the pyramid is 16cm.
The pyramid has a mass of 35.84kg
Calculate the density of the material used to make the pyramid, in g/cm^3

Question 3: A solid triangular based pyramid is made from a material which has a density of $7.2\text{g}/\text{cm}^3$.
The dimensions of the pyramid are shown below.



Calculate the mass of the pyramid.

Question 4: A solid square based pyramid is made out of gold.
The pyramid has base of length 12cm and a height of 7cm.
The pyramid is melted and the gold is used to make a sphere and a cube.
The sphere and cube have the same volume.
Calculate the radius of the sphere, r , and the side length of the cube, x .



Exam Question

The diagram shows a pyramid.

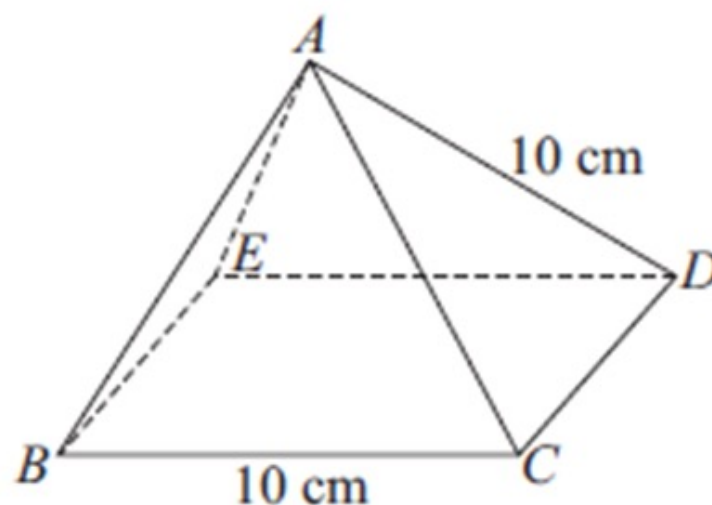


Diagram **NOT**
accurately drawn

$BCDE$ is a square with sides of length 10 cm.

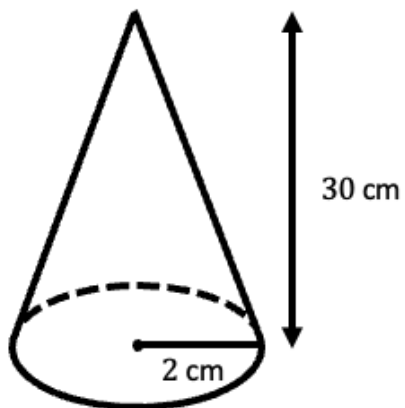
The other faces of the pyramid are equilateral triangles with sides of length 10 cm.

- (a) Calculate the volume of the pyramid.
Give your answer correct to 3 significant figures.

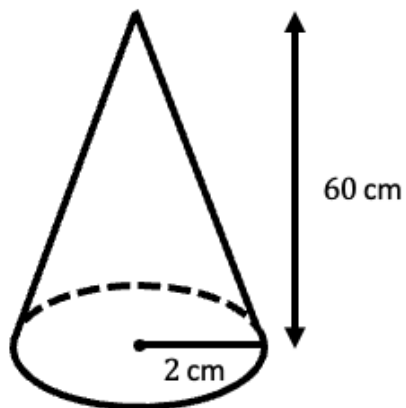
Intelligent Practice

Calculate the volume. Give your answers in terms of π and to 1 decimal place.

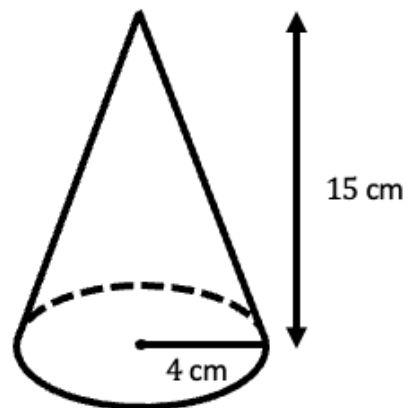
Question 1



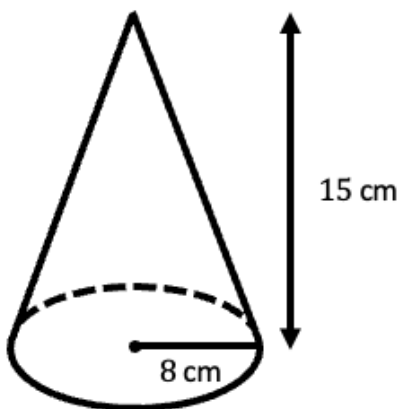
Question 2



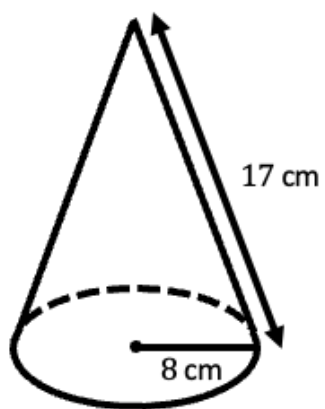
Question 3



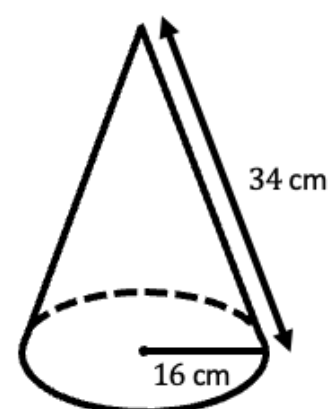
Question 4



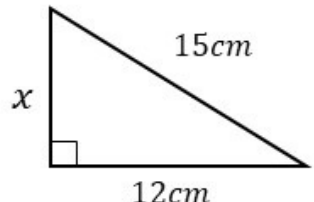
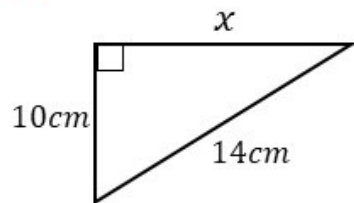
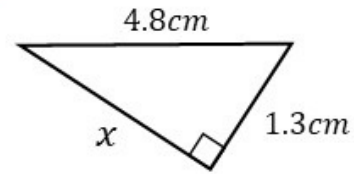
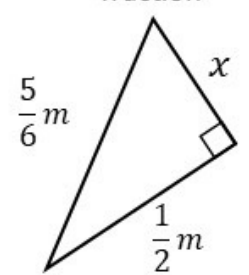
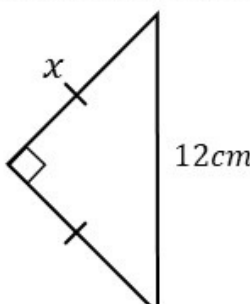
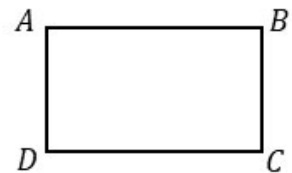
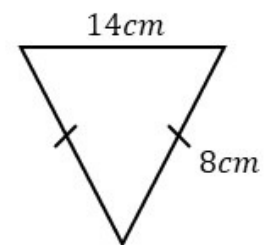
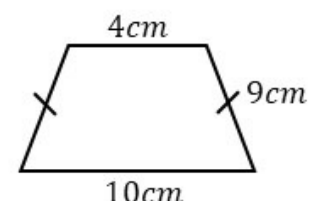
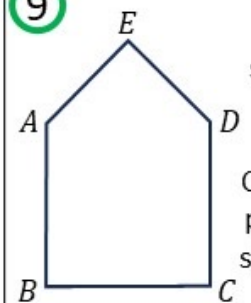
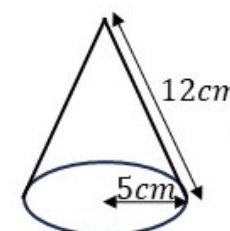
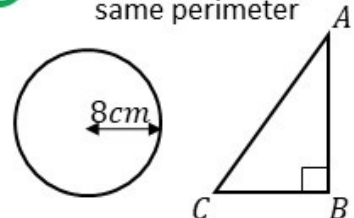
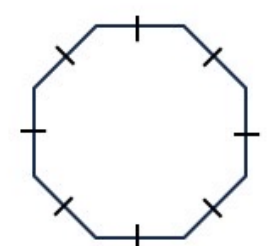
Question 5



Question 6



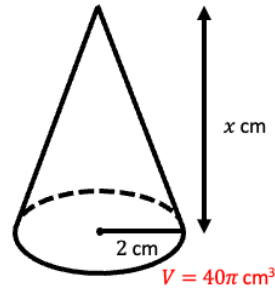
Purposeful Practice

1 Calculate x 	2 Calculate x to 2 d.p. 	3 Calculate x to 1 d.p. 	4 Calculate x, leave as a fraction 
5 Find x leave in exact form 	6 $AB = 12\text{cm}$ $CB = 18\text{cm}$ Calculate BD to 1 d.p. 	7 Calculate the area to 3 s.f. 	8 Calculate the area to 1 d.p. 
9  ABCD is a square with an area of 36cm^2. Calculate the perimeter of shape ABCDE to 2 d.p.	10 Calculate the volume of the cone to 2 d.p.  $V_{\text{Cone}} = \frac{\pi r^2 h}{3}$ r = radius h = height	11 Both shapes have the same perimeter  $AC : AB = 9 : 4$ Calculate BC to 2 d.p.	12 The perimeter is 56cm. Calculate the area to 2 d.p. 

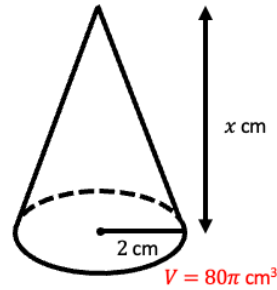
Intelligent Practice

Find x given the volume. Give your answers to 1 decimal place if required.

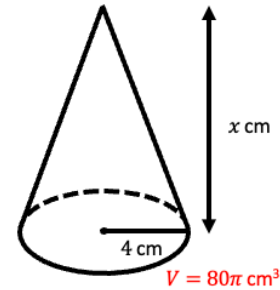
Question 1



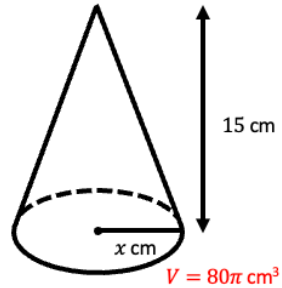
Question 2



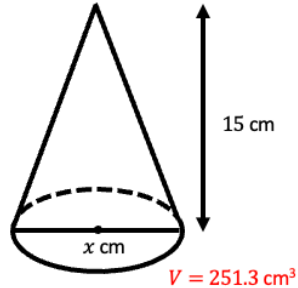
Question 3



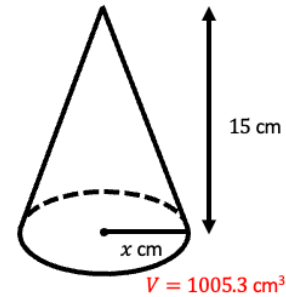
Question 4



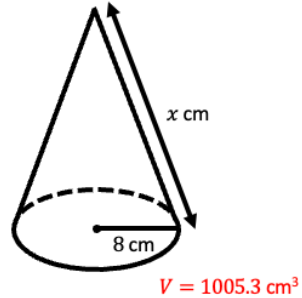
Question 5



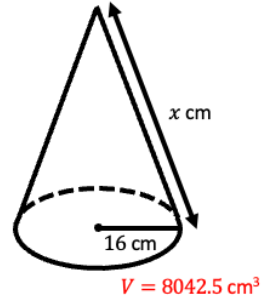
Question 6



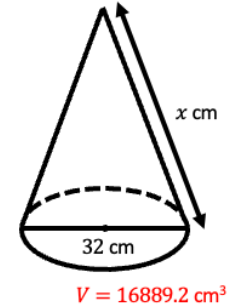
Question 7



Question 8

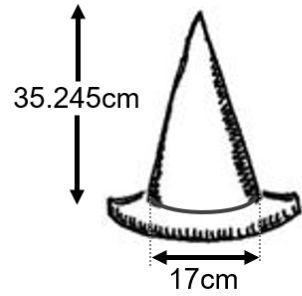


Question 9

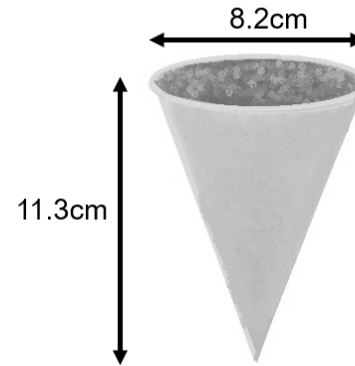
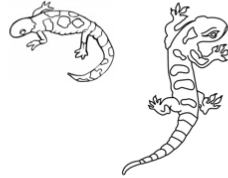


Purposeful Practice

volume of a cone



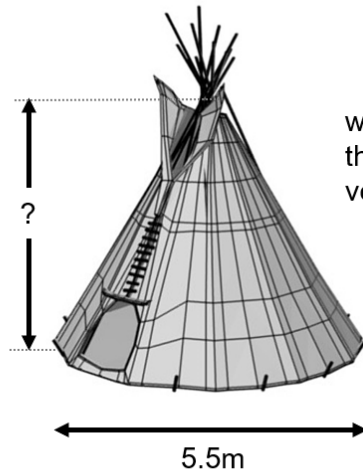
what volume of lizard soup would fit inside the witches' hat?



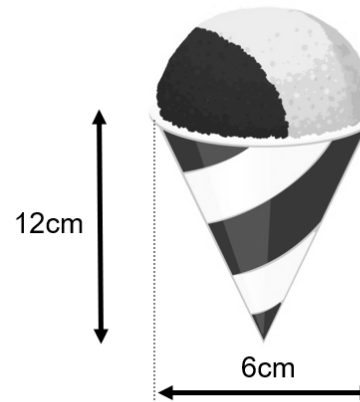
what volume of slush would fit inside the snowcone?

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

$$\text{volume of a sphere} = \frac{4}{3}\pi r^3$$



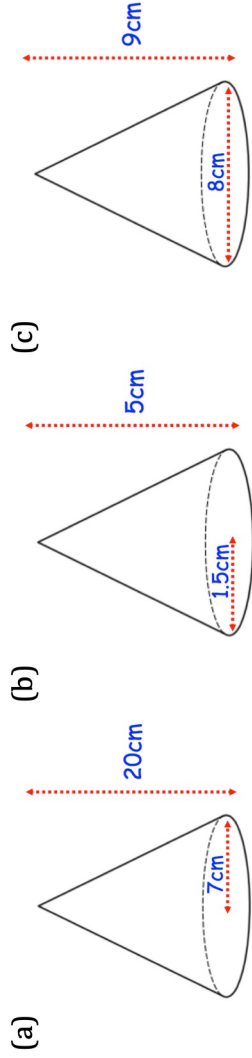
what is the height of the teepee if the volume is 35.6m^3 ?



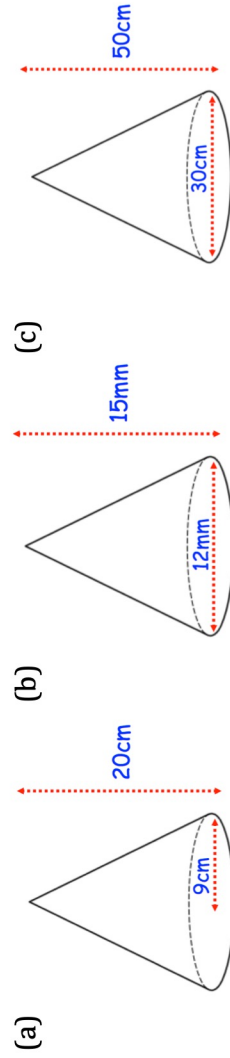
what is the volume of ice cream if the top is a hemisphere (and the cone is full)?

Fluency Practice

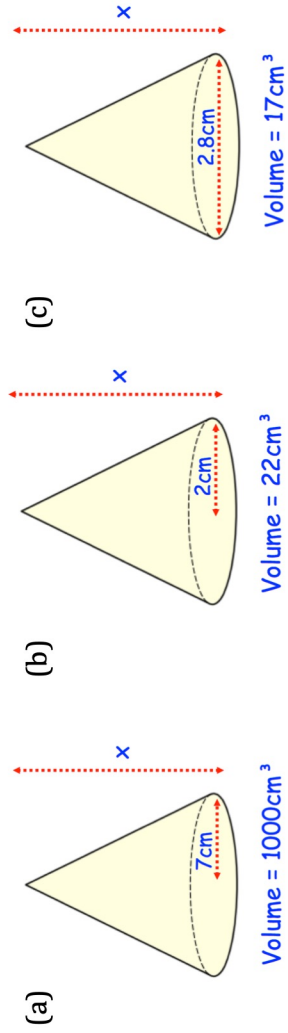
Question 1: Work out the volumes of each of following cones.
Give each answer to one decimal place.



Question 2: Work out the volumes of each of the following cones.
Give each answer in terms of π

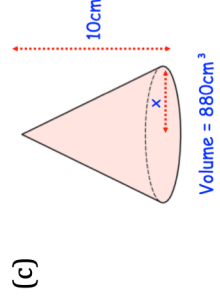
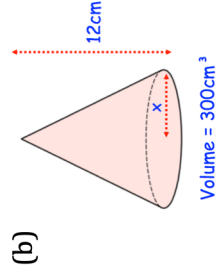
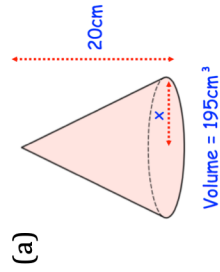


Question 3: Work out the vertical height of each cone.
Give each answer to a suitable degree of accuracy.

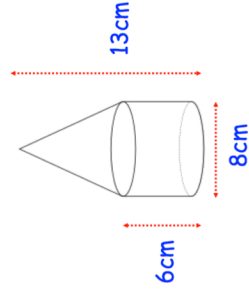


Purposeful Practice

Question 4: Calculate the length of the radius for each of these cones.
Give each answer to a suitable degree of accuracy.

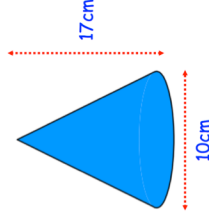


Apply

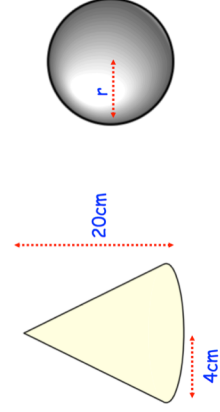


Question 1: A solid is formed from a cylinder and a cone.
Find the volume of the solid.

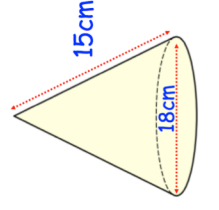
Question 2: A solid cone is made from a material which has a density of 8.7 g/cm^3 .
The dimensions of the cone are shown below.
Find the mass of the cone.



Question 3: The sphere and cone have an equal volume.
Find the radius of the sphere.

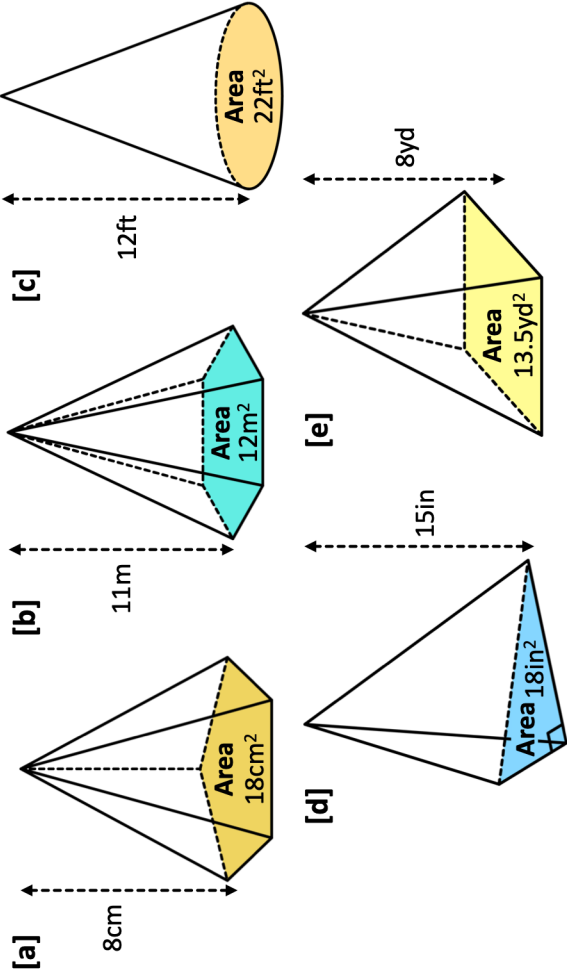


Question 4: Calculate the volume of the cone shown
Give your answer to 1 decimal place.

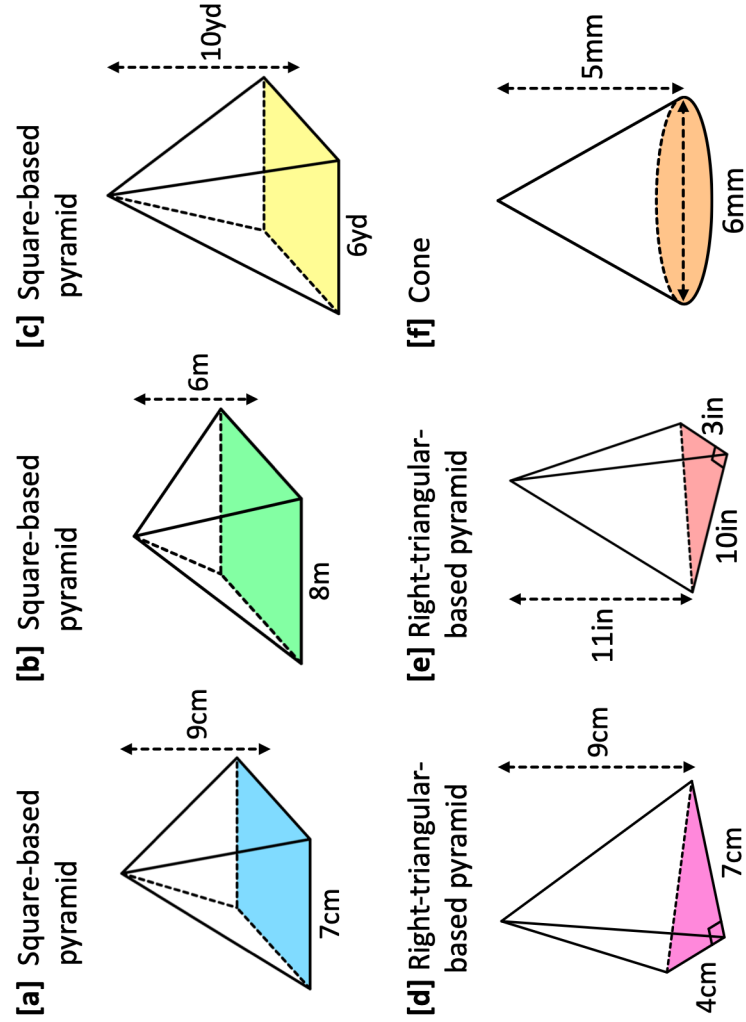


Fluency Practice

Q1 Work out the volume of each of the following pyramids.

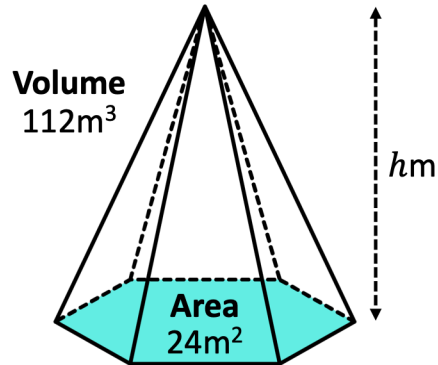


Q2 Work out the volume of each of the following pyramids.

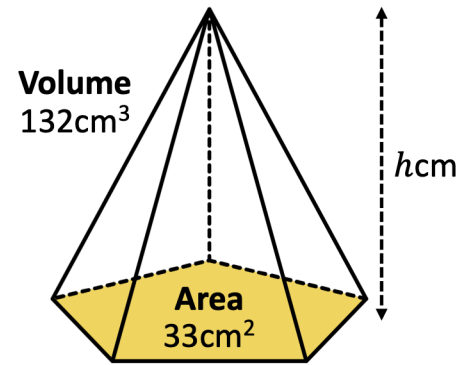


Fluency Practice

Ex3 The following pyramid has a base area of 24m^2 . Given that the volume of the pyramid is 112m^3 , find its height, h m.

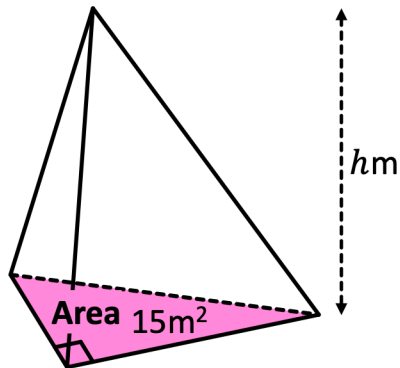


Q3 The following pyramid has a base area of 33cm^2 . Given that the volume of the pyramid is 132cm^3 , find its height, h cm.

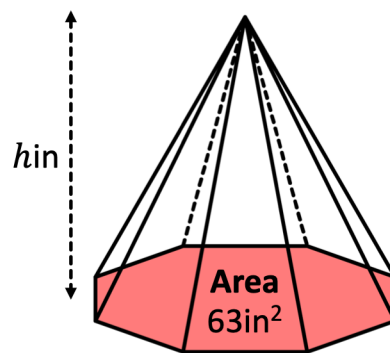


Q4 Work out the height of each of the following pyramids given their volume.

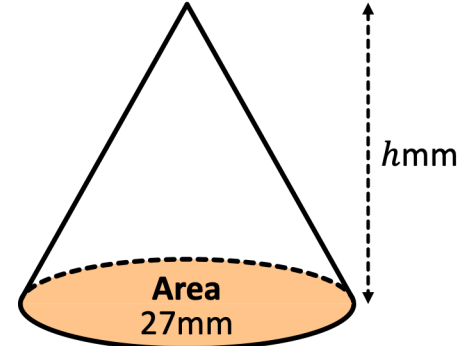
[a] Volume = 105m^3



[b] Volume = 168in^3

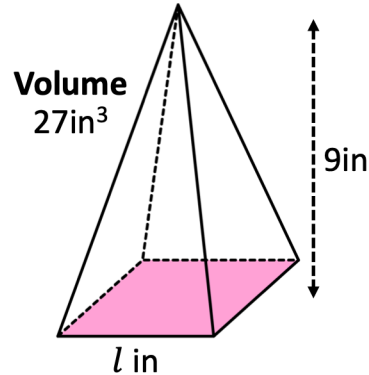


[c] Volume = 108mm^3

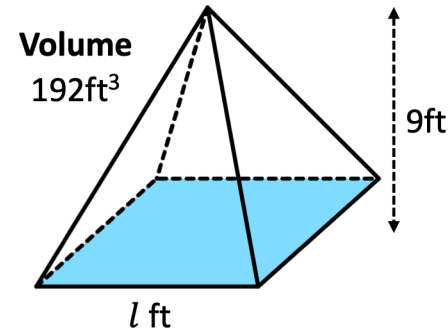


Fluency Practice

Ex4 The following square-based pyramid has a height of 9in. Given that the volume of the pyramid is 27in^3 , find the length of the base, l in.

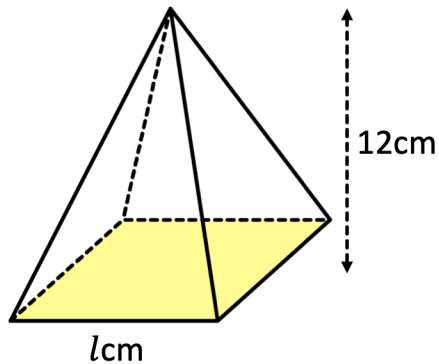


Q5 The following square-based pyramid has a height of 9ft. Given that the volume of the pyramid is 192ft^3 , find the length of the base, l ft.

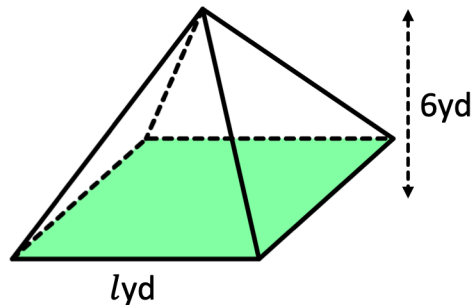


Q6 Work out the missing length of each of the following pyramids given their volume.

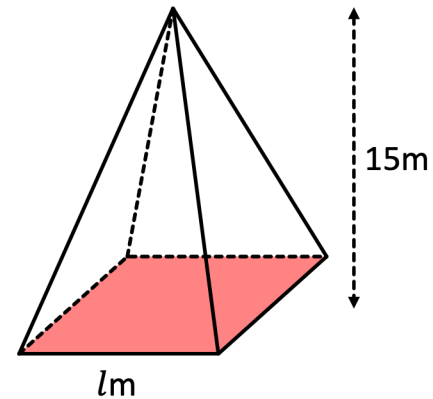
[a] Volume = 100cm^3



[b] Volume = 128yd^3

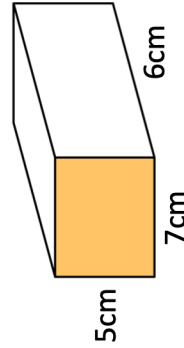
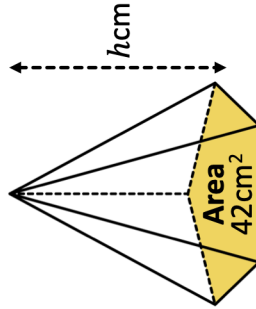


[c] Volume = 500m^3

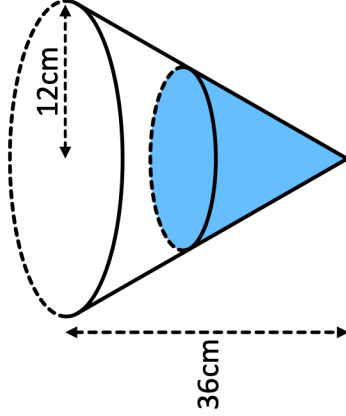


Purposeful Practice

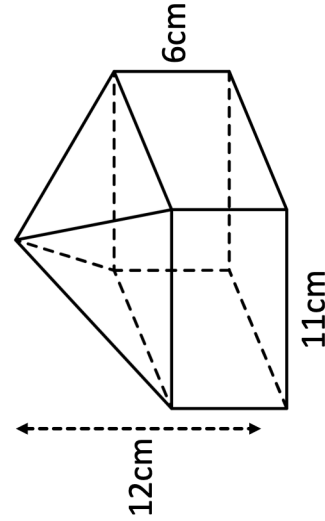
- Q1** The pyramid and the cuboid have the same volume. Find the value of h .



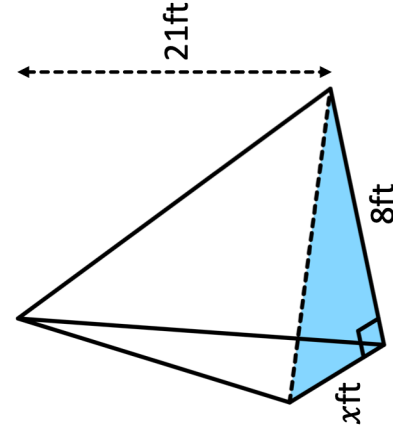
- Q2** The following container is in the shape of a cone. The container is filled with 3L of water. Use $1\text{ L} = 1000\text{ cm}^3$ to find the percentage of the volume of the cone that is taken up by the water to the nearest 1%.



- Q3** The following composite solid is made by joining a cuboid and square-based pyramid. Calculate the volume of the solid.



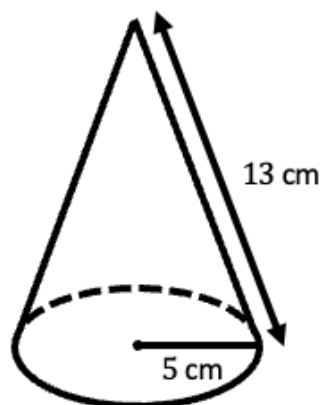
- Q4** The following right-triangular-based pyramid has a height of 9ft. Given that the volume of the pyramid is 84 ft^3 , find the missing length, x ft.



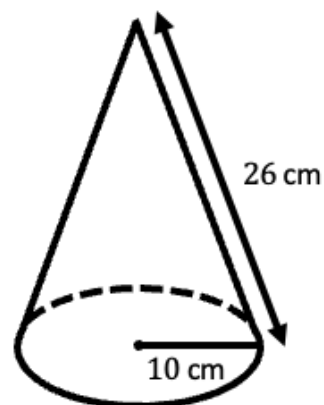
Intelligent Practice

Calculate the total surface area. Give your answers in terms of π and to 1 decimal place.

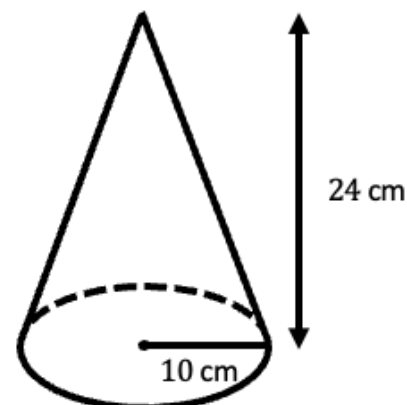
Question 1



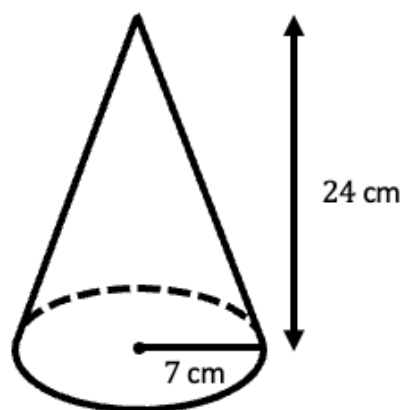
Question 2



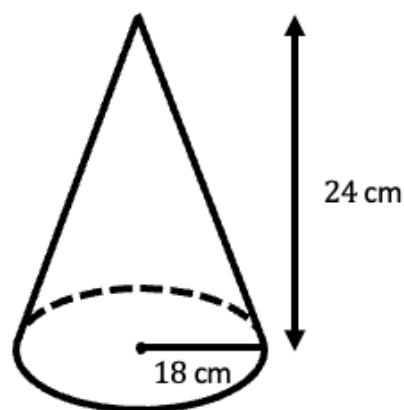
Question 3



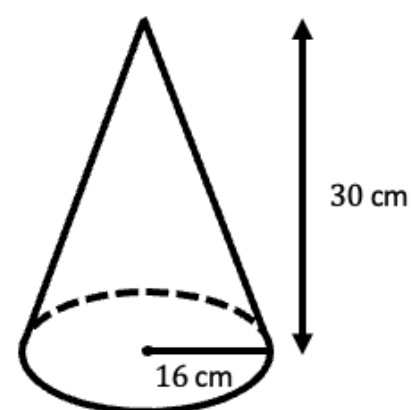
Question 4



Question 5



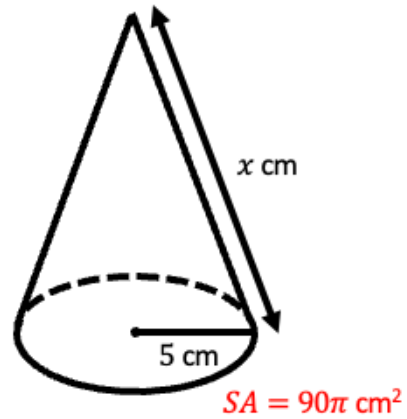
Question 6



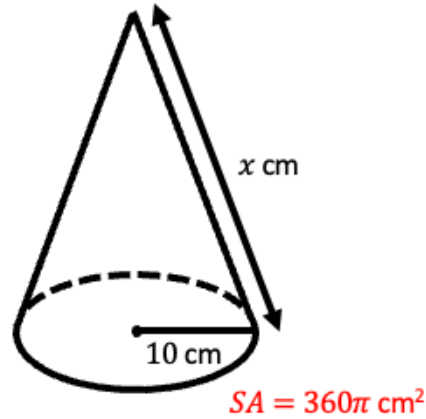
Intelligent Practice

Find x given the total surface area. Give your answers to 1 decimal place if required.

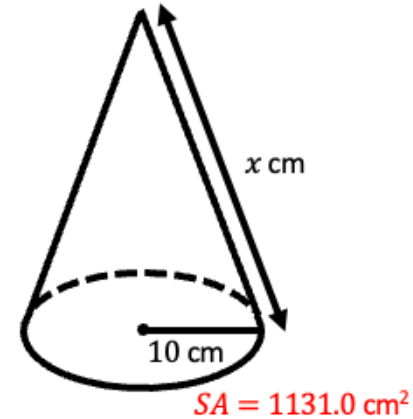
Question 1



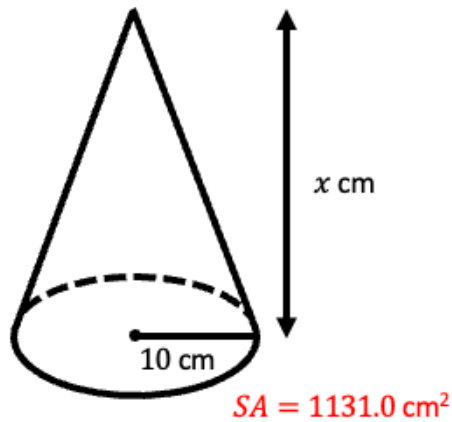
Question 2



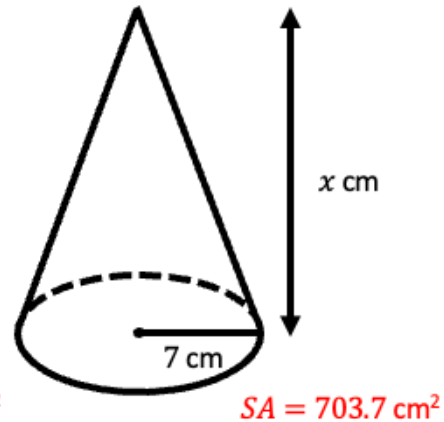
Question 3



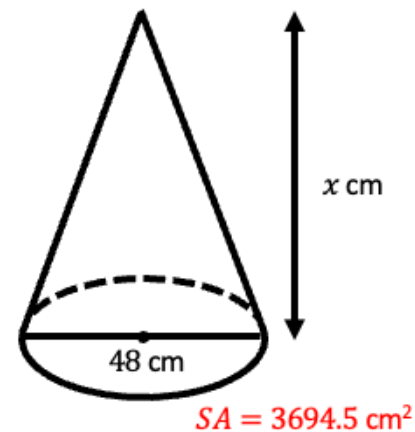
Question 4



Question 5

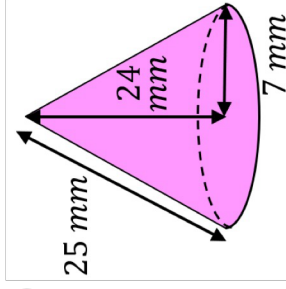
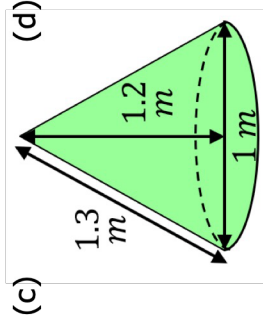
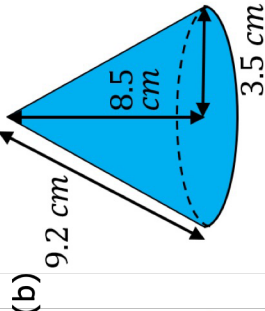
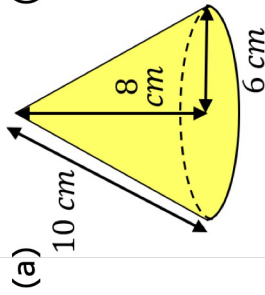


Question 6

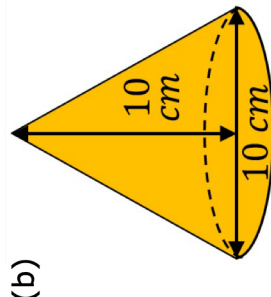
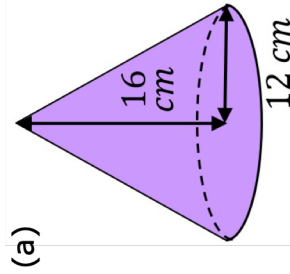


Fluency Practice

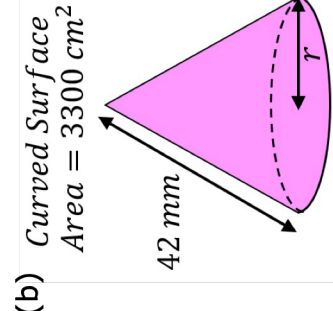
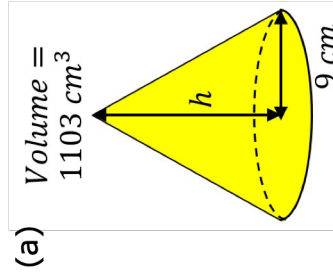
Find the volume and total surface area of each of these cones.



Find the slanted height and curved surface area of these cones.



Find the missing lengths.

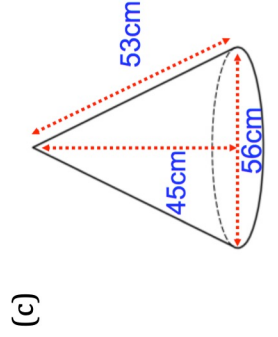
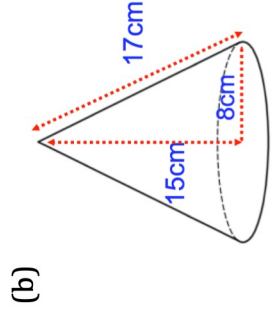
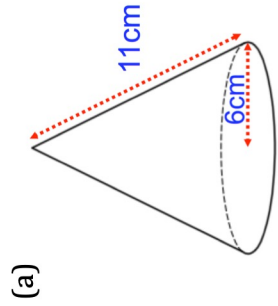


(a) A cone has a slanted height of 26 cm and a curved surface area of $260\pi \text{ cm}^2$. Find its volume.

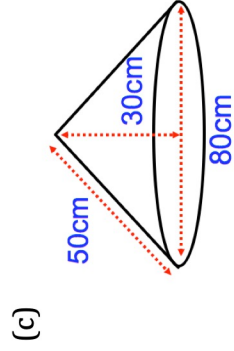
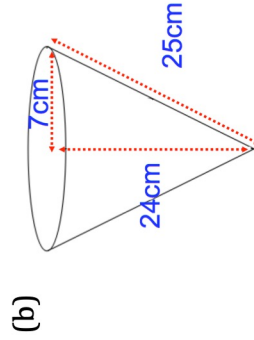
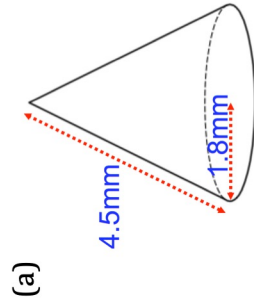
(b) A cone has a radius of 8.5 cm and a volume of 1059 cm^3 . Find its total surface area.

Fluency Practice

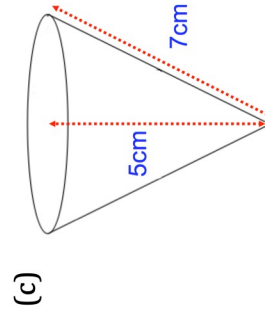
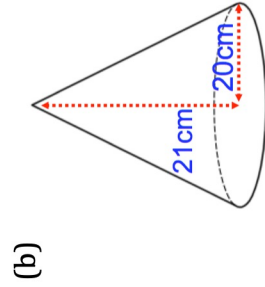
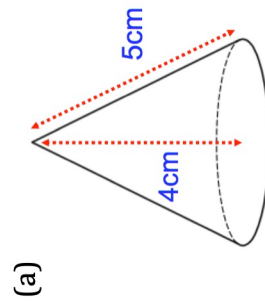
Question 1: Work out the surface areas of each of the following cones.
Give each answer in terms of π



Question 2: Work out the surface areas of each of the following cones.
Give each answer to one decimal place.

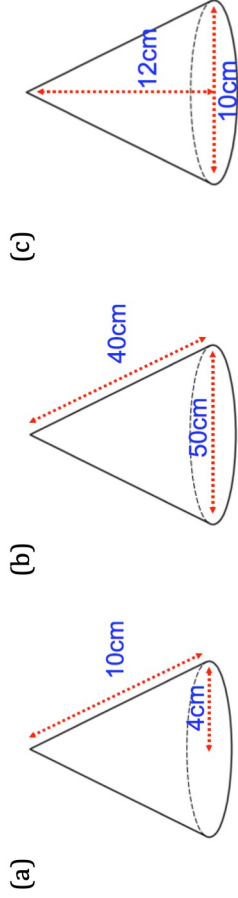


Question 3: Work out the surface areas of each of the following cones.
Give each answer to one decimal place.

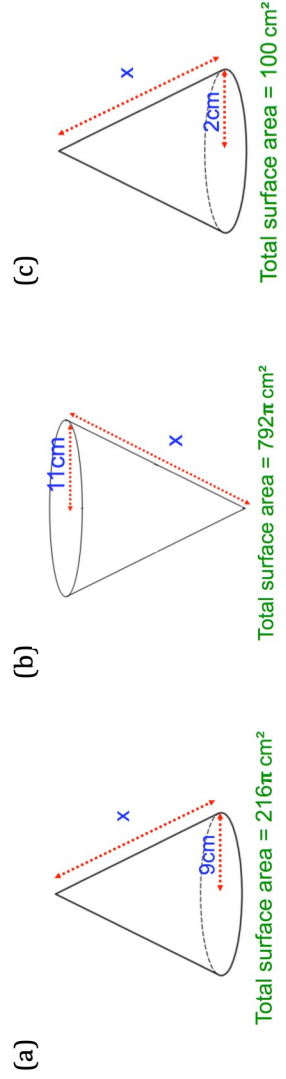


Fluency Practice

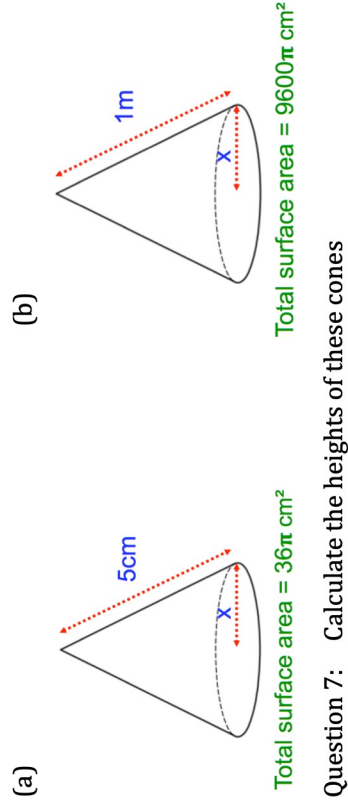
Question 4: Work out the surface area of each of the following cones.
Give each answer in terms of π



Question 5: Calculate the slant height for each of these cones



Question 6: Calculate the lengths of the radius for each of these cones



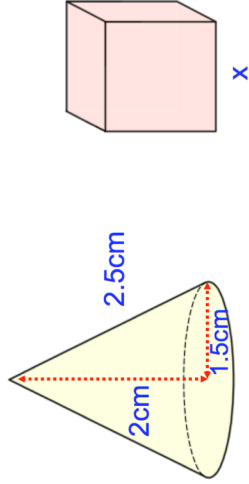
Question 7: Calculate the heights of these cones



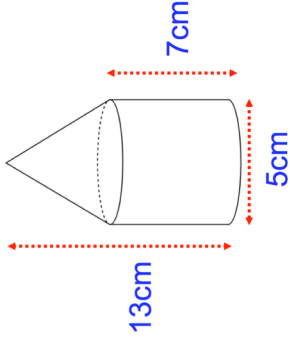
Purposeful Practice

Apply

Question 1: The cone and cube below have the same surface areas.
Work out the side length of the cube, x .

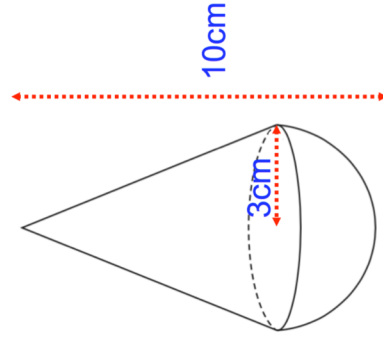


Question 2: The diagram shows a solid shape.
The shape is a cone on top of a cylinder.
Work out the surface area of the shape.
Give your answer correct to 2 significant figures



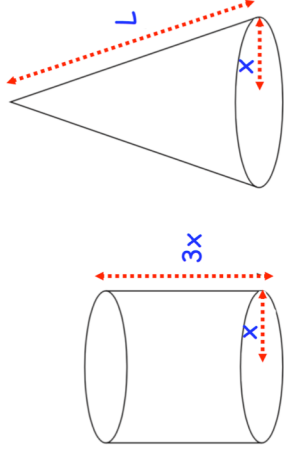
Question 3: A cone has a radius of 9 cm.
The surface area of the cone is $450\pi \text{ cm}^2$
Work out the volume of the cone.
Give your answer in terms of π

Question 4: The diagram shows a solid shape.
The shape is a cone on top of a hemisphere.
Work out the surface area of the shape.
Give your answer correct to 2 significant figures

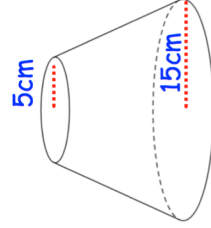


Purposeful Practice

Question 5: The cylinder and cone has the same surface area.
Express L in terms of x .

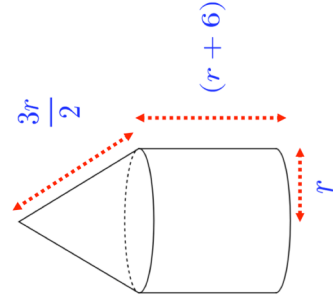


Question 6: A frustum is made from cutting a small cone from the top of a larger cone.
The larger cone was 21 cm tall.



Calculate the surface area of the frustum

Question 7: A cone and cylinder are joined to make a solid.



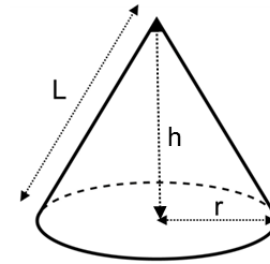
Show the total surface area of the solid is $\frac{3\pi r}{2}(3r + 8)$

Purposeful Practice

surface area of a cone
leaving π in the answer

- (1) find the total surface area, including the circular base, for cones with:

- (a) $r = 5$, $L = 35$
- (b) $r = 4$, $L = 46$
- (c) $r = 8$, $h = 15$



total
surface area

$$\pi rL + \pi r^2$$

- (2) the total surface area, including the circular base, for cones is 300π

what is L if:

- (a) $r = 12$
- (b) $r = 10$
- (c) $r = 5$
- (d) $r = 4$
- (e) $r = 1$

- (3) the total surface area, including the circular base, for cones is 100π

what is r if:

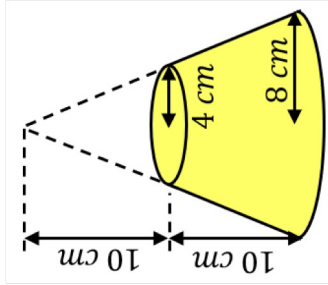
- (a) $L = 15$
- (b) $L = 21$
- (c) $L = 48$
- (d) $L = 99$

why these numbers for L ?

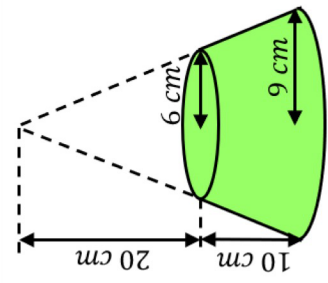
Fluency Practice

Find the volume of each of these frustums.

(a)

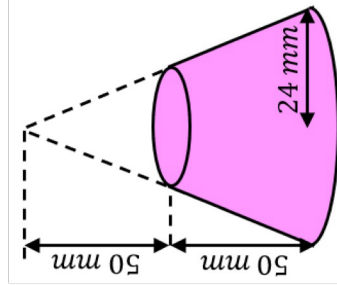


(b)

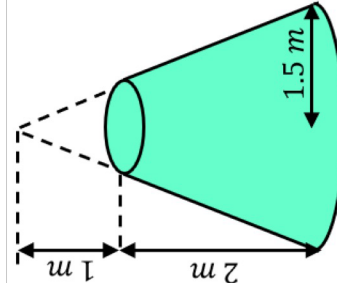


Find the volume of each of these frustums.

(a)

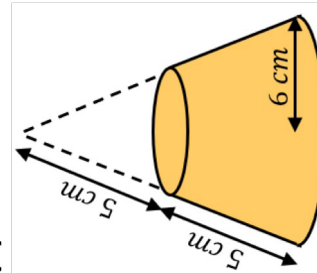


(b)

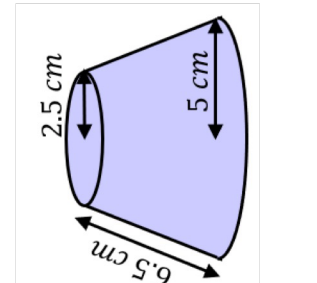


Find the curved surface area and total surface area of each of these frustums.

(a)



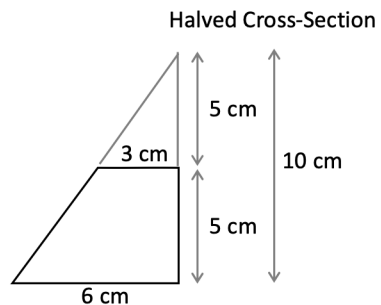
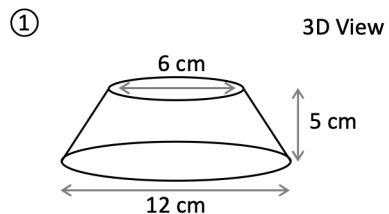
(b)



The base diameter of a frustum is 18 cm and the top diameter is 9 cm. If the frustum has a volume of $378\pi \text{ cm}^3$, find its height.

Fluency Practice

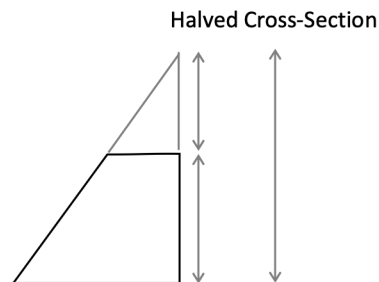
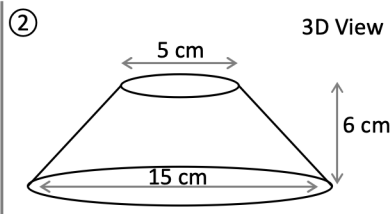
Finding the Volume of Frustums using Similar Triangles



Volume of Large Cone =

Volume of Small Cone =

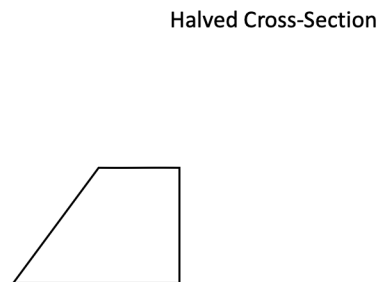
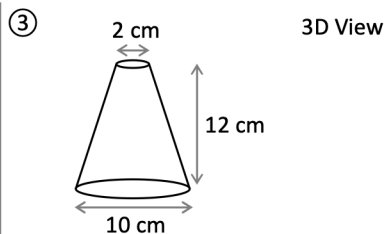
Volume of Frustum =



Volume of Large Cone =

Volume of Small Cone =

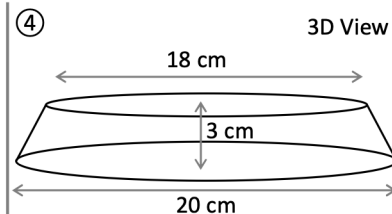
Volume of Frustum =



Volume of Large Cone =

Volume of Small Cone =

Volume of Frustum =



Volume of Large Cone =

Volume of Small Cone =

Volume of Frustum =

Fluency Practice

Volume of Pyramids

①

10 cm

8 cm

Volume =

②

15 cm

6 cm

Volume =

The apex is above the centre of a square base unless stated.

③

3 cm

6 cm

Volume =

④

12 cm

4 cm

Volume =

⑤

13 cm

9 cm

A pyramid with its apex vertically above a base corner.

Volume =

⑥

2 cm

6 cm

6 cm

11 cm

Volume =

⑦

3 cm

6 cm

4 cm

12 cm

Volume =

⑧

5 cm

12 cm

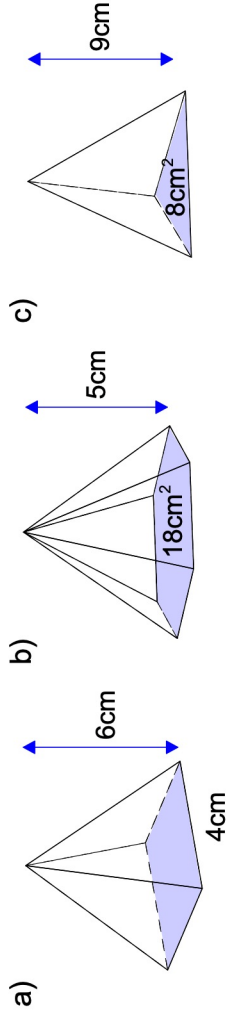
10 cm

Volume =

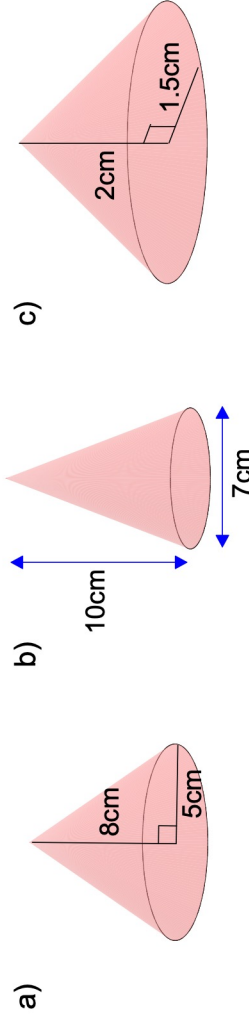
7 Answers	351	180	64	288	213.33	416	36
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Fluency Practice

1. The base of each of these pyramids is a regular polygon. Work out the volume of each pyramid.



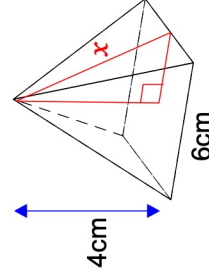
2. Work out the volume of each of these cones, giving your answers both in terms of π , and correct to 3 significant figures.



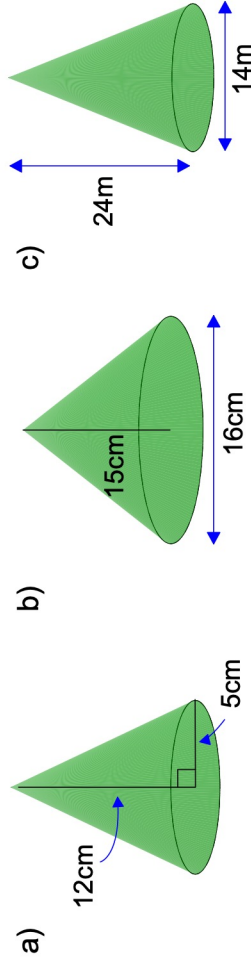
3. Which has a larger volume?

A - a cone with radius 5cm and height 6cm.
B - a cone with radius 6cm and height 5cm.

4. A pyramid has a perpendicular height of 4cm and a square base with a side length of 6cm.

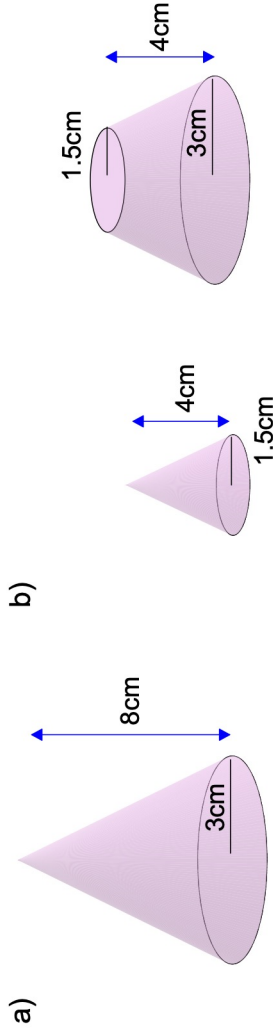


5. Work out the surface area of each cone, giving your answers both in terms of π , and correct to 3 significant figures.

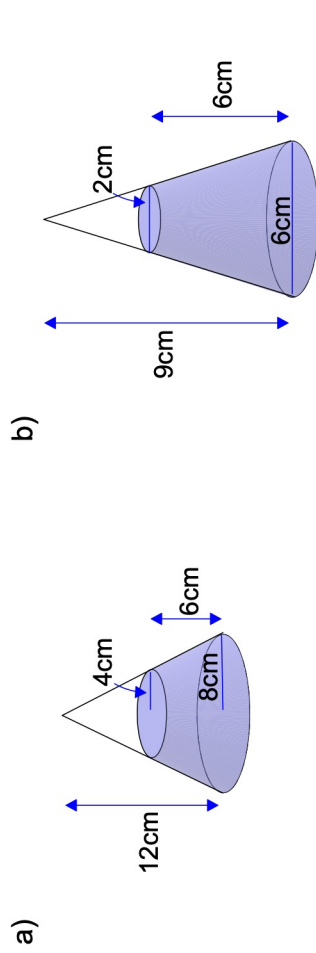


Purposeful Practice

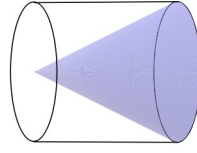
6. The cone in *part a* is cut horizontally to produce the frustum and cone in *b*. Work out the volume of all three shapes in terms of π .



7. Work out the volume of each shaded frustum in terms of π .

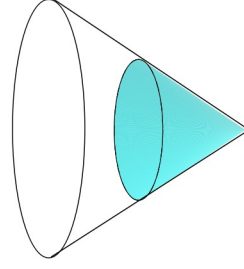


8. A cone sits inside a cylinder with the same radius and same height.



What fraction of the cylinder is taken up by the cone?

9. A container in the shape of a cone is partially filled with water to half of its total height.



Gemma says that half of the volume of the cone is taken up by the water.

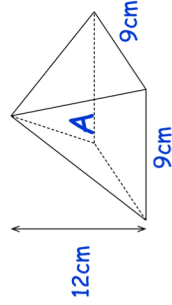
Gemma is wrong. Find the actual fraction of the volume of the cone that is taken up by the water.

(Hint: since the cones are similar, the radius of the surface of the water is half the radius at the top of the cone.)

Fluency Practice

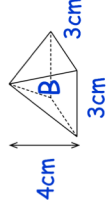
Question 1: Shown is a square based pyramid A.

(a) Find the volume of the square based pyramid.



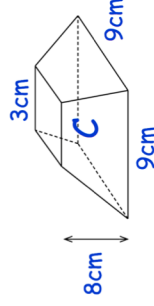
Shown is a smaller square based pyramid B.

(b) Find the volume of the smaller square based pyramid.

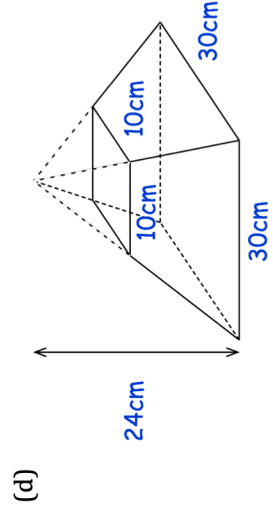
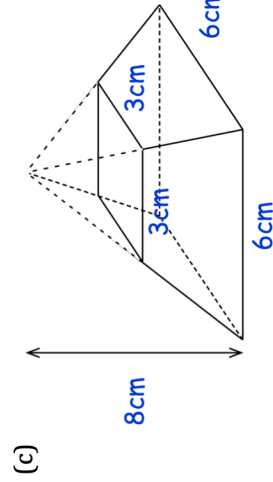
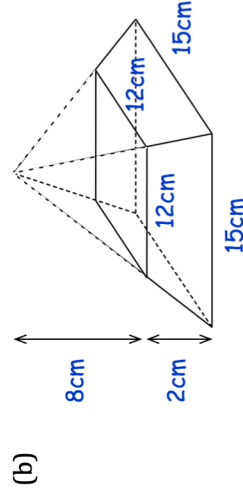
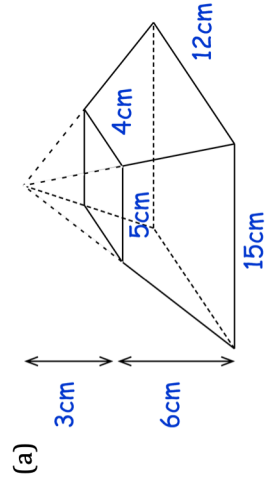


A frustum is created by removing the Pyramid B from the top of Pyramid A.

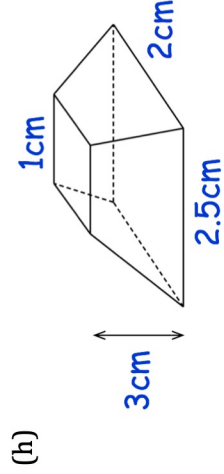
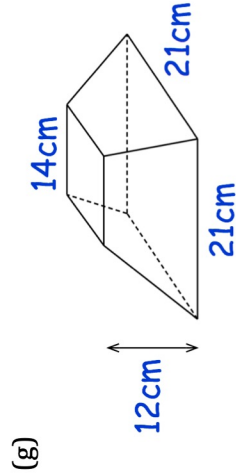
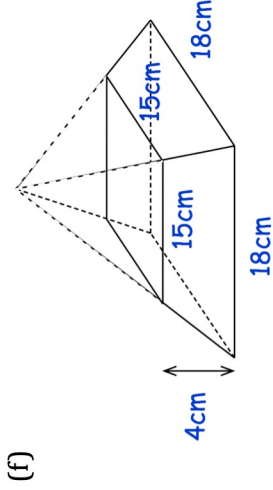
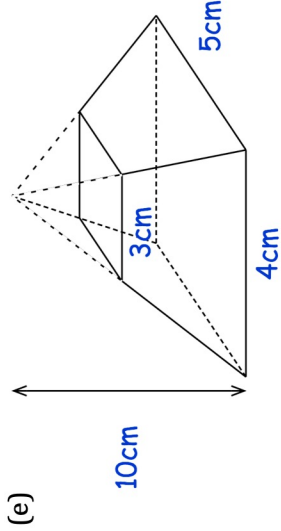
(c) Find the volume of the frustum.



Question 2: Find the volume of the following frustums.

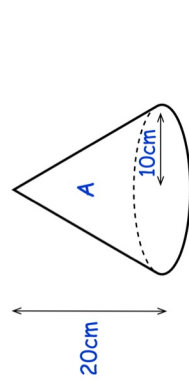


Fluency Practice



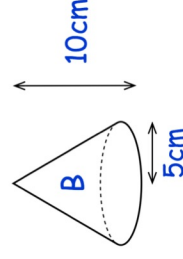
Question 3: Shown is Cone A.

(a) Find the volume of the cone.



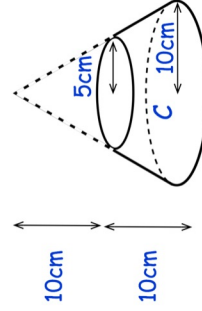
Shown is a smaller Cone, B.

(b) Find the volume of the smaller cone.

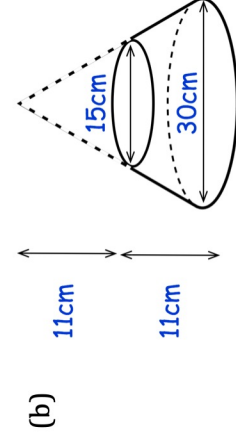
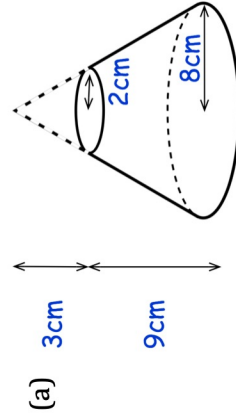


A frustum is created by removing Cone B from the top of Cone A.

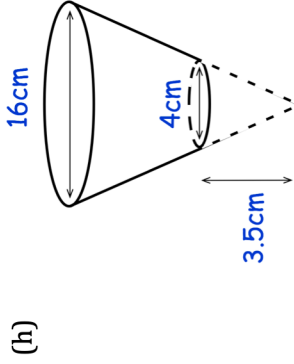
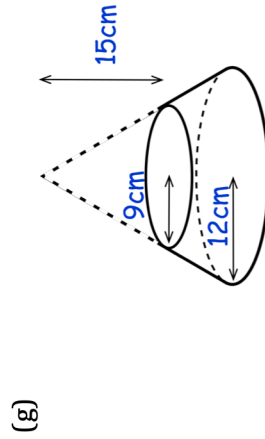
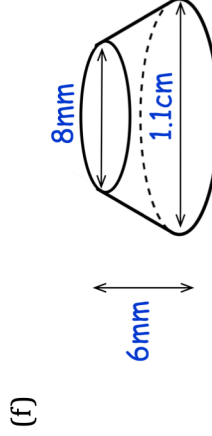
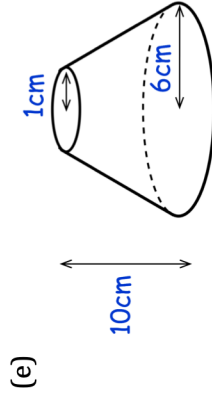
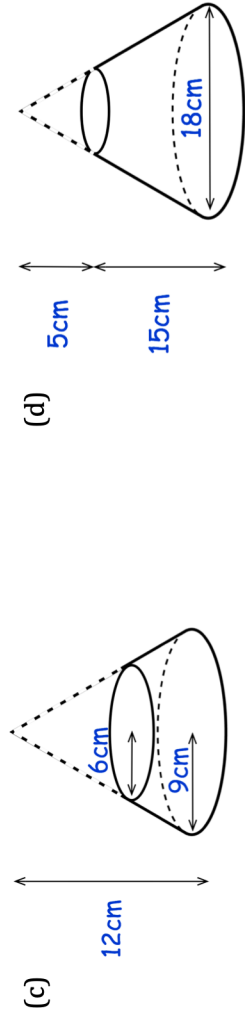
(c) Find the volume of the frustum.



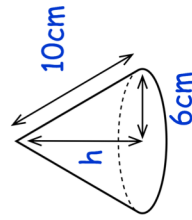
Question 4: Find the volume of the following frustums.



Fluency Practice

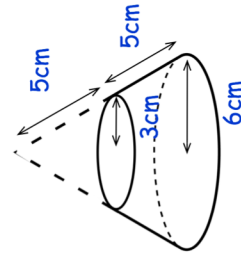


Question 5: Shown below is a cone with a radius of 6cm and a slant height of 10cm.



(a) Find the perpendicular height of the cone, h .

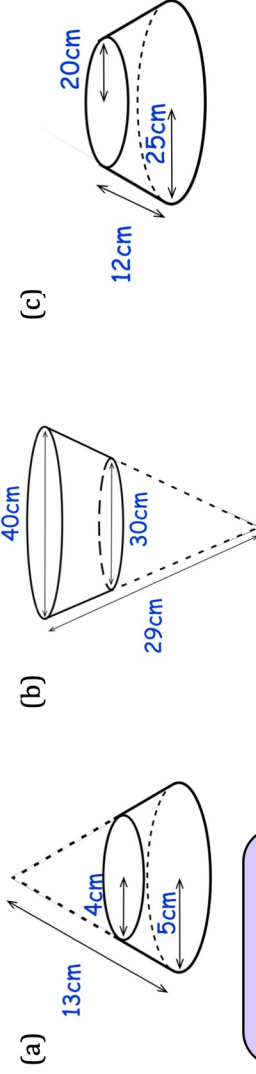
A frustum is made by removing a smaller cone from the top of the cone in (a).



(b) Find the volume of the frustum.

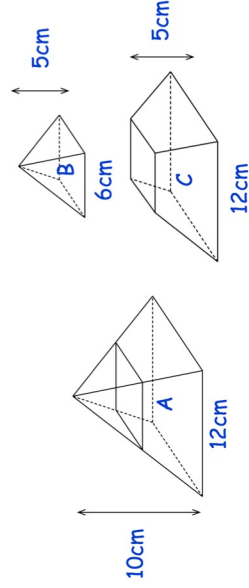
Purposeful Practice

Question 6: Find the volumes of the following frustums.



Apply

Question 1: The square based pyramid A is divided into Pyramid B and Frustum C.



- Work out the volume of Pyramid A.
- Work out the volume of Pyramid B.
- Work out the volume of Frustum C.

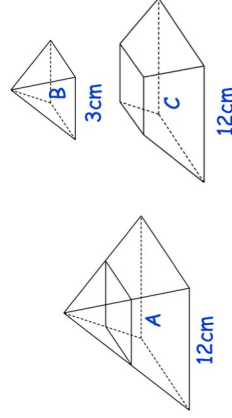
Douglas says that since Pyramid A and Pyramid B are similar, and since the base length of B is half of the base length of A, the volume of B will be one-eighth of the volume of A.

(d) Show that Douglas is correct.

Jack says that means that the volume of Frustum C will be seven-eighths of the volume of Pyramid A.

(e) Show that Jack is correct.

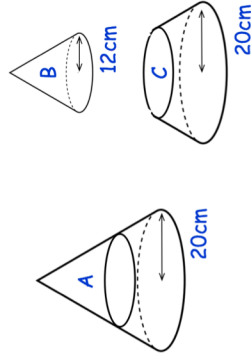
Question 2: The square based Pyramid A is divided in Pyramid B and Frustum C.



- Express the volume of Pyramid B as a fraction of the volume of Pyramid A.
- Express the volume of Frustum C as a fraction of the volume of Pyramid A.

Purposeful Practice

Question 3: Cone A is divided into Cone B and Frustum C.

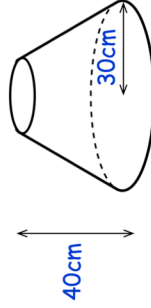


Express the volume of Frustum C as a fraction of the volume of Cone A.
Give your answer in its simplest form.

Question 4: Magda is making a solid glass sculpture.

Magda has a glass cone with base radius of 30cm and perpendicular height 60cm.

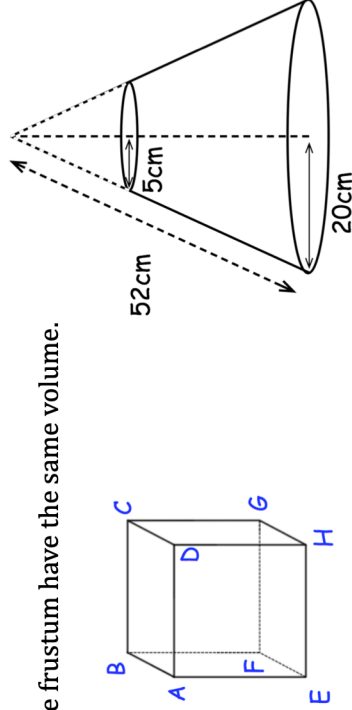
She removes a smaller cone from the top of the cone to leave a frustum.



The density of the glass is 2.7 g/cm^3

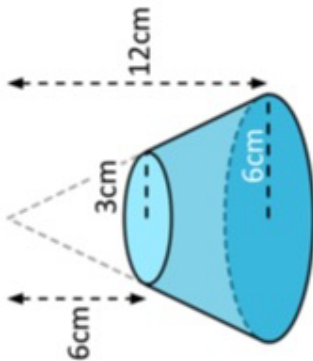
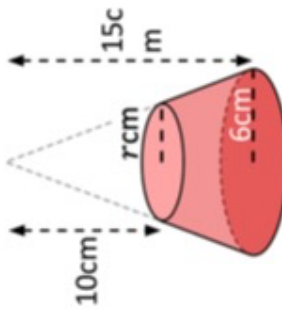
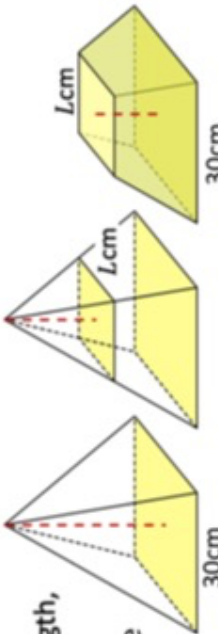
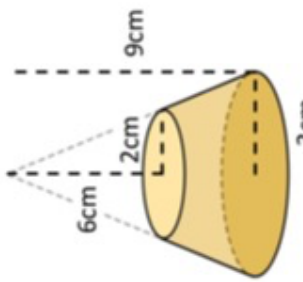
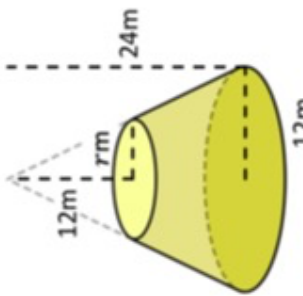
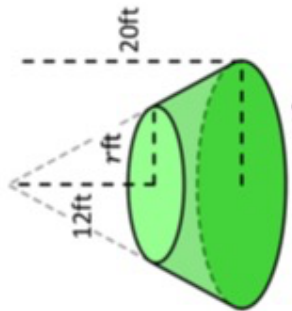
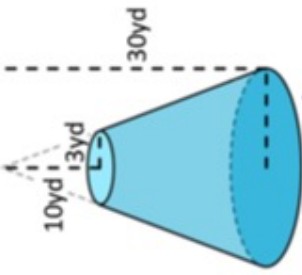
Find the mass of the sculpture.

Question 5: The cube and the frustum have the same volume.



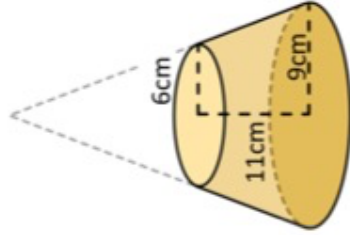
Find the length of AG.

Fluency Practice

Ex1 Find the volume of the frustum. 	Ex2 Find the missing length of the frustum's top radius and hence find the volume of the frustum in terms of π. 
Ex3 Shown is a square-based pyramid with height 50cm and base side length 30cm. A smaller square-based pyramid height 20cm is removed to form a frustum. [a] Work out the base side length, L, of the smaller pyramid. [b] Work out the volume of the frustum. 	
Q1 Work out the volume of each of the following frustums.	
[a] 	[b] 
[c] 	[d] 

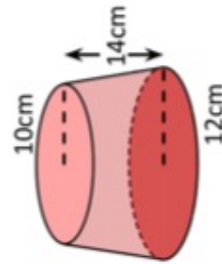
Purposeful Practice

Ex4 Find the missing length of the frustum's top radius and hence find the volume of the frustum in terms of π .

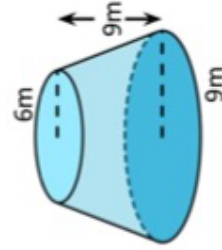


Q2 Work out the volume of each of the following frustums.

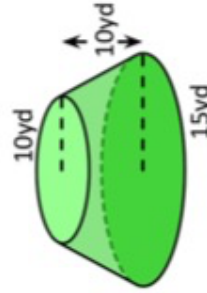
[a]



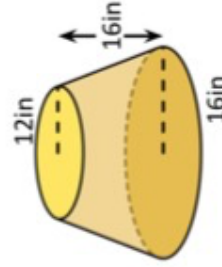
[b]



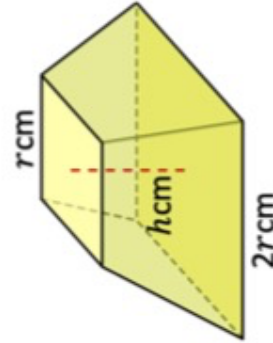
[c]



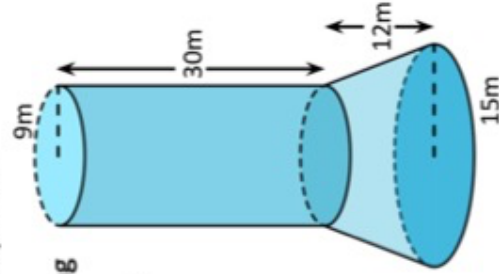
[d]



Q3 The diagram shows a square-based frustum. The base side-length, $2r$ cm is twice the size of the top side-length, r cm. The height of the frustum is h cm. Find an expression for the volume of the frustum.



Q4 The chemistry flask consists of a frustum and a cylinder. Calculate its volume leaving your answer in terms of π .



Fluency Practice

Finding the Surface Area of Frustums using Similar Triangles

①

3D View

Halved Cross-Section

Curved Surface Area of Large Cone =

Curved Surface Area of Small Cone =

Curved Surface Area of Frustum
+ Top & Base =

②

3D View

Halved Cross-Section

Curved Surface Area of Large Cone =

Curved Surface Area of Small Cone =

Curved Surface Area of Frustum
+ Top & Base =

③

3D View

Halved Cross-Section

Curved Surface Area of Large Cone =

Curved Surface Area of Small Cone =

Curved Surface Area of Frustum
+ Top & Base =

④

3D View

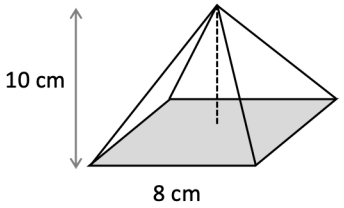
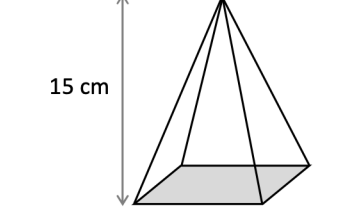
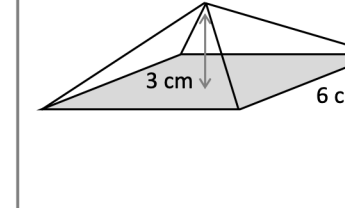
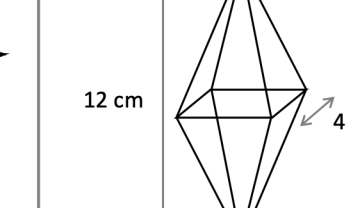
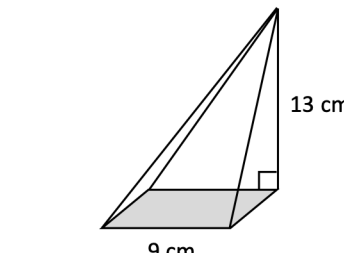
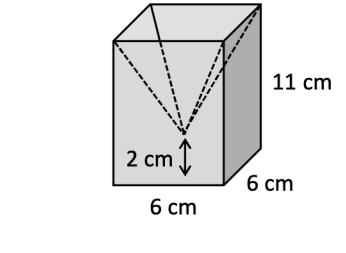
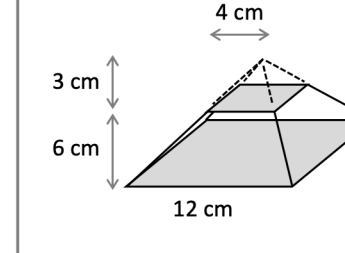
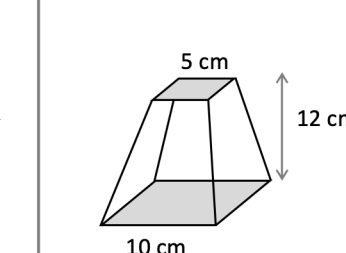
Halved Cross-Section

Curved Surface Area of Large Cone =

Curved Surface Area of Small Cone =

Curved Surface Area of Frustum
+ Top & Base =

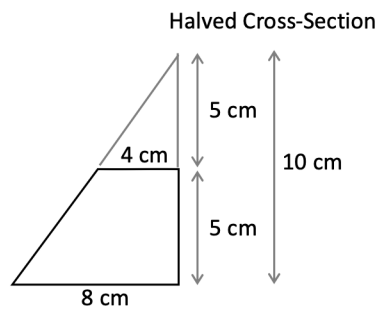
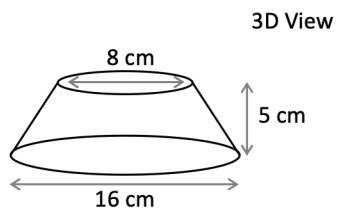
Fluency Practice

Surface Area of Pyramids		The apex is above the centre of a square base unless stated.					
① 	② 	③ 	④ 				
Surface Area =	Surface Area =	Surface Area =	Surface Area =				
⑤  A pyramid with its apex vertically above a base corner.	⑥ 	⑦ 	⑧ 				
Surface Area =	Surface Area =	Surface Area =	Surface Area =				
7 Answers	413.84	219.56	340.30	86.91	236.33	390.75	101.19

Fluency Practice

Finding the Volume & Surface Area of Frustums using Similar Triangles

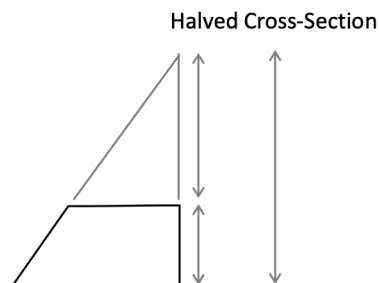
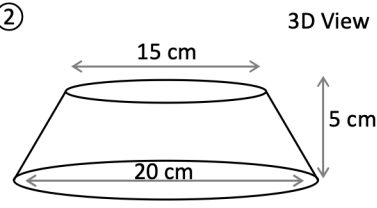
①



Volume =

Surface Area =

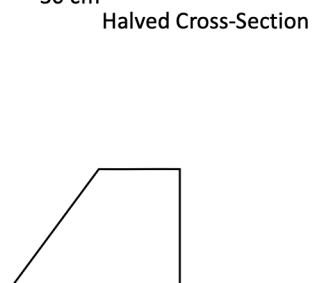
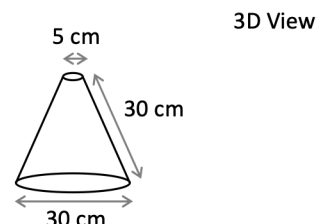
②



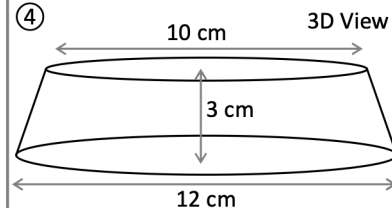
Volume =

Surface Area =

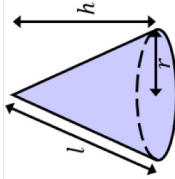
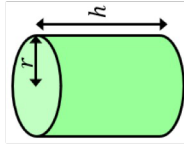
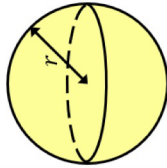
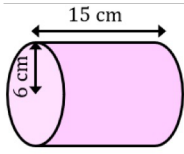
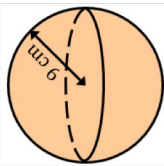
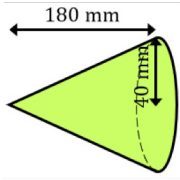
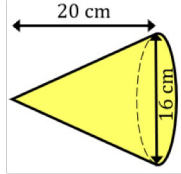
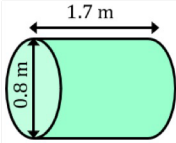
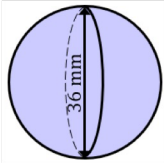
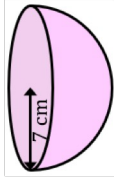
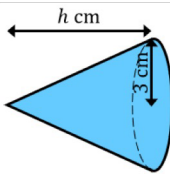
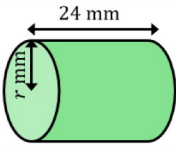
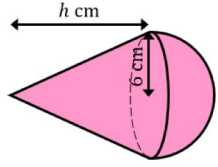
③



④

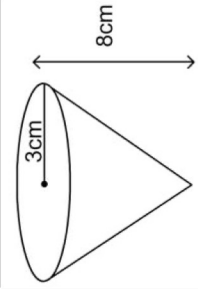
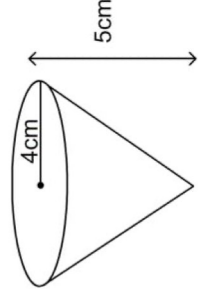
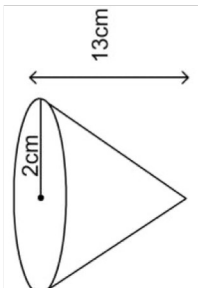
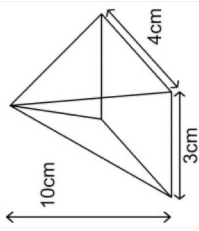
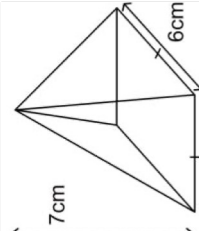
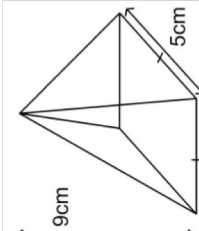
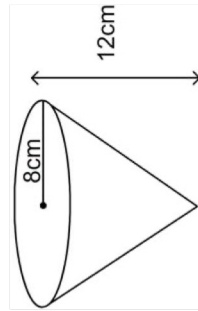
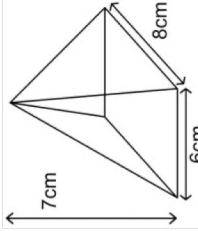
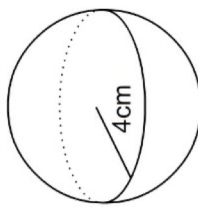
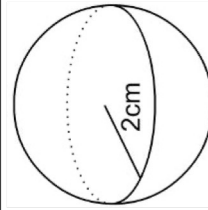
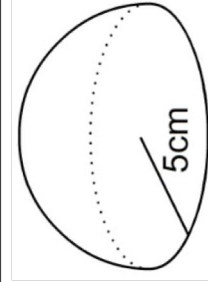
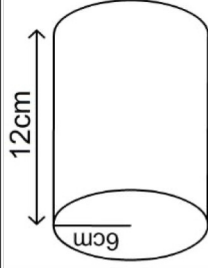
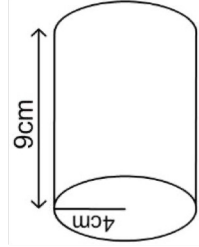
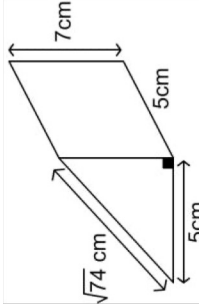
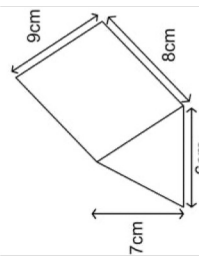
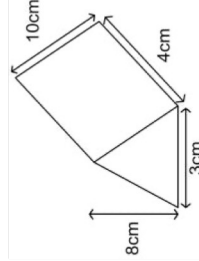
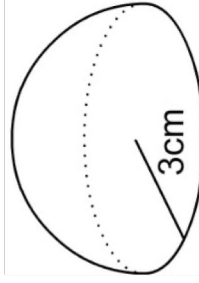
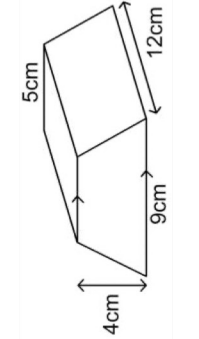


Purposeful Practice

Volume of Cylinders, Cones and Spheres		
		
Volume of Cone = $\frac{1}{3}\pi r^2 h$	Volume of Cylinder = $\pi r^2 h$	Volume of Sphere = $\frac{4}{3}\pi r^3$
(a) Find the volume, giving your answer in terms of π	(b) Find the volume, giving your answer to the nearest cm^3	(c) Find the volume, giving your answer to 3 significant figures
		
(d) Find the volume, giving your answer to 3 significant figures	(e) Find the volume, giving your answer to 2 decimal places	(f) Find the volume, leaving your answer in terms of π
		
(g) Find the volume of the hemisphere to the nearest cm^3	(h) The cone has a volume of $39\pi \text{ cm}^3$. Find the height h .	(i) The cylinder has a volume of 6100 mm^2 . Find its radius to the nearest mm.
		
(j) A shape is made by joining a hemisphere to a cylinder. Both have a radius of 6.5 cm. Find the total volume of the shape.	(k) A shape is made by joining a cone to a hemisphere, where both shapes have the same radius. The total volume is $402\pi \text{ cm}^3$. Find the height of the cone.	

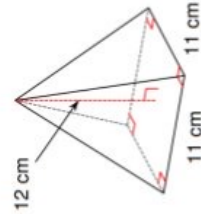
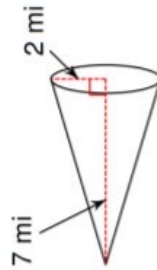
Purposeful Practice

In each row, determine which shape has the largest volume.

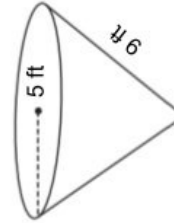
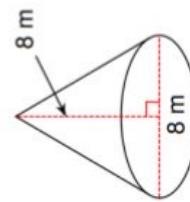
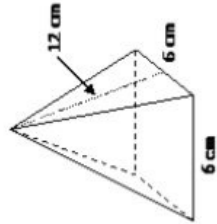
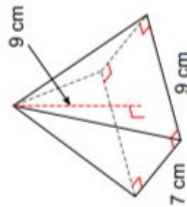
		
		
		
		
		
		

Purposeful Practice

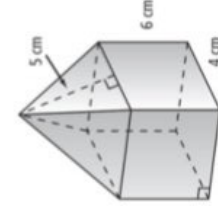
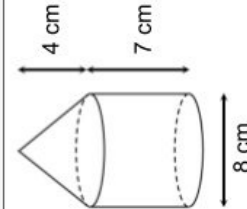
Find the volume of each shape. Add the solutions to all four problems in each set together and record in the centre oval. Add the solutions to all four problems in each set together and record in the centre oval. Round all answers to the nearest whole unit.



Add 'Em Up #1



Add 'Em Up #2



Exam Questions

- 13 The diagram shows a swimming pool in the shape of a prism.

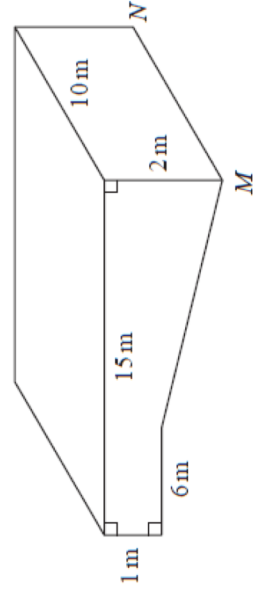


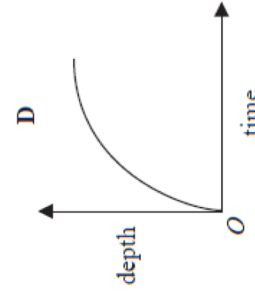
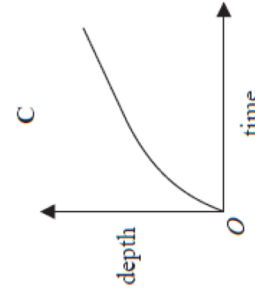
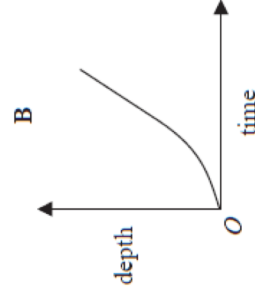
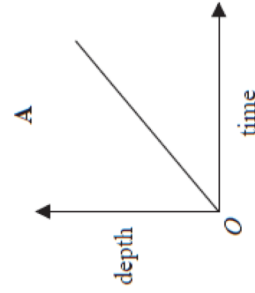
Diagram NOT
accurately drawn

The swimming pool is empty.

The swimming pool is filled with water at a constant rate of 50 litres per minute.

- (a) Work out how long it will take for the swimming pool to be completely full of water.
Give your answer in hours.
($1 \text{ m}^3 = 1000 \text{ litres}$)

Here are four graphs.



- (b) Write down the letter of the graph that best shows how the depth of the water in the pool above the line MN changes with time as the pool is filled.

(1)

(Total for Question 13 is 6 marks)

Exam Question

17 Sumeet has a pond in the shape of a prism.

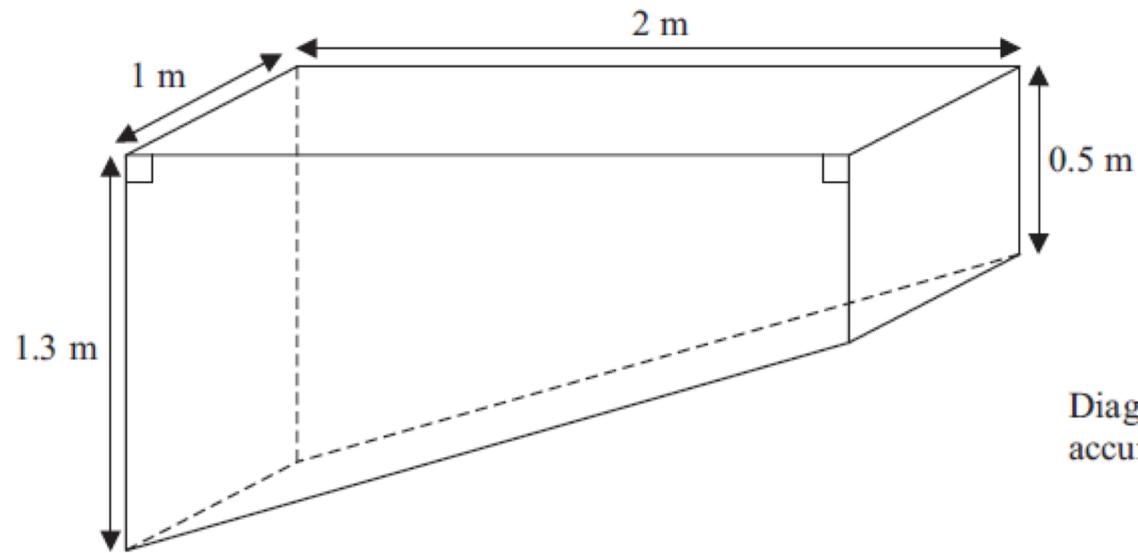


Diagram **NOT**
accurately drawn

The pond is completely full of water.
Sumeet wants to empty the pond so he can clean it.
Sumeet uses a pump to empty the pond.

The volume of water in the pond decreases at a constant rate.
The level of the water in the pond goes down by 20 cm in the first 30 minutes.

Work out how much more time Sumeet has to wait for the pump to empty the pond completely.

Exam Question

23 The diagram shows a container for grain.

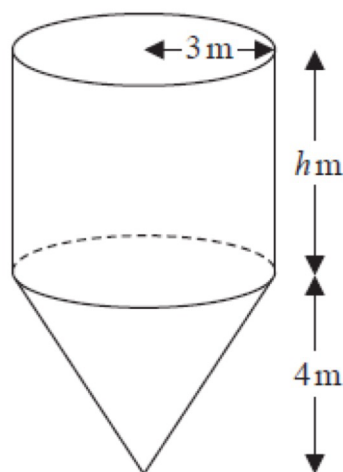


Diagram NOT
accurately drawn

The container is a cylinder on top of a cone.
The cylinder has a radius of 3 m and a height of h m.
The cone has a base radius of 3 m and a vertical height of 4 m.

The container is empty.
The container is then filled with grain at a constant rate.

After 5 hours the depth of the grain is 6 metres above the vertex of the cone.
After 9 hours the container is full of grain.

Work out the value of h .
Give your answer as a fraction in its simplest form.
You must show all your working.

Exam Question

6.

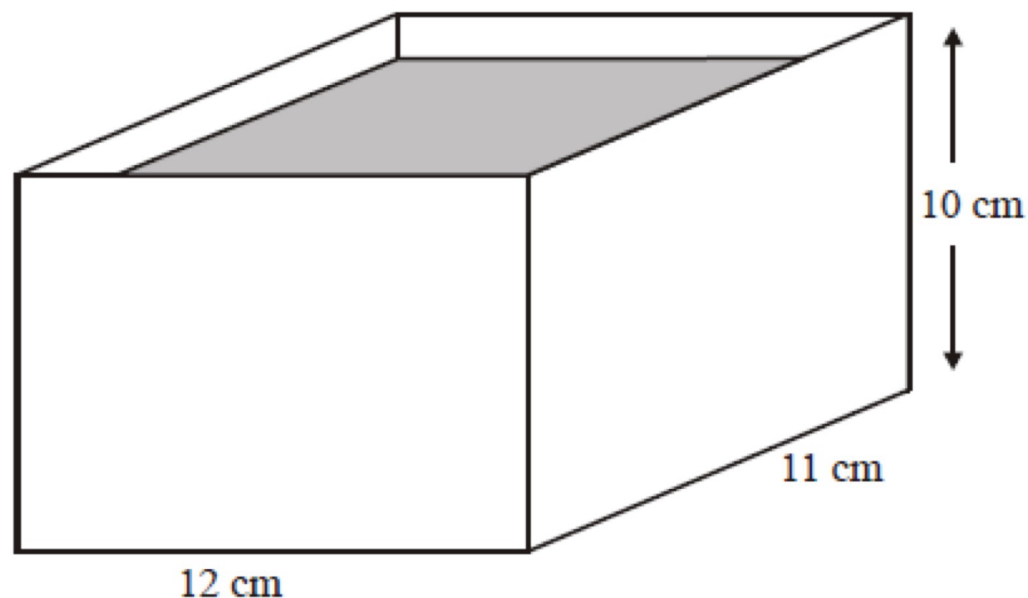
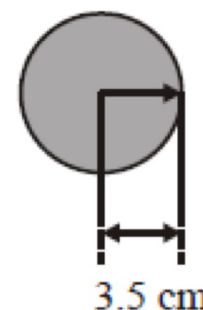


Diagram **NOT**
accurately drawn



A rectangular container is 12 cm long, 11 cm wide and 10 cm high.
The container is filled with water to a depth of 8 cm.

A metal sphere of radius 3.5 cm is placed in the water.
It sinks to the bottom.

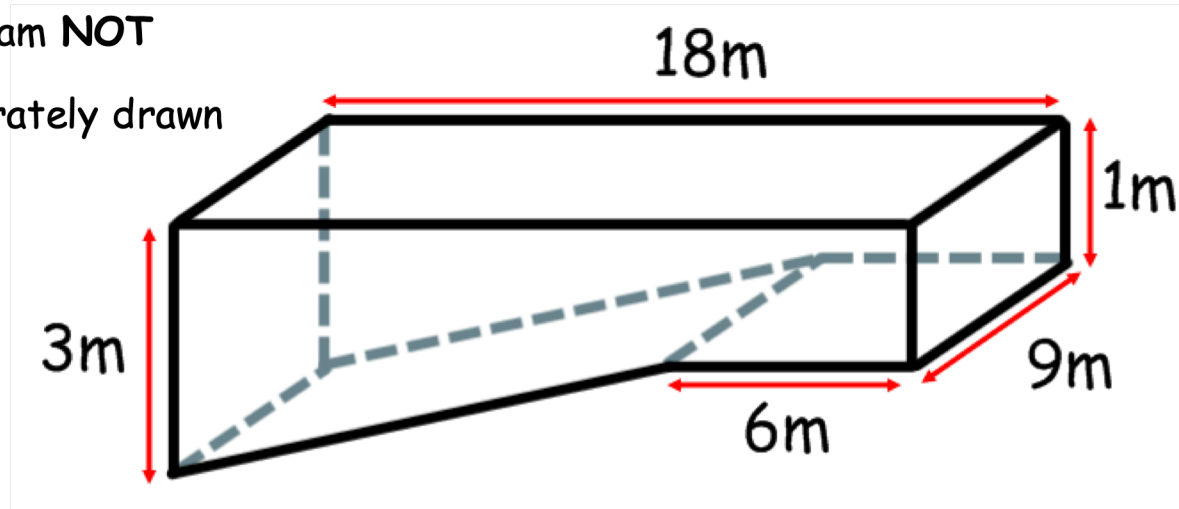
Calculate the rise in the water level.
Give your answer correct to 3 significant figures.

Exam Question

1) James has a swimming pool in the shape of a prism.

Diagram NOT

Accurately drawn



The swimming pool is empty.

It is filled with water at a constant rate.

It takes 4 hours for the water to be 2 meters deep from the deepest point.

a) How long will it take to completely fill the pool?

Give your answer in hours.

($1\text{m}^3 = 1000\text{litres}$)

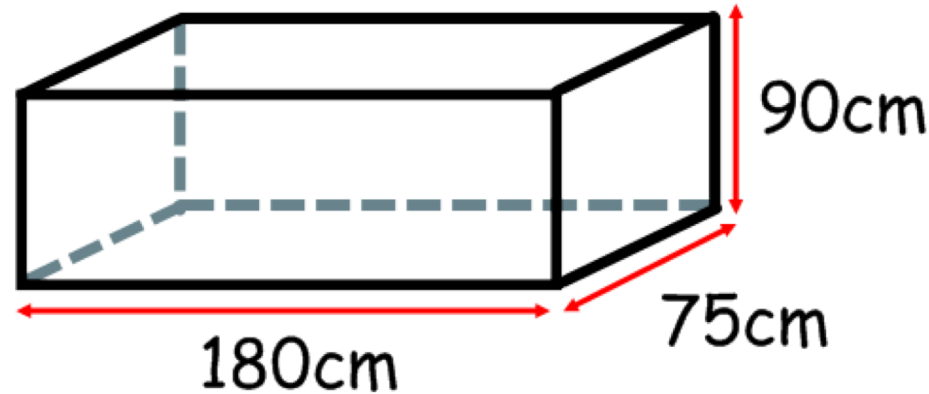
You must show all your working.

Exam Question

2) Abigail has a fish tank in the shape of a cuboid.

Diagram **NOT**

Accurately drawn



The fish tank is filled with water at a constant rate.

It takes 6.35 seconds to fill 1 gallon.

The fish tank is empty.

a) How long will it take to fill the whole tank?

$1\text{cm}^3 = 0.001$ litres

1 gallon = 4.54609 litres

You must show all your working.

Exam Question

3) Sachyham has built a new structure to store grain.

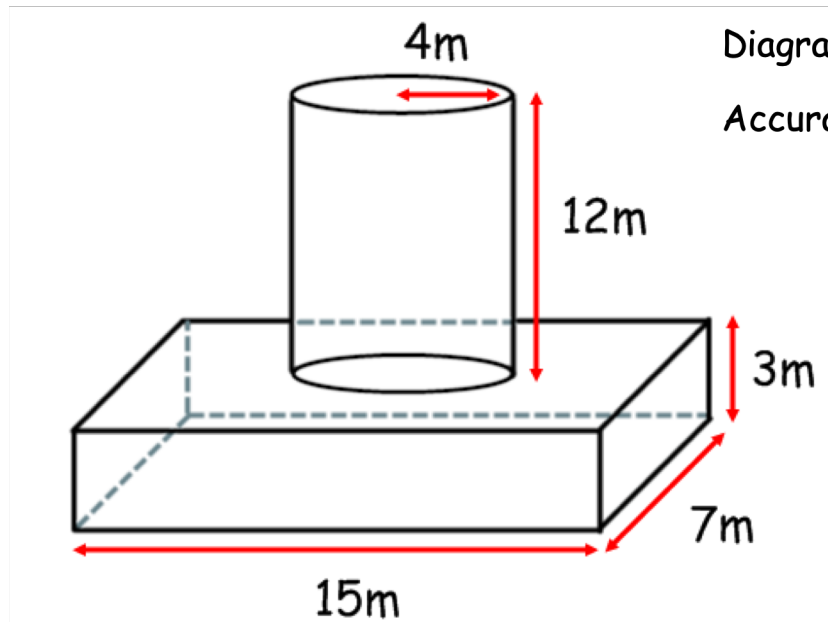


Diagram **NOT**
Accurately drawn

The structure is empty.

The structure fills with grain at a constant rate.

After 3 hours the structure is filled 5 meters above the centre of the base.

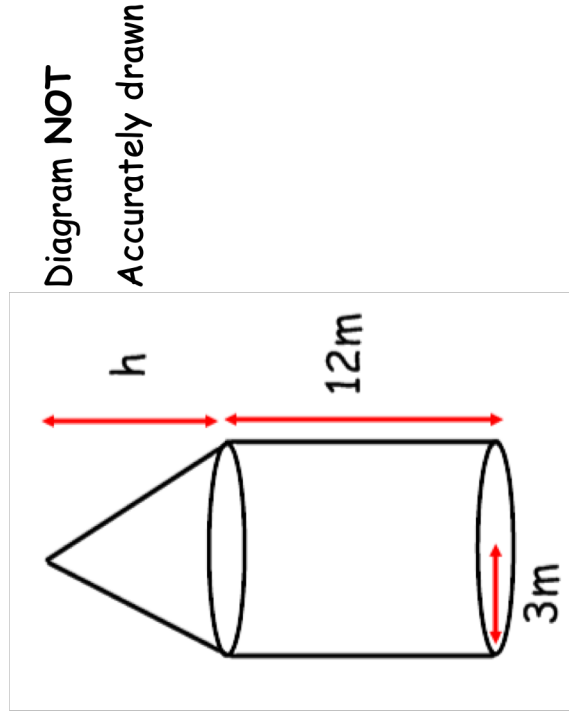
a) How long will it take to fill the structure?

Round your answer to the nearest minute.

You must show all your working.

Exam Question

4) The diagram shows a storage container for flour.



The container is a cone on top of a cylinder.

The cylinder has a radius of 3m and a height of 12m.

The cone has a radius of 3m and a height of h m.

The container is empty.

The container is then filled with flour at a constant rate.

After 3 hours the depth of the flour is 5 meters high.

After 8 hours the container is full of flour.

Work out the value of h .

You must show all your working.

Exam Question

5) The diagram shows a glass water container.

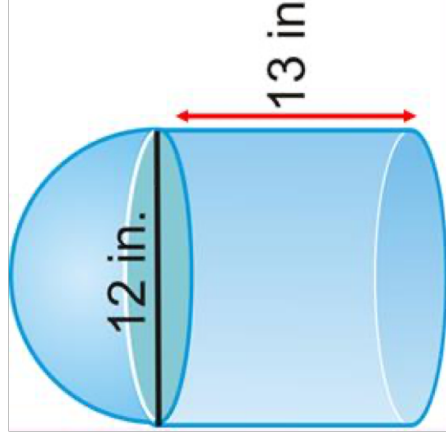


Diagram NOT
Accurately drawn

The container is a hemisphere on top of a cylinder.
The cylinder has a diameter of 12 inches and a height of 13 inches.
The hemisphere has a diameter of 12 inches.

The container is empty.

The container is then filled with water at a constant rate.

After 9 minutes the depth of the water is 7 inches high.
Will the container be full after 21 minutes?

Explain your answer.

You must show all your working.

Exam Question

6) The diagram shows a rocket.

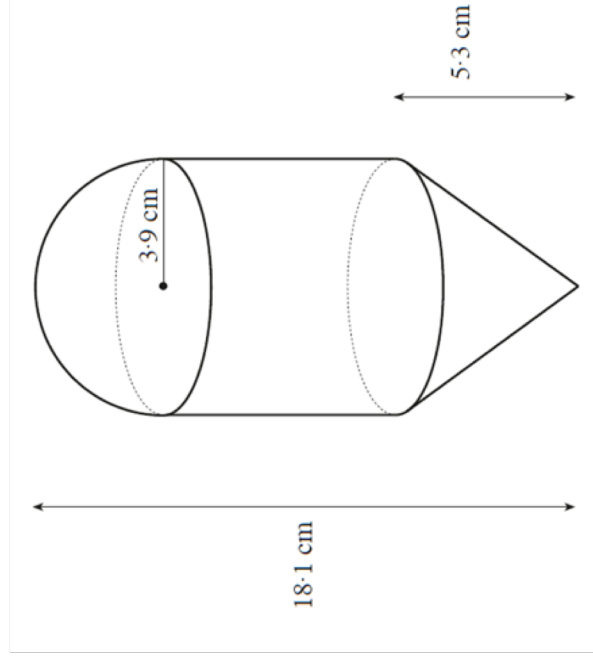


Diagram NOT
Accurately drawn

The rocket is a hemisphere on top of a cylinder on top of a cone.
The hemisphere has a radius of 3.9cm.
The cone has a height of 5.3cm.
The whole rocket has a height of 18.1cm.

The container is empty.

The rocket is then filled to the top with fuel at a constant rate.

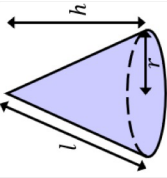
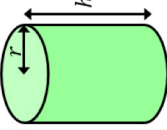
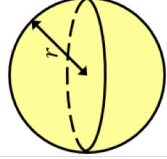
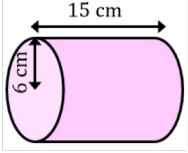
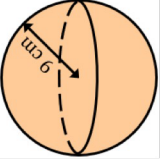
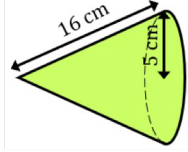
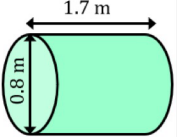
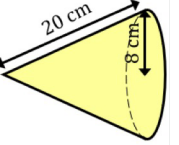
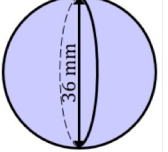
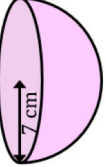
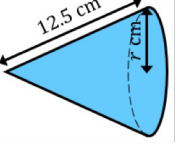
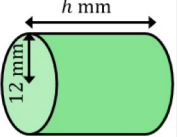
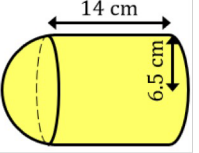
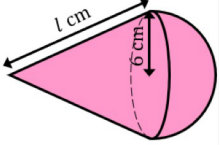
After 15 minutes the depth of the fuel will be 7.7cm above the vertex of the cone.

How long will it take to fill the whole rocket?

Round your answer to the nearest minute.

You must show all your working.

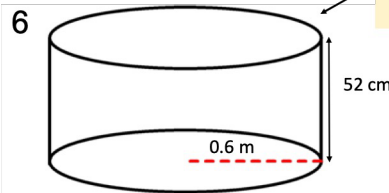
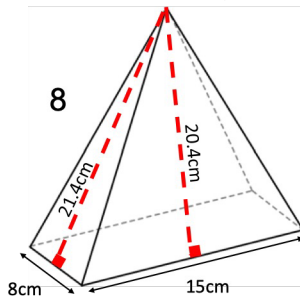
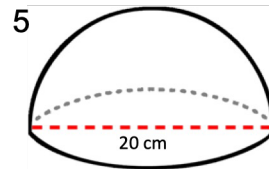
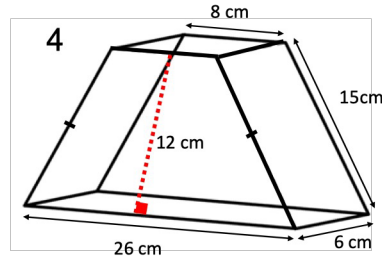
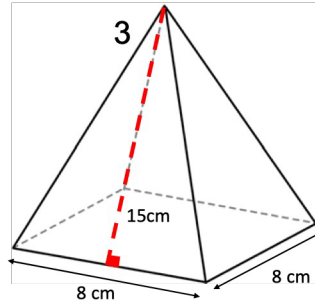
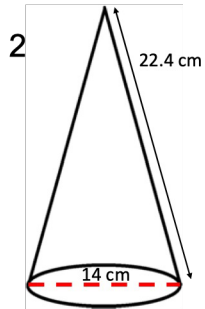
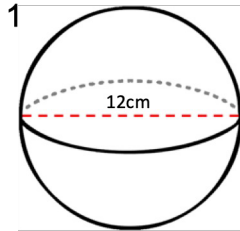
Purposeful Practice

Surface Areas of Cylinders, Cones and Spheres			
 Curved Surface Area of Cone $= \pi r l$	 Curved Surface Area of Cylinder $= 2\pi r h$	 Surface Area of Sphere $= 4\pi r^2$	
(a) Find the curved surface area, giving your answer in terms of π 	(b) Find the surface area, giving your answer to 3 significant figures 	(c) Find the curved surface area giving your answer to the nearest cm^2 	
(d) Find the total surface area, giving your answer to 2 decimal places 	(e) Find the total surface area, giving your answer to the nearest cm^2 	(f) Find the surface area, leaving your answer in terms of π 	
(g) Find the total surface area of the hemisphere, leaving your answer in terms of π 	(h) The cone has a curved surface area of 177 cm^2. Find the radius r to 1 decimal place. 	(i) The total surface area is $744\pi \text{ mm}^2$. Find the height of the cylinder. 	
(j) A shape is made by joining a hemisphere to a cylinder. Both have a radius of 6.5 cm. Find the surface area of the compound shape to the nearest cm^2. 	(k) A shape is made by joining a cone to a hemisphere, where both shapes have the same radius. The total surface area is $246\pi \text{ cm}^2$. Find the slanted height l of the cone. 		

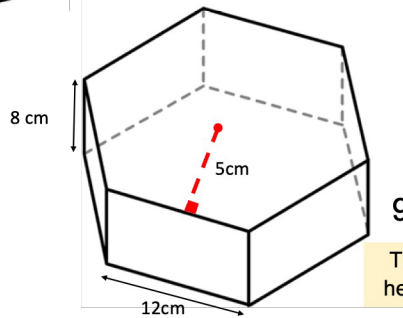
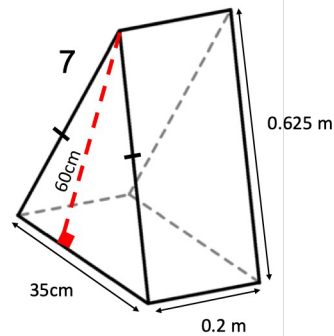
Fluency Practice

SURFACE AREA

Calculate the surface area of these solids.
Match your answers to the ones below. There is one missing answer. Complete this yourself.



Careful! The units are not the same.



This is a regular hexagonal prism.

$$942.5\text{cm}^2$$

$$646.5\text{cm}^2$$

$$5300\text{cm}^2$$

$$452.4\text{cm}^2$$

$$304\text{cm}^2$$

$$42223\text{cm}^2$$

$$936\text{cm}^2$$

$$792\text{cm}^2$$



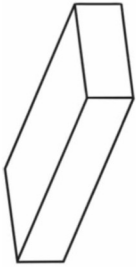
Fluency Practice

Q	Work out the:	Answers
1	Surface area of a cube of side length 5 <i>cm</i>	
2	Volume of a cube of side length 5 <i>cm</i>	
3	Surface area of a cuboid measuring 3 <i>cm</i> by 4 <i>cm</i> by 5 <i>cm</i>	
4	Volume of a cuboid measuring 3 <i>cm</i> by 4 <i>cm</i> by 5 <i>cm</i>	
5	Surface area of a cylinder with a radius of 5 <i>cm</i> and a height of 12 <i>cm</i>	
6	Volume of a cylinder with a radius of 5 <i>cm</i> and a height of 12 <i>cm</i>	
7	Surface area of a cone with a radius of 5 <i>cm</i> and a height of 12 <i>cm</i>	
8	Volume of a cone with a radius of 5 <i>cm</i> and a height of 12 <i>cm</i>	
9	Surface area of a sphere with a radius of 5 <i>cm</i>	
10	Volume of a sphere with a radius of 5 <i>cm</i>	
11	Surface area of a triangular prism. The cross-section of the prism is a right-angled triangle with a base of 5 <i>cm</i> and a perpendicular height of 12 <i>cm</i> . The length of the prism is 4 <i>cm</i> .	
12	Volume of a triangular prism. The cross-section of the prism is a right-angled triangle with a base of 5 <i>cm</i> and a perpendicular height of 12 <i>cm</i> . The depth of the prism is 4 <i>cm</i> .	
13	Surface area of a square-based pyramid. The square base has a side length of 10 <i>cm</i> . The perpendicular height of the pyramid is 12 <i>cm</i>	
14	Surface area of a square-based pyramid. The square base has a side length of 10 <i>cm</i> . The perpendicular height of the pyramid is 12 <i>cm</i>	

Fluency Practice

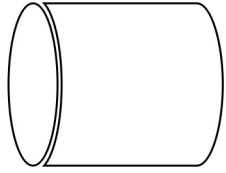
Find the missing value in each question.

①



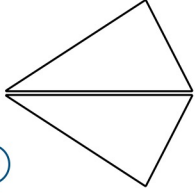
Volume = 800cm^3
Height = ?
Area of Base = 8cm

②



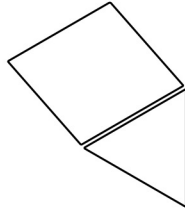
Volume = 1200cm^3
Height = ?
Radius = 8cm

③



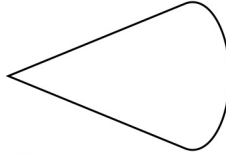
Volume = 1500cm^3
Height = ?
Area of base = 30cm^2

④



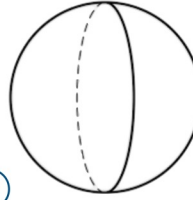
Volume = 2000cm^3
Height = ?
Area of cross-section = 15cm^2

⑤



Volume = 300cm^3
Height = ?
Radius = 4cm

⑥



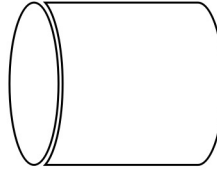
Volume = 800cm^3
Radius = ?

⑦



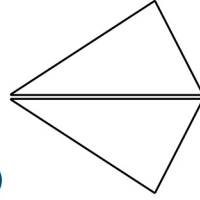
Volume = 1200cm^3
Height = 12cm
Area of Base =

⑧



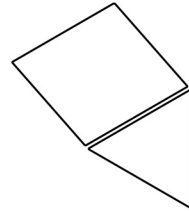
Volume = 900cm^3
Height = 15cm
Radius = ?

⑨



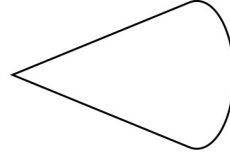
Volume = 600cm^3
Height = 12cm
Area of base = ?

⑩



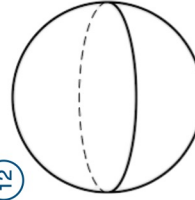
Volume = 3000cm^3
Height = 60cm
Area of cross-section = ?

⑪



Volume = 2000cm^3
Height = 5cm
Radius = ?

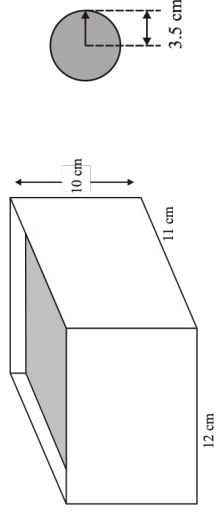
⑫



Volume = 9000cm^3
Diameter = ?

Purposeful Practice

1. A rectangular container is 12 cm long, 11 cm wide and 10 cm high. The container is filled with water to a depth of 8 cm.

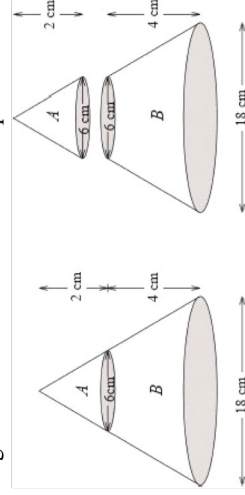


A metal sphere of radius 3.5 cm is placed in the water. It sinks to the bottom.

Calculate the rise in the water level.
Give your answer correct to 3 significant figures.

2. The diagram represents a large cone of height 6 cm and base diameter 18 cm.

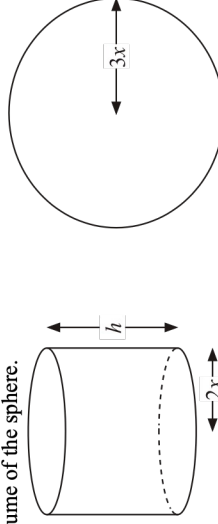
The large cone is made by placing a small cone *A* of height 2 cm and base diameter 6 cm on top of a frustum *B*.



Calculate the volume of the frustum *B*.
Give your answer in terms of π .

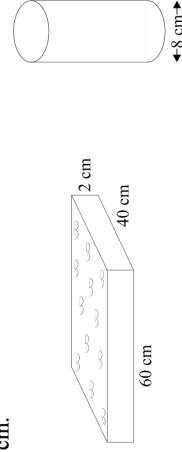
3. The diagram shows a cylinder and a sphere.

The radius of the base of the cylinder is $2x$ cm and the height of the cylinder is h cm.
The radius of the sphere is $3x$ cm.
The volume of the cylinder is equal to the volume of the sphere.



Express h in terms of x .
Give your answer in its simplest form.

4. A rectangular tray has length 60 cm, width 40 cm and depth 2 cm. It is full of water.

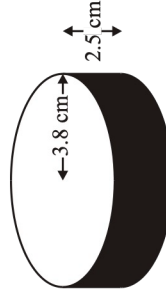


The water is poured into an empty cylinder of diameter 8 cm.

Calculate the depth, in cm, of water in the cylinder.
Give your answer correct to 3 significant figures.

5. An ice hockey puck is in the shape of a cylinder with a radius of 3.8 cm, and a thickness of 2.5 cm.

It is made out of rubber with a density of $1.5 \text{ grams per cm}^3$.

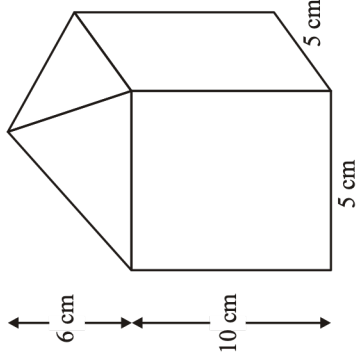


Work out the mass of the ice hockey puck.
Give your answer correct to 3 significant figures.

Purposeful Practice

6.

The diagram shows a model.
The model is a cuboid with a pyramid on top.
The base of the model is a square with sides of length 5 cm.
The height of the cuboid in the model is 10 cm.
The height of the pyramid in the model is 6 cm.



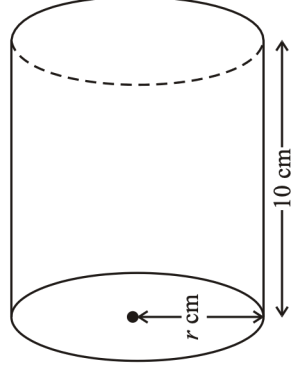
(a) Calculate the volume of the model.

The model represents a concrete post.
The model is built to a scale of 1:30
The surface area of the model is 290 cm^2 .

(b) Calculate the surface area of the post.
Give your answer in square metres.

7.

The diagram shows a cylinder.
The radius of the cylinder is $r \text{ cm}$.
The length of the cylinder is 10 cm.
The volume of the cylinder is 140 cm^3 .



Work out the value of r .
Give your answer correct to 3 significant figures.

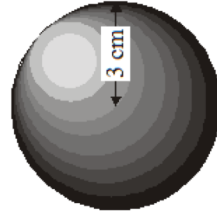
8.

Ben fills a container with boxes.
Each box is a cube of side 0.5 m.

The container is a cuboid of
length 9 m,
width 4 m and
height 3 m.

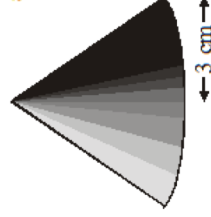
Work out how many boxes will fit exactly into the container.

9.



The radius of a sphere is 3 cm.
The radius of the base of a cone is also 3 cm.
The volume of the sphere is 3 times the volume of the cone.

Diagram NOT
accurately drawn

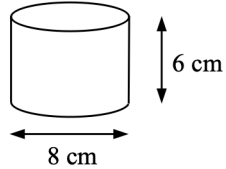


Work out the curved surface area of the cone.
Give your answer as a multiple of π .

Fluency Practice

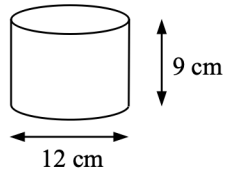
A1

Calculate the **curved** surface area.



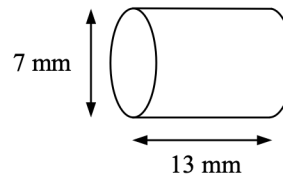
A2

Calculate the volume.



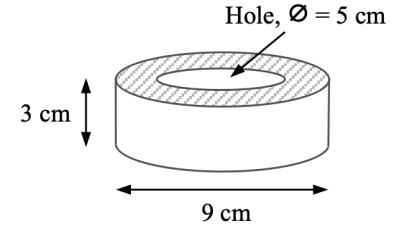
A3

Calculate the **total** surface area.



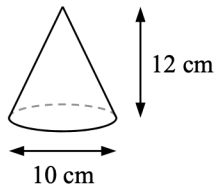
A4

Calculate the volume.



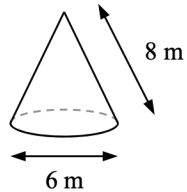
B1

Calculate the volume.



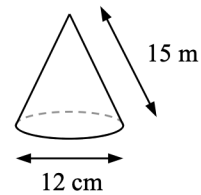
B2

Calculate the **curved** surface area.



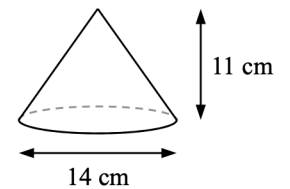
B3

Calculate the volume.



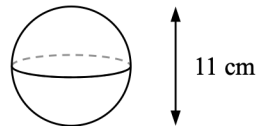
B4

Calculate the **total** surface area.



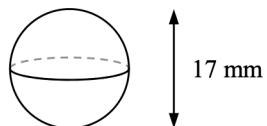
C1

Calculate the surface area.



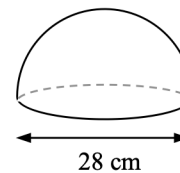
C2

Calculate the volume.



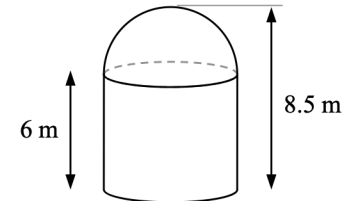
C3

Calculate the **total** surface area of the hemisphere.



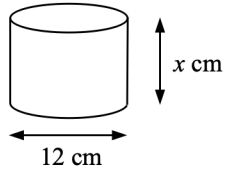
C4

Calculate the **total** surface area.



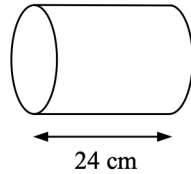
Fluency Practice

A1 Volume is 340 cm^3



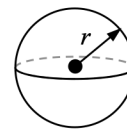
Calculate the height, x .

A2 Volume is 1500 cm^3



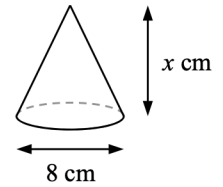
Calculate the radius.

A3 Surface area is 180 cm^2



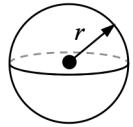
Calculate the radius, r .

A4 Volume is 140 cm^3



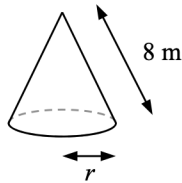
Calculate the height, x .

B1 Volume is 540 cm^3



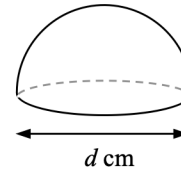
Calculate the radius, r .

B2 Curved surface area is 90 m^2



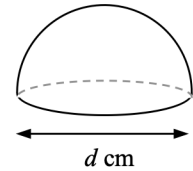
Calculate the radius, r .

B3 Volume is 300 cm^3



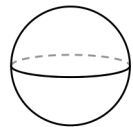
Calculate the diameter, d .

B4 Total surface area is 540 cm^2



Calculate the diameter, d .

C1 Volume is 268 cm^3



Find the surface area.

C2 Volume is 770 cm^3



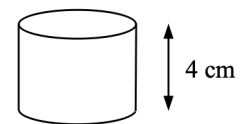
find the **total** surface area.

C3 Volume is 594 cm^3



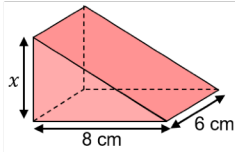
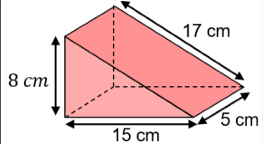
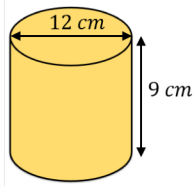
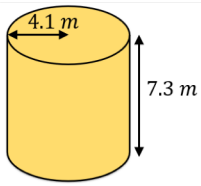
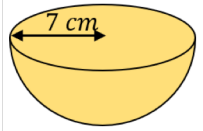
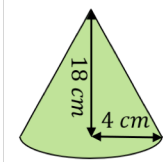
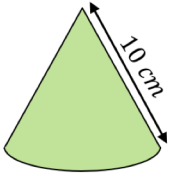
Find the curved surface area.

C4 Total surface area is 100 cm^2



Find the volume.

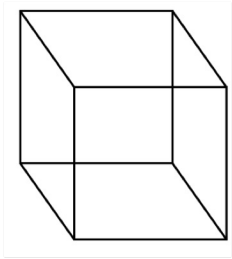
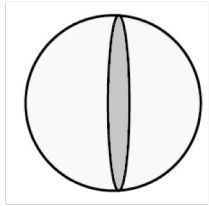
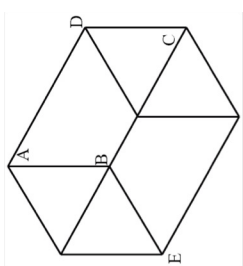
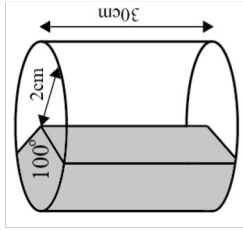
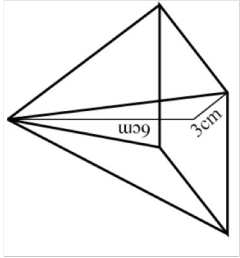
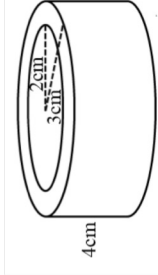
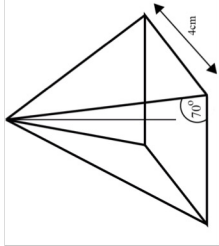
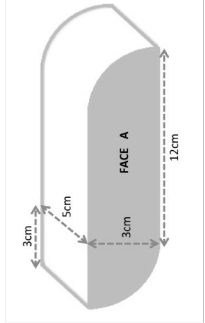
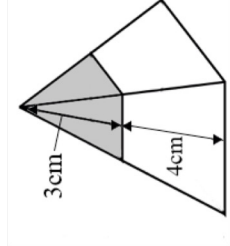
Fluency Practice

Volume and Surface Area Revision			
(a) The volume of a cuboid is 320 cm^3 . Its height is 16 cm and the length is 5 cm . Find the width of the cuboid.	(b) Find the surface area of a cube with side length 8.5 cm .	(c) The volume of the prism is 264 cm^3 . Find x . 	(d) Find the surface area of this prism. 
(e) Find the volume of the cylinder, giving your answer to 3 significant figures. 	(f) Find the total surface area of the cylinder, leaving your answer in terms of π . 	(g) The volume of a sphere is $288\pi \text{ cm}^3$. Find the radius of the sphere.	(h) Find the total surface area of the hemisphere, giving your answer to 3 significant figures. 
(i) Find the volume of the cone, leaving your answer in terms of π . 	(j) A cone has a slanted height of 10 cm and a curved surface area of $60\pi \text{ cm}^2$. Find the volume of the cone, giving your answer to 3 significant figures. 	(k) A cylinder has a height of 16 cm and a radius of $x \text{ cm}$. A sphere has a radius of $2x \text{ cm}$. The volume of the cylinder and the sphere are equal. Find the value of x .	

Purposeful Practice

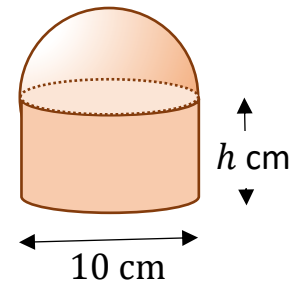
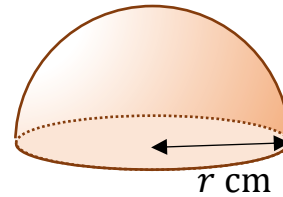
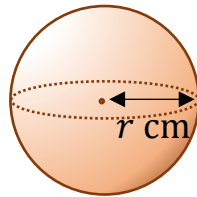
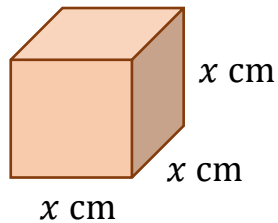
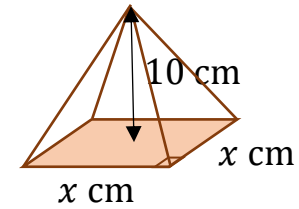
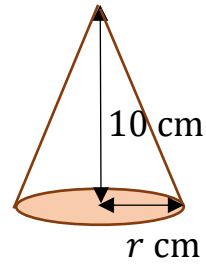
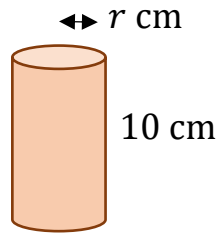
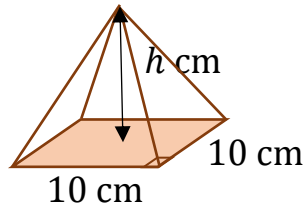
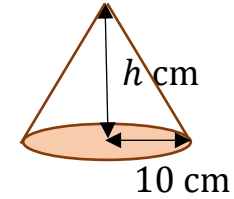
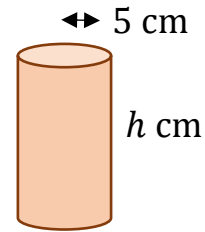
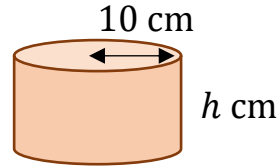
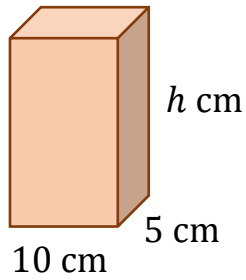
Mixed Volume and Surface Area Problems			
(a)	(b)	(c)	(d)
The surface area of a sphere with radius 10 cm is equal to the curved surface area of a cylinder with the same radius as the sphere and height $h\text{ cm}$. Find the height h .	A cylinder with height $h\text{ cm}$ and radius 6 cm has the same volume as a sphere with radius 9 cm . Find the value of h .	A metal cylinder is to be melted down and turned into spheres with radius 3 cm . The cylinder has a radius of 12 cm and a height of 25 cm . How many whole spheres can be made?	A cone with slanted height 25 cm and radius 8 cm has the same curved surface area as a hemisphere. Find the radius r of the hemisphere.
(e)	(f)	(g)	(h)
A cylinder has a radius r and height $15r$. A sphere has radius $3r$. Find the ratio of the volume of the sphere to the volume of the cylinder in its simplest form.	A hemisphere with radius $2r$ has the same total surface area as a cylinder with radius r . Find the height of the cylinder in terms of r .	A cone has a radius of $\frac{3}{2}x$ and a height of $3x$. A sphere has a radius of kx . The ratio of the volume of the cone to the volume of the sphere is $4 : 1$. Find the value of k as a fraction in its simplest form.	A hemisphere of radius $(r + 2)$ is attached to the base of a cone with radius $(r + 2)$ and slant height $5r$. The total surface area of the compound shape is 273π . Find the volume of the compound shape.

Purposeful Practice

	The cube has volume 125cm^3 Find its surface area.		The shaded circle bisects the sphere. If the circle has area $49\pi\text{cm}^2$ find the surface area of the sphere.
	$BC = 6\text{cm}$ $AC = 3\sqrt{5}\text{ cm}$ $AE = \sqrt{13}\text{ cm}$ Find the surface area of the shape.		Find the surface area of the shaded shape.
	Find the surface area of the square based pyramid		Find the surface area of the hollow tube.
	A quarter of a sphere is shown. If the volume of this shape is $9\pi\text{ cm}^3$ what is its surface area?		Find the surface area of the square-based pyramid.
	Assuming face A has rotational symmetry of order 2, calculate the surface area of the whole 3-D shape.		The tip of the square-based pyramid is painted as shown, using 30cm^2 of paint. If 200cm^2 more paint is needed to cover the entire shape, what is the width of the base?

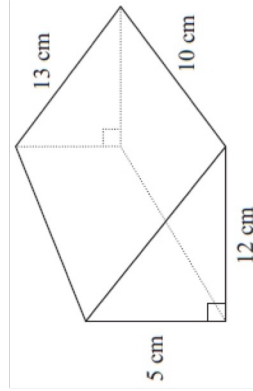
Purposeful Practice

Each of these common 3D shapes has a volume of one litre.
Find the missing length in each case.



Exam Questions

Q1.



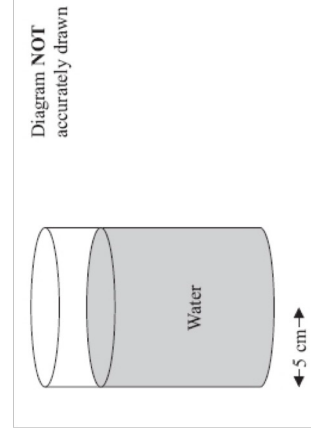
Work out the total surface area of this triangular prism.

Q2. Here is a vase in the shape of a cylinder.

The vase has a radius of 5 cm.

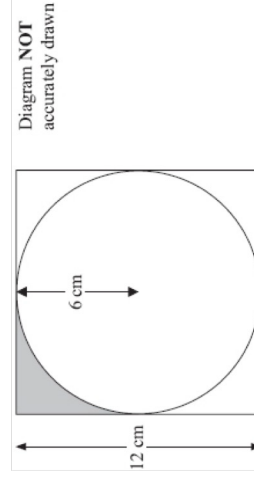
There are 1000 cm^3 of water in the vase.

Work out the depth of the water in the vase.
Give your answer correct to 1 decimal place.



Q3. The diagram shows a circle drawn inside a square.

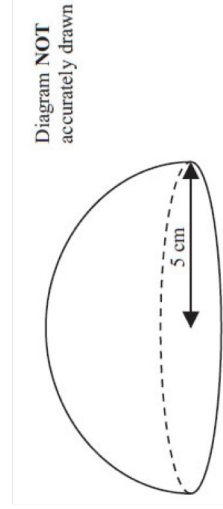
The circle has a radius of 6 cm. The square has a side of length 12 cm. Work out the shaded area. Give your answer in terms of π .



Q4.

The diagram shows a solid hemisphere of radius 5 cm.

Find the **total** surface area of the solid hemisphere.
Give your answer in terms of π .



Exam Questions

Q5.

A frustum is made by removing a small cone from a similar large cone.

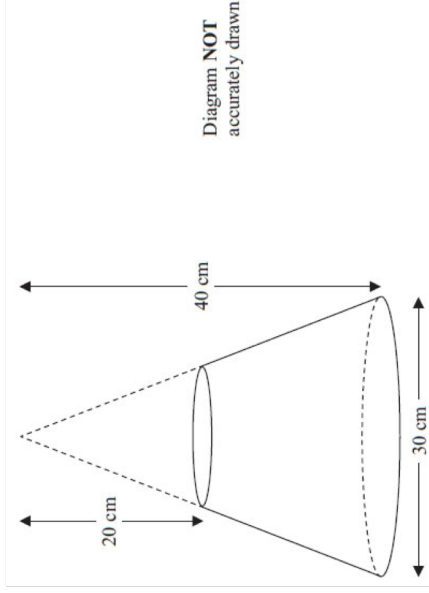
The height of the small cone is 20 cm.

The height of the large cone is 40 cm.

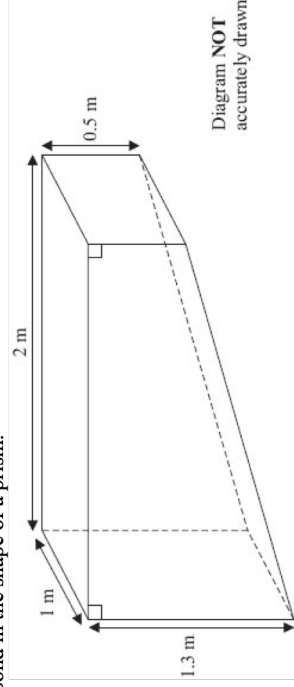
The diameter of the base of the large cone is 30 cm.

Work out the volume of the frustum.

Give your answer correct to 3 significant figures.



Q6. Sumeet has a pond in the shape of a prism.



The pond is completely full of water.

Sumeet wants to empty the pond so he can clean it.

Sumeet uses a pump to empty the pond.

The volume of water in the pond decreases at a constant rate.

The level of the water in the pond goes down by 20 cm in the first 30 minutes.

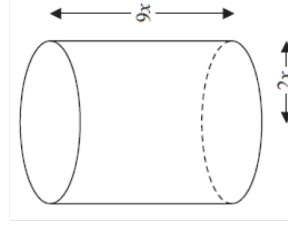
Work out how much more time Sumeet has to wait for the pump to empty the pond completely.

Q7. The diagram shows a solid metal cylinder.

The cylinder has base radius $2x$ and height $9x$.

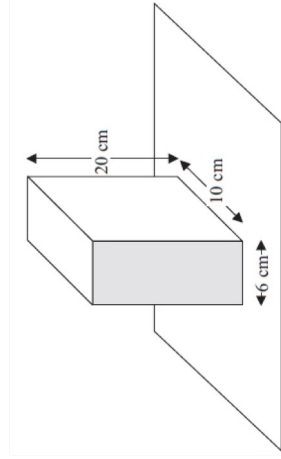
The cylinder is melted down and made into a sphere of radius r .

Find an expression for r in terms of x .



Exam Questions

Q8. Jane has a carton of orange juice.
The carton is in the shape of a cuboid.



The depth of the orange juice in the carton is 8 cm.

Jane closes the carton.

Then she turns the carton over so that it stands on the shaded face.

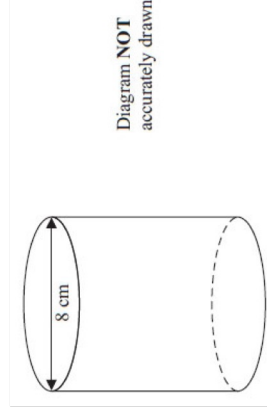
Work out the depth, in cm, of the orange juice now.

Q9. Ella is designing a glass in the shape of a cylinder.

The glass must hold a minimum of $\frac{1}{2}$ litre of liquid.

The glass must have a diameter of 8 cm.

Calculate the minimum height of the glass.



Q10. * The diagram shows the triangle PQR .

$$PQ = x \text{ cm}$$

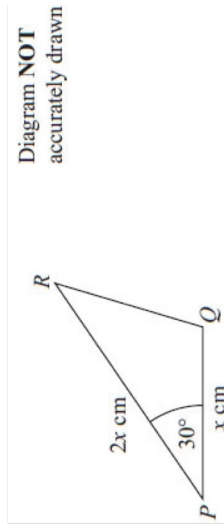
$$PR = 2x \text{ cm}$$

$$\text{Angle } QPR = 30^\circ$$

$$\text{The area of triangle } PQR = A \text{ cm}^2$$

$$\sqrt{2A}$$

Show that $x =$



Q11.

The diagram shows a pyramid.

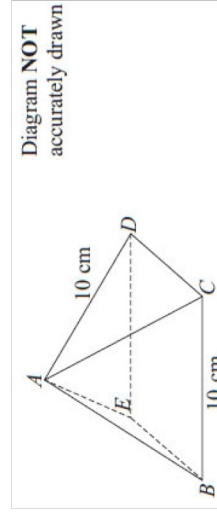
$BCDE$ is a square with sides of length 10 cm.

The other faces of the pyramid are equilateral triangles with sides of length 10 cm.

(a) Calculate the volume of the pyramid.

Give your answer correct to 3 significant figures.

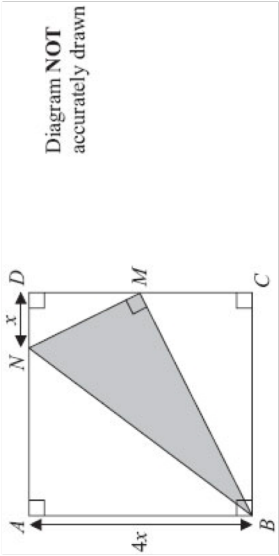
(b) Find the size of angle DAB .



Exam Questions

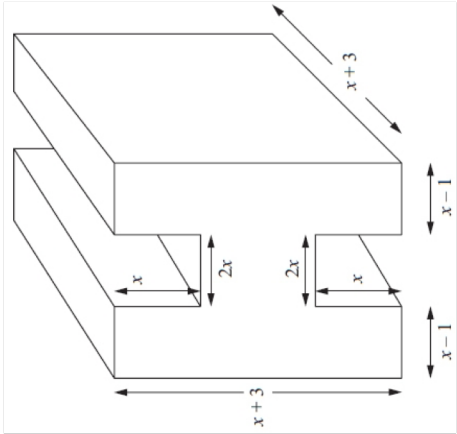
Q12.

$ABCD$ is a square with a side length of $4x$
 M is the midpoint of DC .
 N is the point on AD where $ND = x$
 BMN is a right-angled triangle.
 Find an expression, in terms of x , for the area of triangle BMN .
 Give your expression in its simplest form.

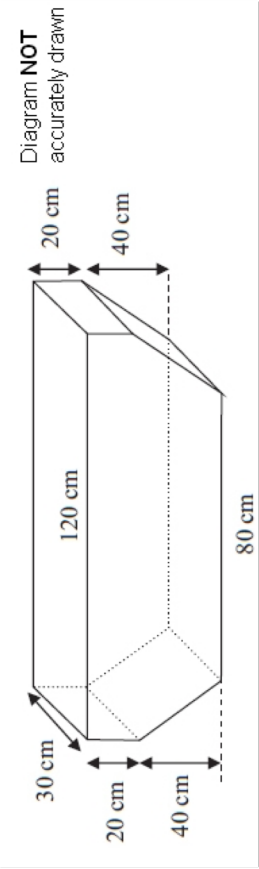


Q13.

The diagram shows a prism.
 All measurements are in cm.
 All corners are right angles.
 The volume of the prism is $V \text{ cm}^3$.
 Find a formula for V .



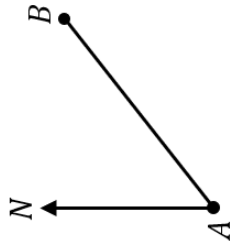
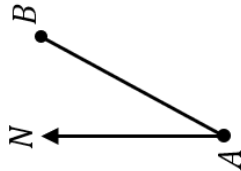
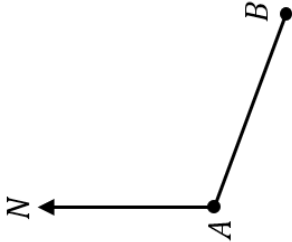
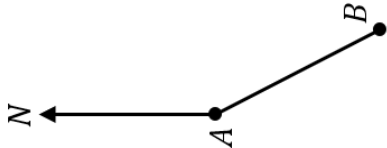
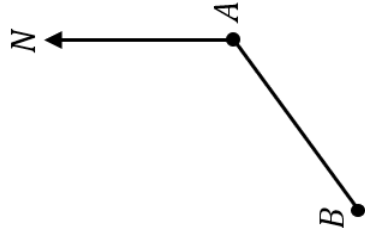
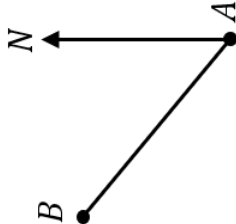
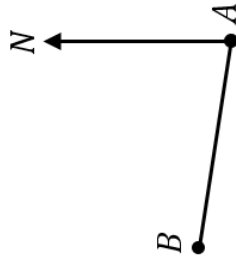
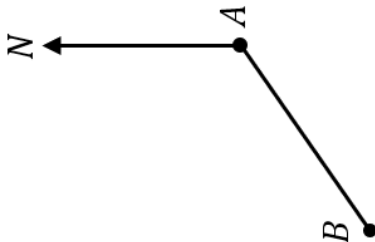
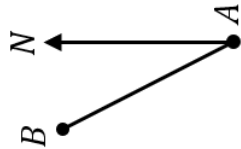
Q14. A water trough is in the shape of a prism.



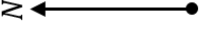
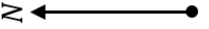
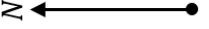
Hamish fills the trough completely.
 Water leaks from the bottom of the trough at a constant rate.
 2 hours later, the level of the water has fallen by 20 cm.
 Water continues to leak from the trough at the same rate.
 How many more minutes will it take for the trough to empty completely?

4 Bearings

Fluency Practice

Measuring Bearings			
For each question, find the bearings of B from A:			
(a)			
(d)			
(g)			

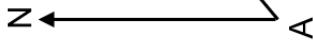
Fluency Practice

Drawing Bearings		
For each question, draw a line on the bearing given:		
(a)	(b)	(c)
085° 	040° 	115° 
(d)	(e)	(f)
155° 	200° 	310° 
(g)	(h)	(i)
262° 	148° 	327° 

Fluency Practice

Measure the bearing of B from A.

(a)



(b)



(c)



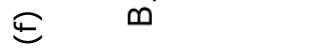
(d)



(e)



(f)



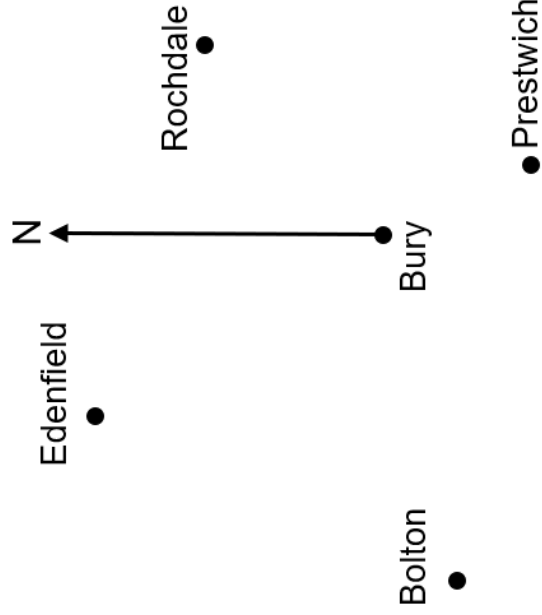
Draw the following bearings:

- (a) A point B on a bearing of 135° from A
- (b) A point B on a bearing of 080° from A
- (c) A point B on a bearing of 162° from A

Draw the following bearings:

- (a) A point B on a bearing of 300° from A
- (b) A point B on a bearing of 205° from A
- (c) A point B on a bearing of 330° from A

Fluency Practice



Using a scale of 1 cm to 2 km, find the distance and bearings of the following:

- (a) Rochdale from Bury
- (b) Prestwich from Bury
- (c) Edenfield from Bury
- (d) Bolton from Bury

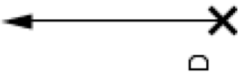
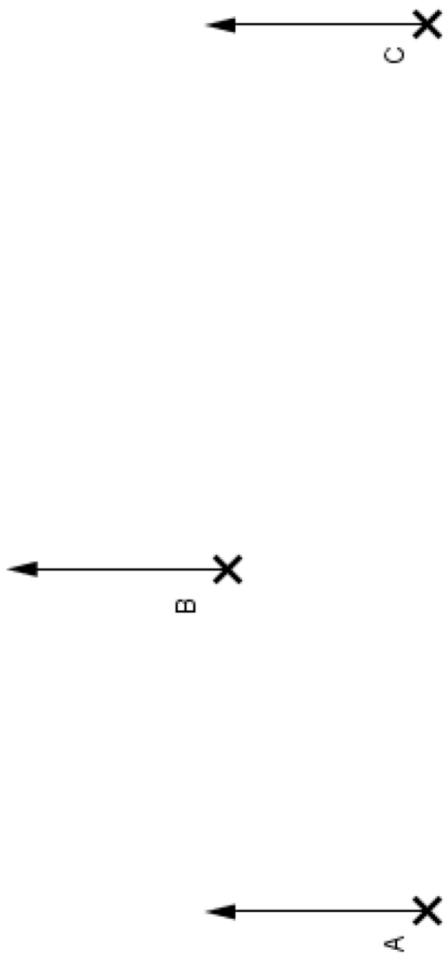
Using the same scale diagram, find the bearing of:

- (a) Bury from Edenfield
- (b) Bury from Rochdale

A ship sails from a port on a bearing of 100° for 50 km. It then turns and sails on a bearing of 240° for 80 km. Using a scale of 1 cm to 10 km, draw a scale diagram. Find the distance of the ship from the port, and the bearing it must head on to return to the port.

- (a) The bearing of B from A is 110° . Find the bearing of A from B.
- (b) The bearing of B from A is x° . Find the bearing of A from B.

Fluency Practice



Find the bearing of...

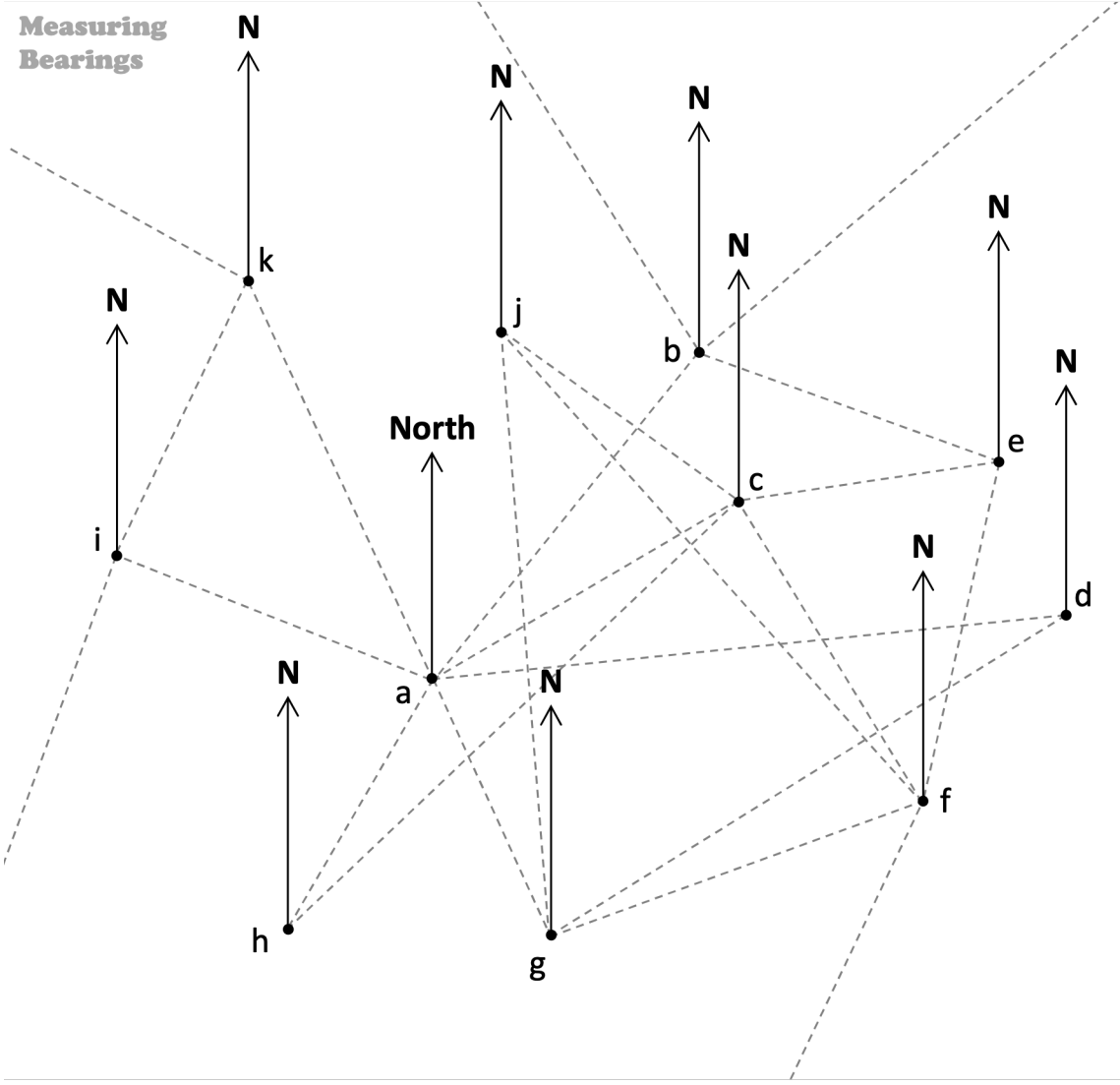
B from A:	
C from A:	
D from A:	
A from B:	
C from B:	
D from B:	
A from C:	
B from C:	
D from C:	
A from D:	
B from D:	
C from D:	

What do you notice about opposite pairs of bearings?
(eg B from A and A from B)

Why do you think this might be?

Fluency Practice

Measuring Bearings



Complete this table:
(try to be accurate to within 5°)

	Bearing
a to b	
a to c	
a to d	
c to f	
a to g	
a to h	
f to g	
a to i	
c to j	
f to j	
k to a	
k from a	
i from k	
c from e	
e from f	
g from d	
h from c	

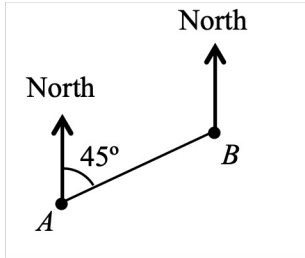
Point X is on a bearing of 050° from b,
and a bearing of 330° from e.
Mark the position of point X.

Point Y is on a bearing of 215° from e,
and a bearing of 115° from a.
Mark the position of point Y.

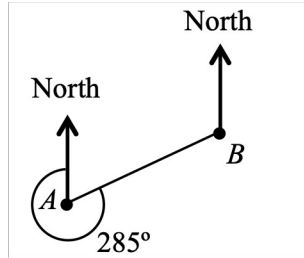
Point Z is on a bearing of 282° from h,
and a bearing of 187° from i.
Find the bearing of Z from point j.

Fluency Practice

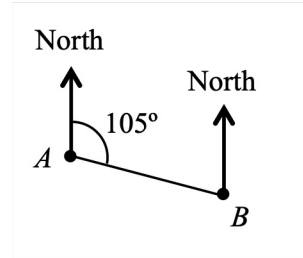
A1 Find the bearing of B from A



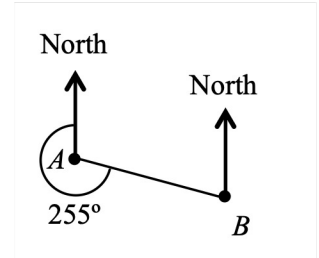
A2 Find the bearing of B from A



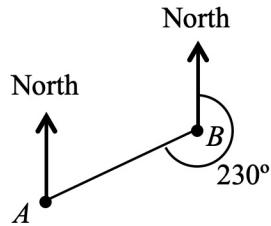
A3 Find the bearing of B from A



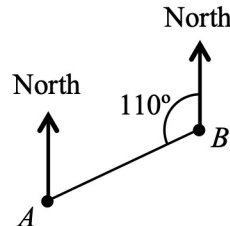
A4 Find the bearing of B from A



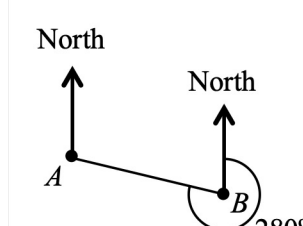
B1 Find the bearing of A from B



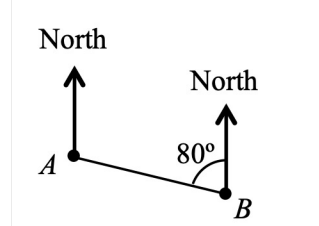
B2 Find the bearing of A from B



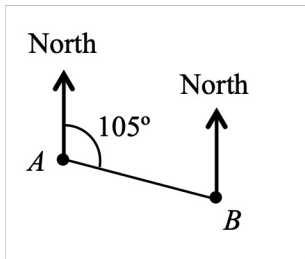
B3 Find the bearing of A from B



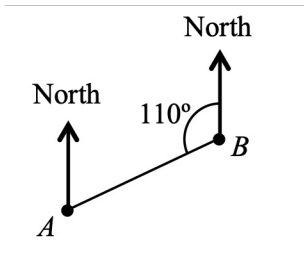
B4 Find the bearing of A from B



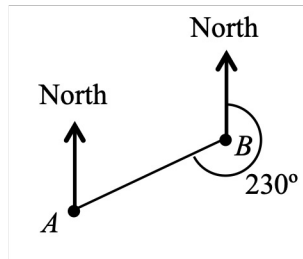
C1 Find the bearing of A from B



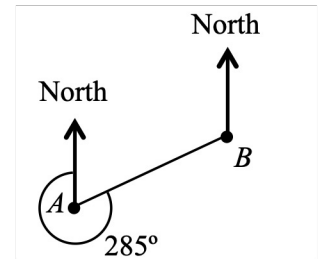
C2 Find the bearing of B from A



C3 Find the bearing of B from A

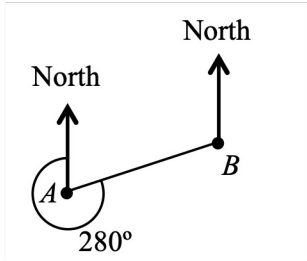


C4 Find the bearing of A from B

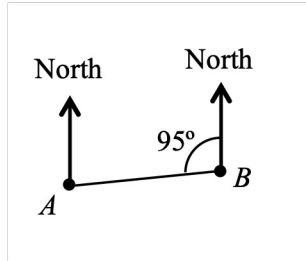


Fluency Practice

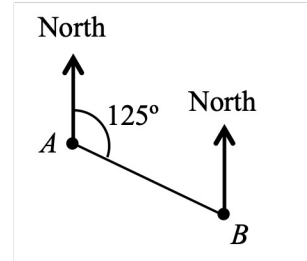
A1 Find the bearing of A from B



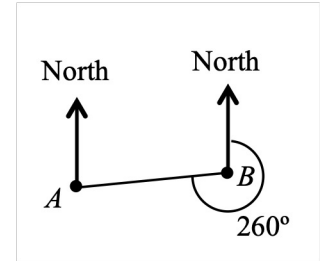
A2 Find the bearing of A from B



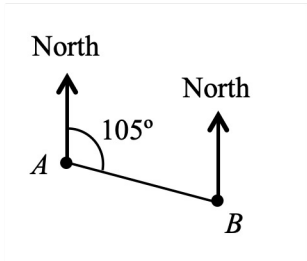
A3 Find the bearing of B from A



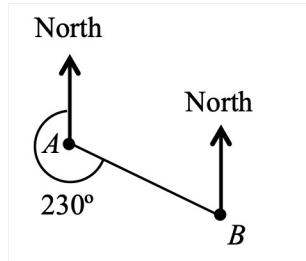
A4 Find the bearing of B from A



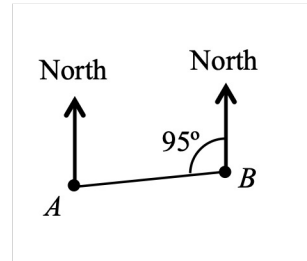
B1 Find the bearing of B from A



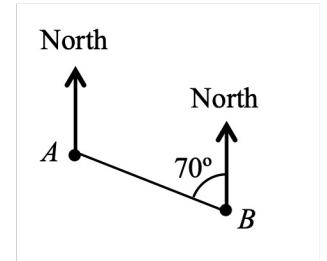
B2 Find the bearing of A from B



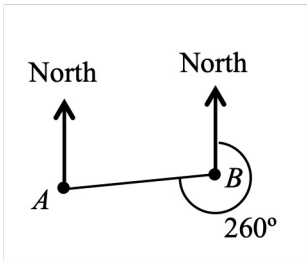
B3 Find the bearing of B from A



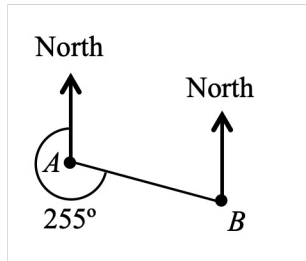
B4 Find the bearing of A from B



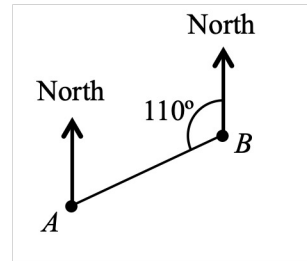
C1 Find the bearing of A from B



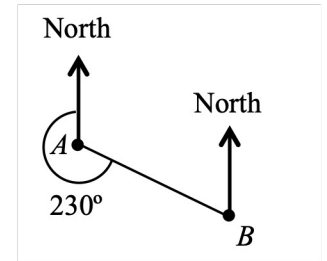
C2 Find the bearing of B from A



C3 Find the bearing of A from B

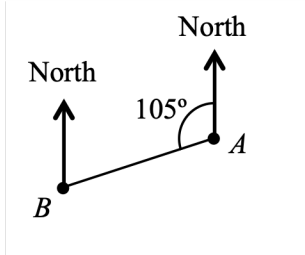


C4 Find the bearing of B from A

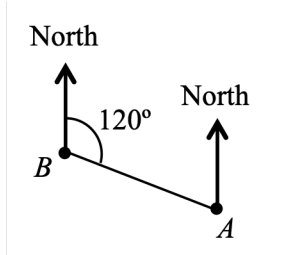


Fluency Practice

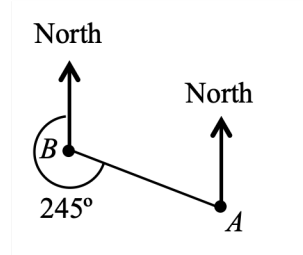
A1 Find the bearing of B from A



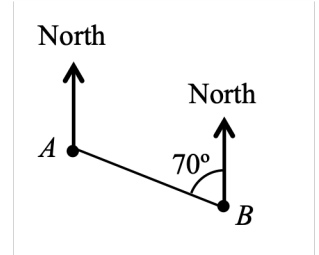
A2 Find the bearing of B from A



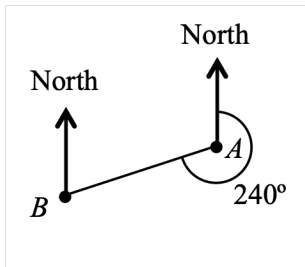
A3 Find the bearing of A from B



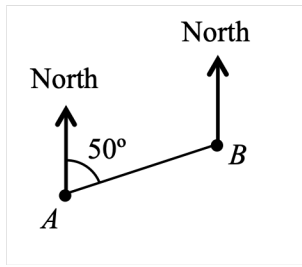
A4 Find the bearing of A from B



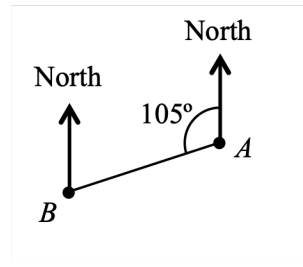
B1 Find the bearing of A from B



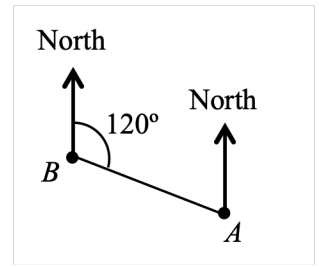
B2 Find the bearing of B from A



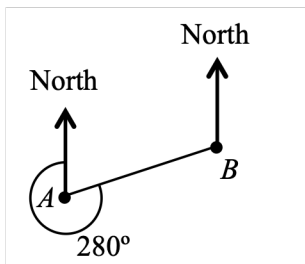
B3 Find the bearing of A from B



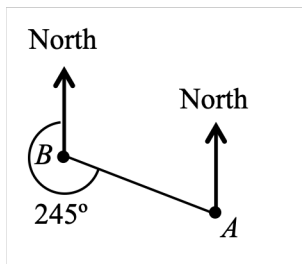
B4 Find the bearing of B from A



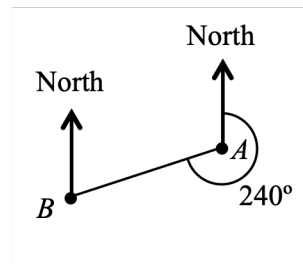
C1 Find the bearing of A from B



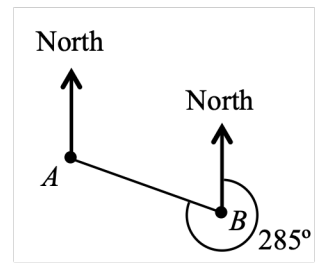
C2 Find the bearing of B from A



C3 Find the bearing of B from A

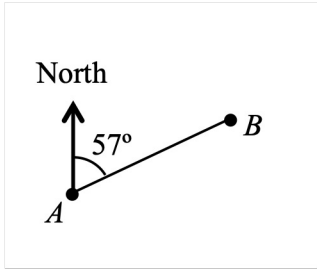


C4 Find the bearing of B from A

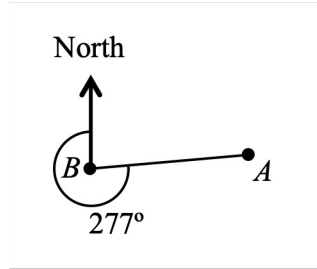


Fluency Practice

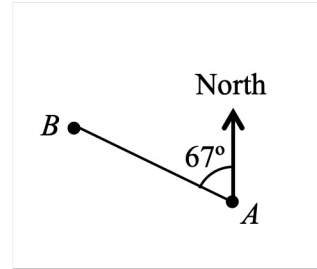
A1 Find the bearing of A from B



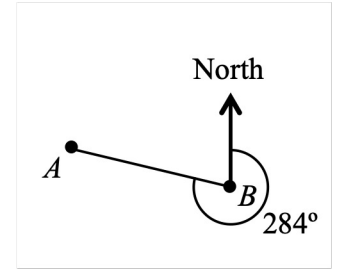
A2 Find the bearing of A from B



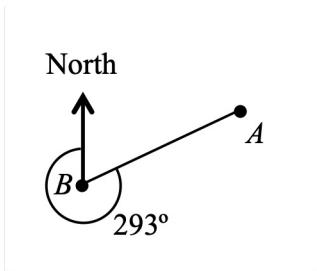
A3 Find the bearing of B from A



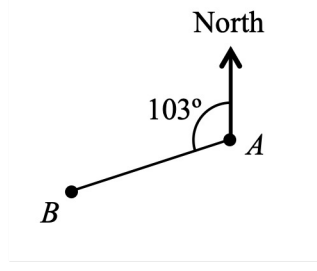
A4 Find the bearing of B from A



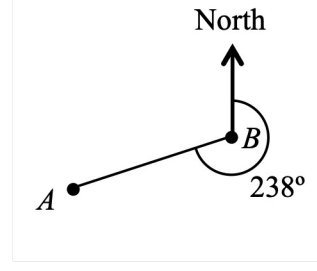
B1 Find the bearing of B from A



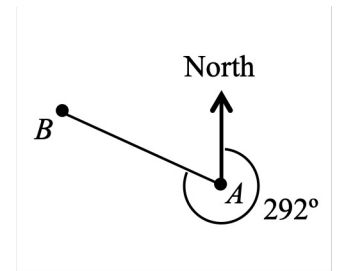
B2 Find the bearing of B from A



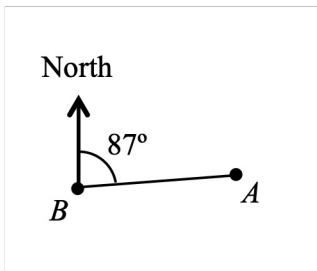
B3 Find the bearing of A from B



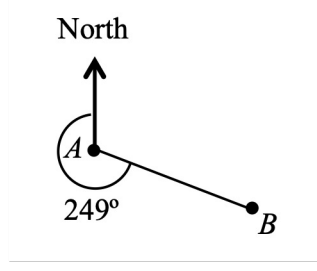
B4 Find the bearing of A from B



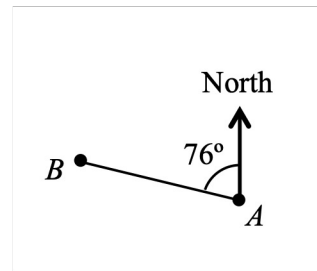
C1 Find the bearing of A from B



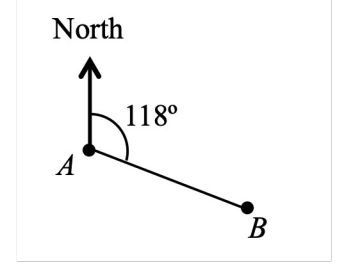
C2 Find the bearing of B from A



C3 Find the bearing of A from B

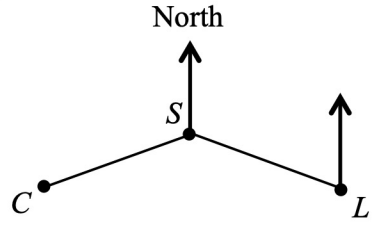


C4 Find the bearing of A from B

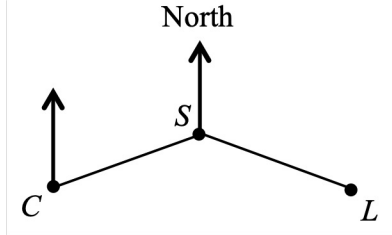


Fluency Practice

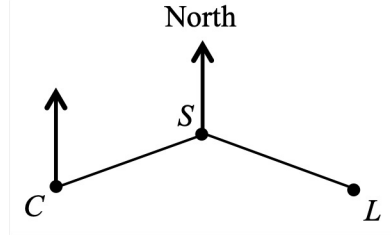
A1 The bearing of S from L is 285° .
Find the bearing of L from S



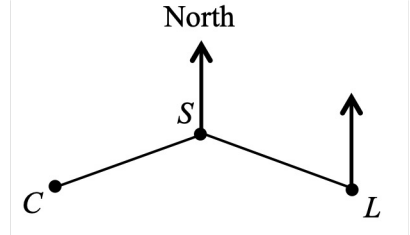
A2 The bearing of S from C is 76° .
Find the bearing of C from S



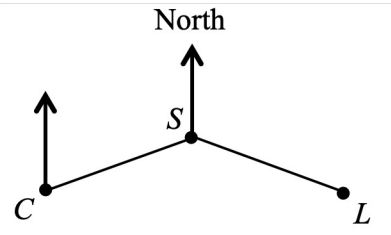
A3 The bearing of L from S is 118° .
Find the bearing of S from L



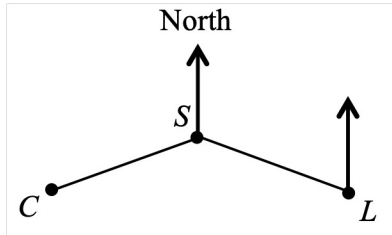
A4 The bearing of C from S is 252° .
Find the bearing of S from C



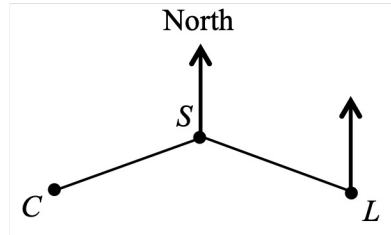
B1 The bearing of S from C is 68° .
Find the bearing of C from S



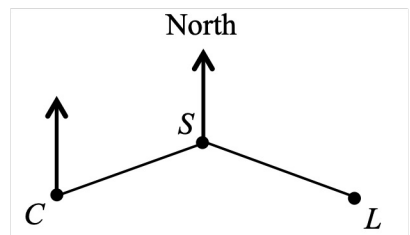
B2 The bearing of L from S is 106° .
Find the bearing of S from L



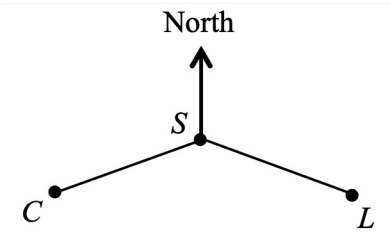
B3 The bearing of S from L is 289° .
Find the bearing of L from S



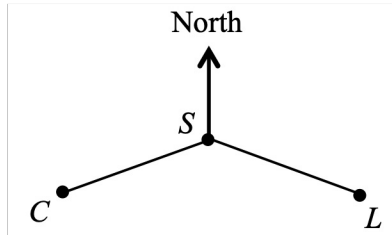
B4 The bearing of C from S is 258° .
Find the bearing of S from C



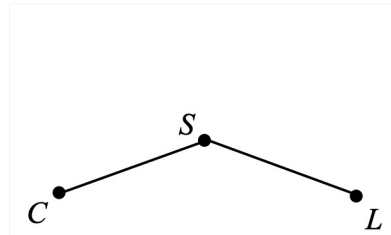
C1 The bearing of S from L is 294° .
Find the bearing of L from S



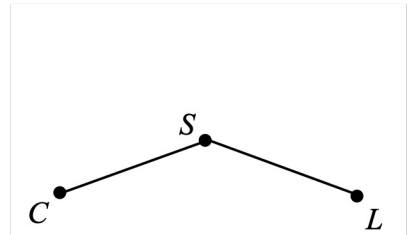
C2 The bearing of C from S is 248° .
Find the bearing of S from C



C3 The bearing of S from L is 289° .
Find the bearing of L from S



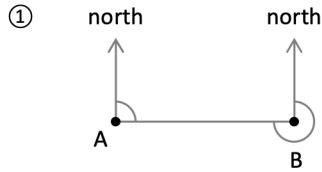
C4 The bearing of C from S is 241° .
Find the bearing of S from C



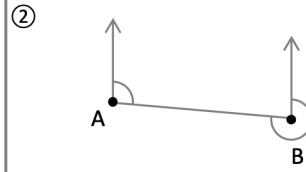
Fluency Practice

Calculating Bearings

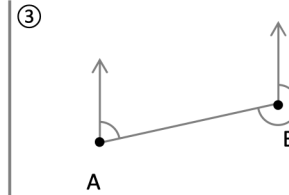
How can you label the diagrams to help?



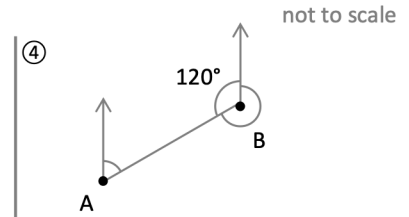
A to B = 090° B to A =



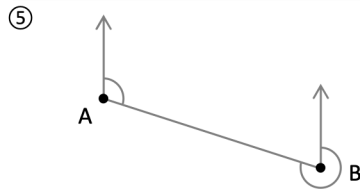
A to B = 100° B to A =



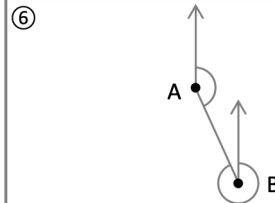
A to B = 080° B to A =



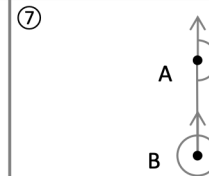
A to B = B to A =



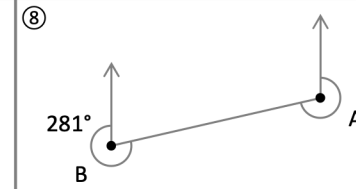
A to B = 112° B to A =



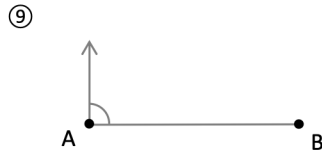
B to A = 340° A to B = °



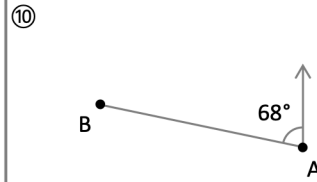
A to B = 180° B to A =



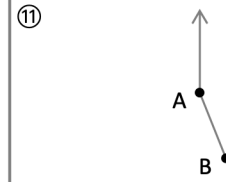
A to B = B to A =



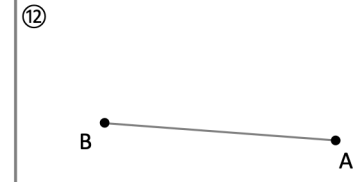
A to B = 089° A from B =



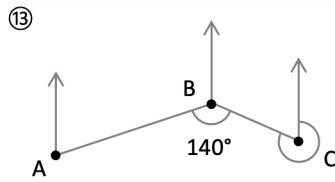
A to B = A from B =



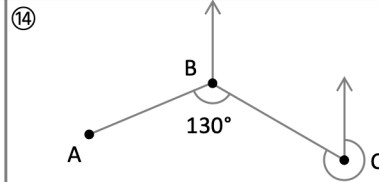
B from A = 163° B to A =



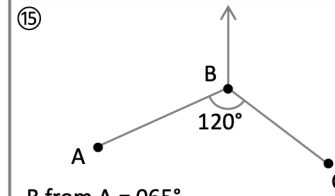
A to B = 272° A from B =



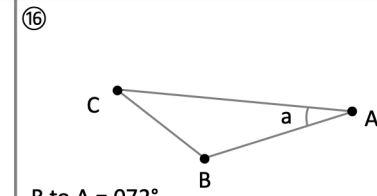
C to B = 290° B to A =



B from C = 305° A to B =



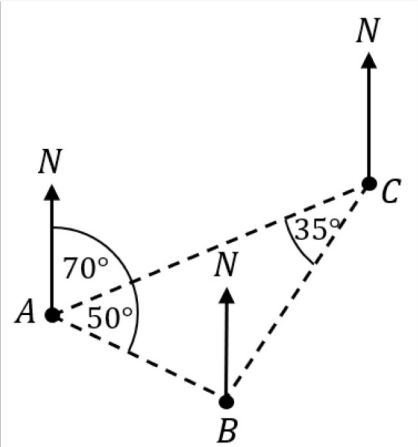
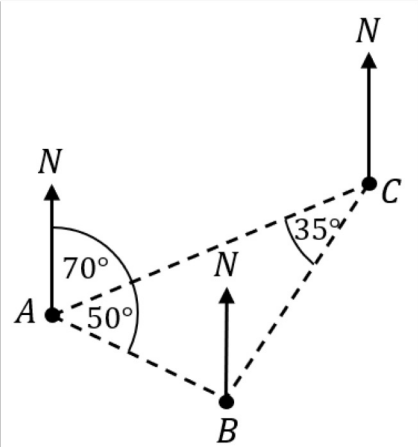
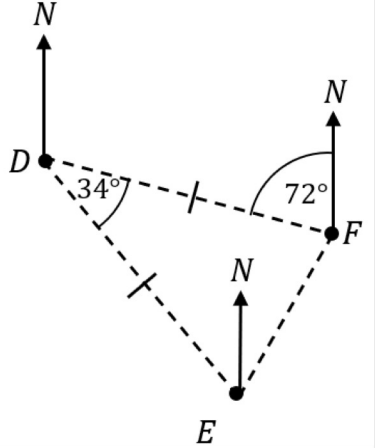
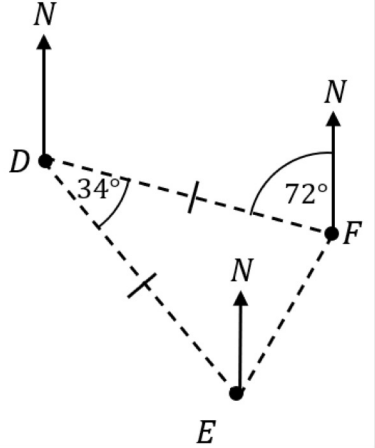
B from A = 065°
B to C = B from C =



B to A = 072°
A from C = 094° Angle a =

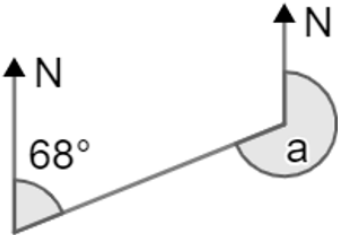
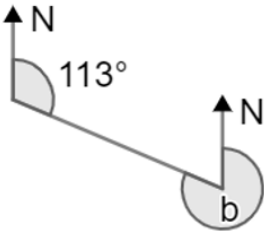
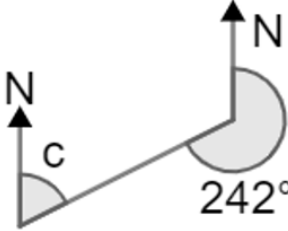
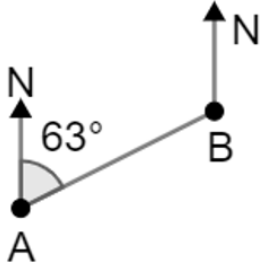
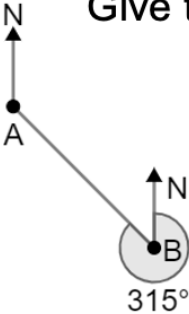
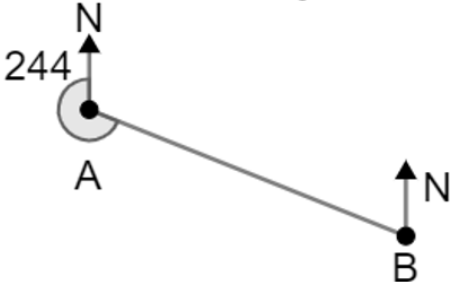
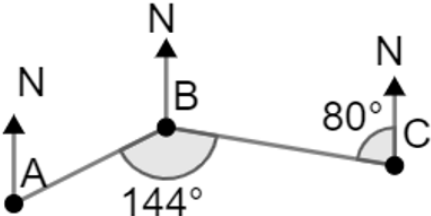
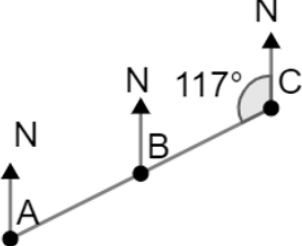
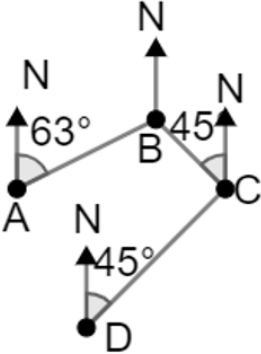
15 Answers	000°	160°	260°	292°	075°	079°	292°	060°
	280°	269°	250°	240°	259°	270°	112°	

Fluency Practice

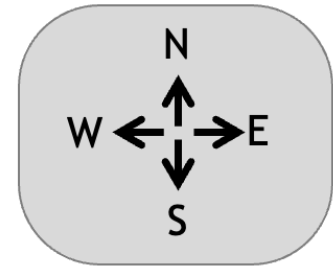
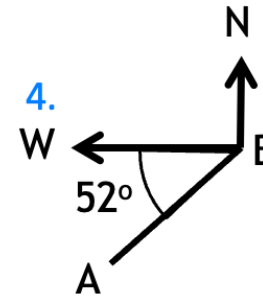
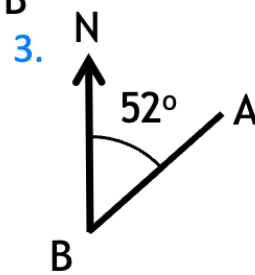
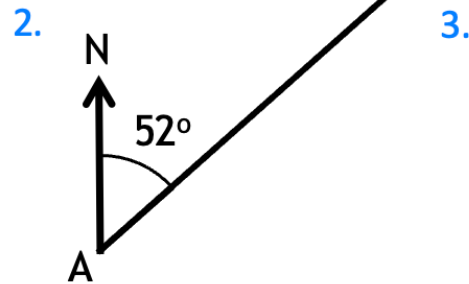
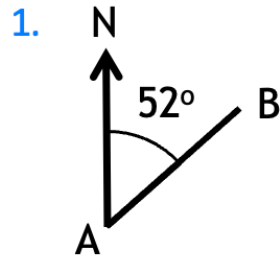
Calculating Bearings			
Diagram NOT drawn to scale 	(a)	(b)	(c)
	Find the bearing of C from A	Find the bearing of B from A	Find the bearing of A from C
Diagram NOT drawn to scale 	(d)	(e)	(f)
	Find the bearing of C from B	Find the bearing of A from B	Find the bearing of B from C
Diagram NOT drawn to scale 	(g)	(h)	(i)
	Find the bearing of D from F	Find the bearing of F from D	Find the bearing of E from D
Diagram NOT drawn to scale 	(j)	(k)	(l)
	Find the bearing of E from F	Find the bearing of D from E	Find the bearing of F from E

Fluency Practice

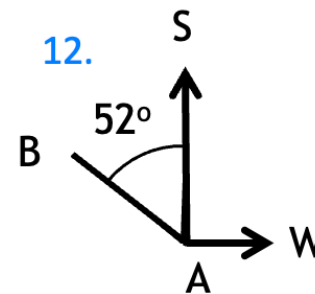
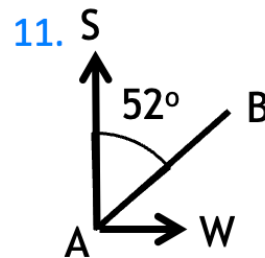
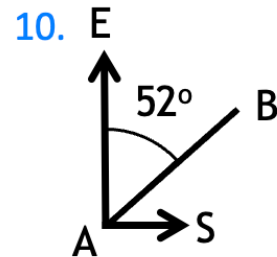
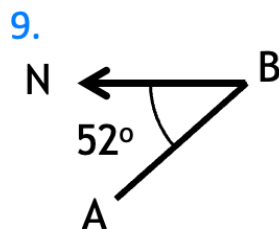
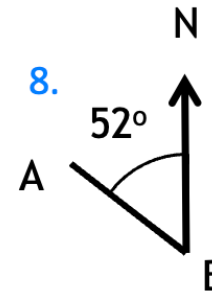
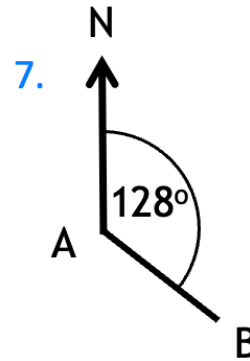
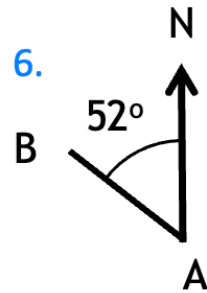
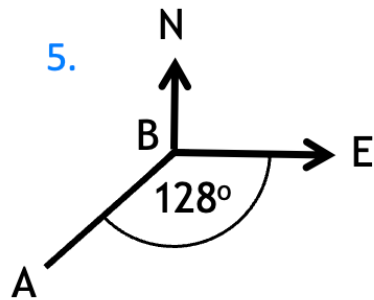
Work out the bearings

		
Give the bearing to A from B 	Give the bearing to B from A 	Give the bearing to A from B 
Give the bearing of B from A 	AC is straight line. Give the bearing of B from A 	What is the bearing of D from C? 

Intelligent Practice



Each question contains point A, point B and directions indicated with an arrow.



In each case, find the bearing of B from A.

Fluency Practice

With words

1) The bearing from A to B is 060° . What is the bearing to A from B?

2) The bearing from C to D is 100° . What is the bearing to C from D?

3) E is on a bearing of 300° from F. What is the bearing of F from E?

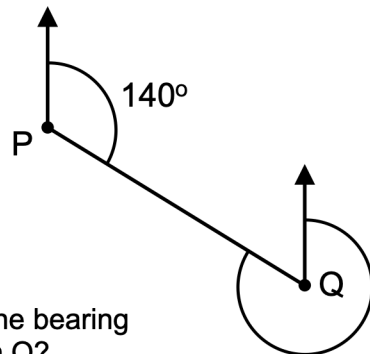
4) G is southwest from H? What bearing is H from G?

5) A boat is equidistant from two lighthouses. It is on a bearing of 80° from lighthouse A and a bearing of 300° from light house B. What is the bearing from lighthouse A to lighthouse B?

Fluency Practice

the bearing of P from Q and the bearing of Q from P

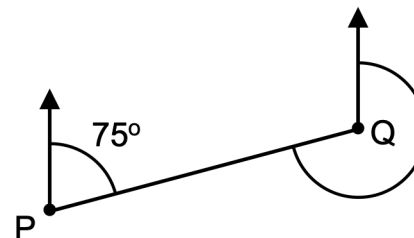
(1)



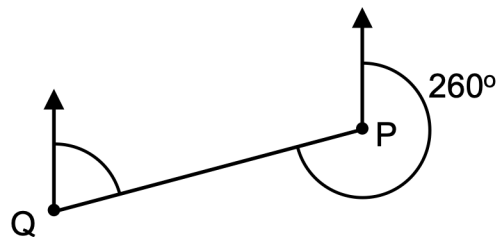
what is the bearing
of P from Q?

(2)

what is the bearing
of P from Q?



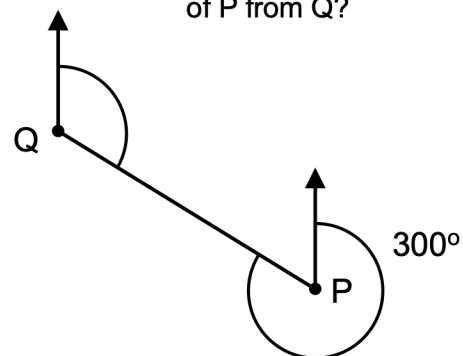
(3)



what is the bearing
of P from Q?

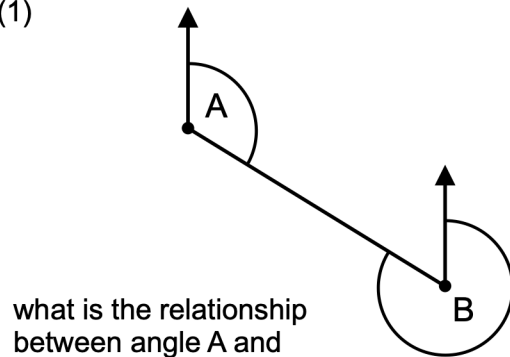
(4)

what is the bearing
of P from Q?



Fluency Practice

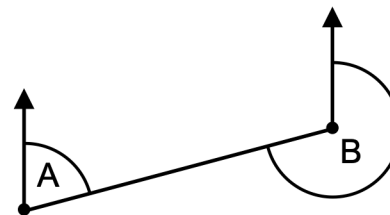
(1)



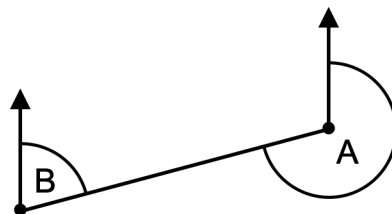
what is the relationship
between angle A and
angle B ?

(2)

what is the relationship
between angle A and
angle B ?

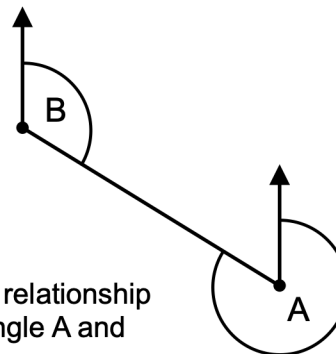


(3)



what is the relationship
between angle A and
angle B ?

(4)

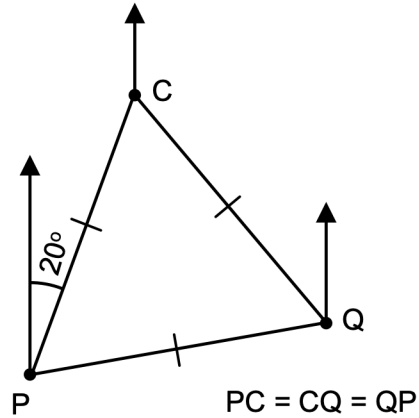


what is the relationship
between angle A and
angle B ?

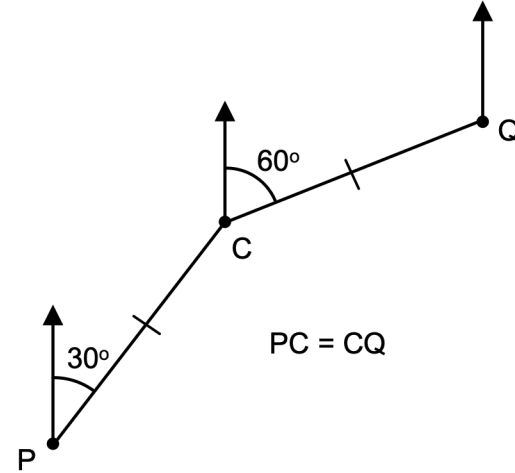
Fluency Practice

what is the bearing of Q from P?

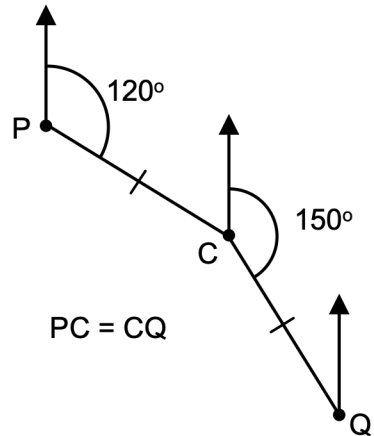
(1)



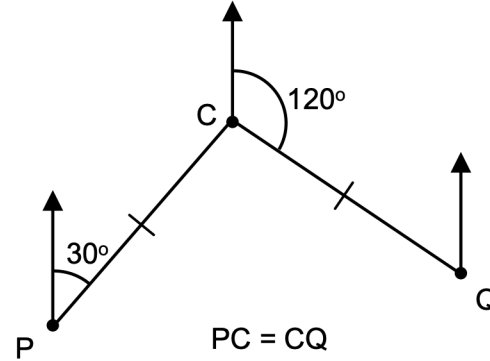
(2)



(3)



(4)



what are the bearings of P from Q?

Fluency Practice

right-angles triangles

(1)

triangle ABC is right-angled at A
($\angle BAC = 90^\circ$)

the bearing of B from A is 050°
the bearing of C from B is 180°
what is the bearing of A from C?

(2)

triangle ABC is right-angled at A
($\angle BAC = 90^\circ$)

the bearing of B from A is 050°
the bearing of C from B is 200°
what are the angles in the triangle?

(3)

triangle ABC is right-angled at B
($\angle ABC = 90^\circ$)

$\angle CAB = 25^\circ$

the bearing of B from A is 130°
the bearing of C from B is 220°
what is the bearing of A from C?

(4)

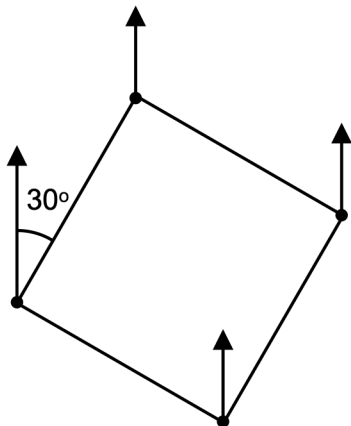
triangle ABC is right-angled at B
($\angle ABC = 90^\circ$)

the bearing of B from A is 010°
the bearing of C from B is 100°
what is the bearing of C from A?

Fluency Practice

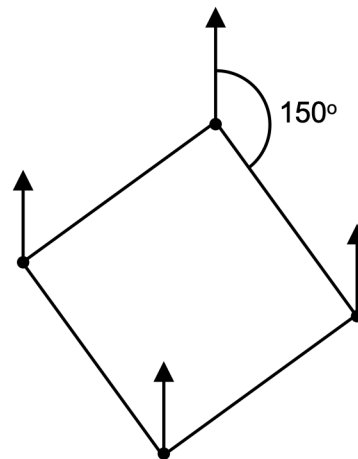
a square

(1)



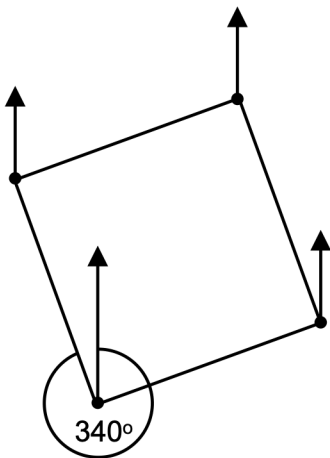
what do the
four bearings
add up to?

(2)



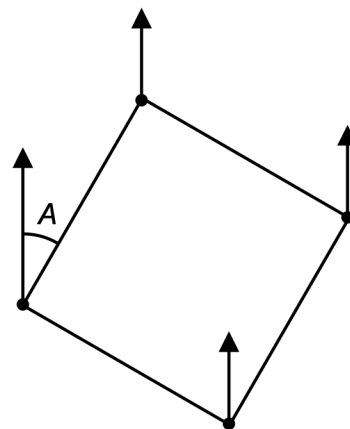
what do the
four bearings
add up to?

(3)



what do the
four bearings
add up to?

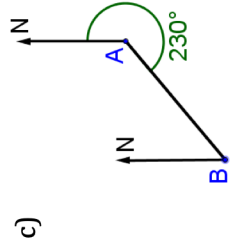
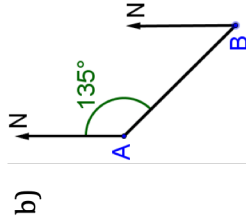
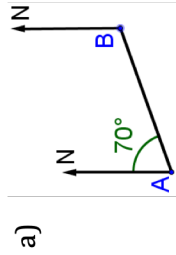
(4)



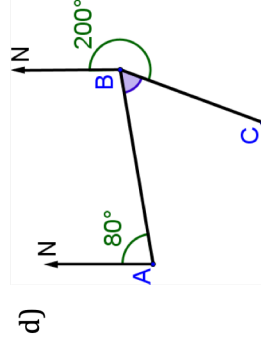
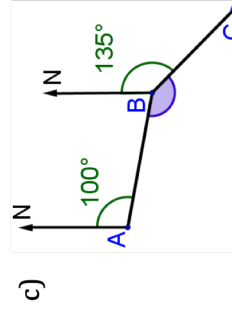
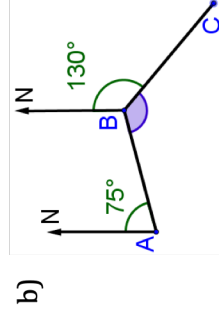
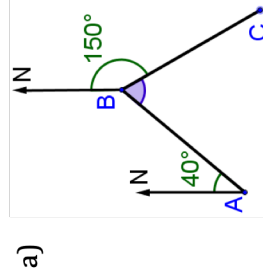
what do the
four bearings
add up to?

Purposeful Practice

- Each diagram shows the bearing of B from A. Calculate the bearing of A from B.

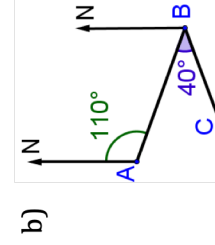
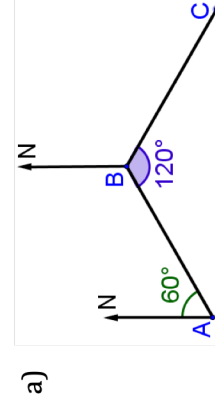


- Determine the shaded angle ABC in each diagram. You do not need a scale drawing or protractor.



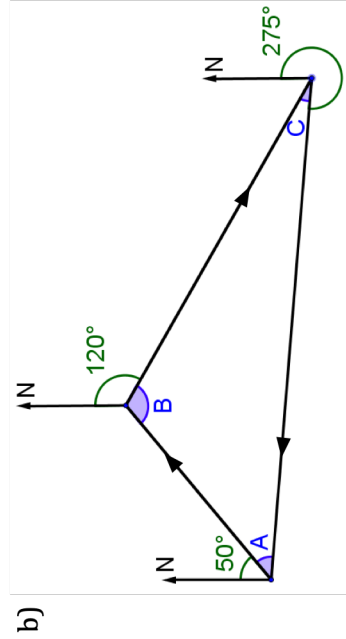
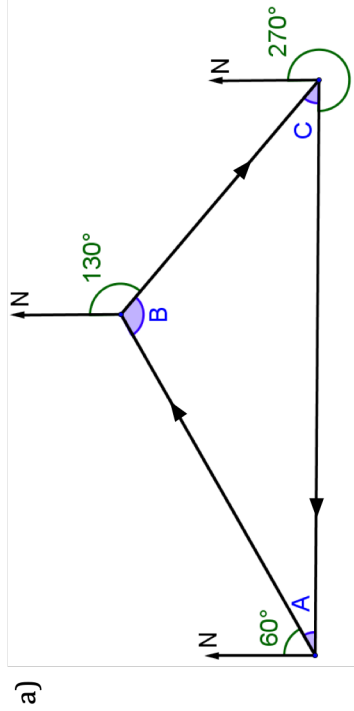
- In each diagram, a boat sails from A to B, then turns through the marked angle and sails to C. When the boat is at B, calculate:

- the bearing of A from B
- the bearing of C from B

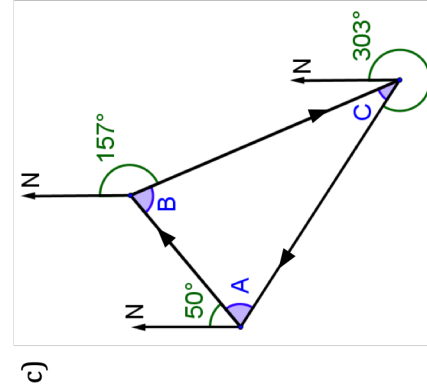


Purposeful Practice

4. A boat sails a triangular course clockwise as shown. Calculate the internal angles A, B and C in each triangle.



(Hint: angle A is not 40° .
Find angles B and C first.)

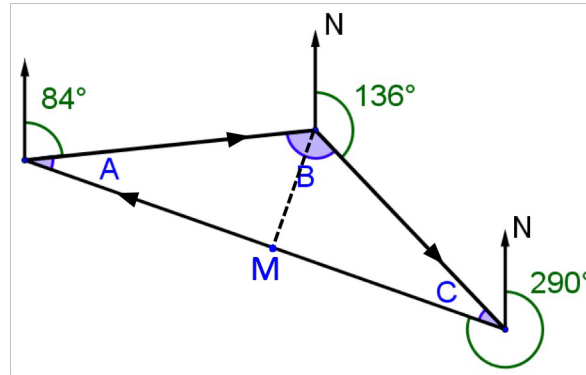


What do you notice about this triangle?

5. Use your answer for question 4 to calculate the bearings needed to sail each course anticlockwise instead, i.e. the bearings from A to C, then C to B and finally B to A.

Purposeful Practice

6. The organisers decide that the course ABC below is too long. They make a new course ABM, where M is halfway between A and C.



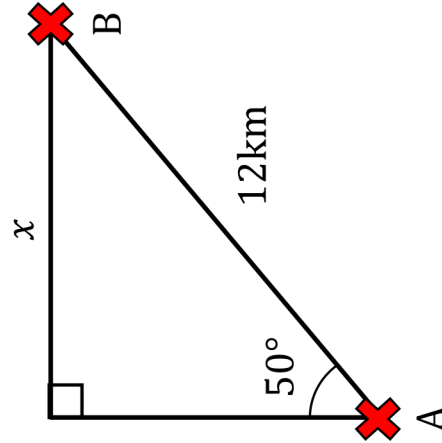
- a) Calculate the internal angles A, B and C in the original course and hence explain why the turn at M must be exactly 90 degrees.
 - b) Find the two new bearings needed to complete this course, i.e.
 - i. the bearing of M from B
 - ii. the bearing of A from M
7. a) Sketch a clockwise triangular course where the first leg is on a bearing of 040° and all three legs are the same distance. Calculate the other two bearings.
- b) State the second two bearings if the first leg is instead on a bearing of 051° .
8. A particularly mathematical sailing club want a course in the shape of an isosceles triangle. If the first leg is on a bearing of 040° and the second leg is 188° , sketch two possible courses and calculate the bearing of the third leg.

Purposeful Practice

(diagrams not to scale!)
Give your answers to 1 d.p.

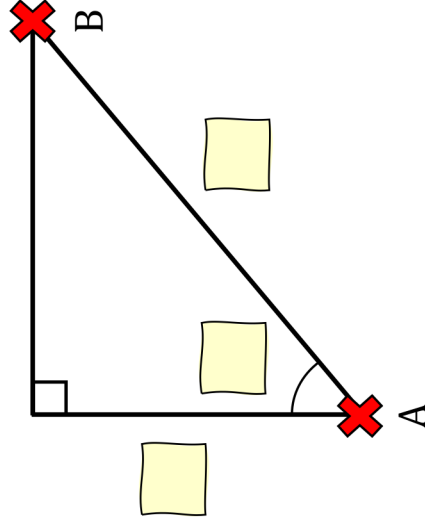
Q1

A ship travels from A to B on a bearing of 050 degrees for a distance of 12km. How far east did it travel?



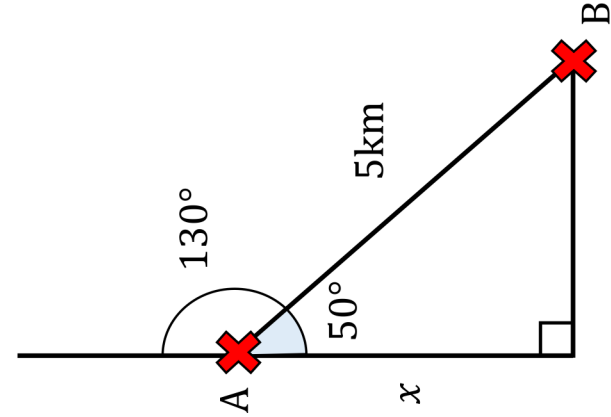
Q2

A ship travels from A to B on a bearing of 070 degrees for a distance of 23km. How far north did it travel?



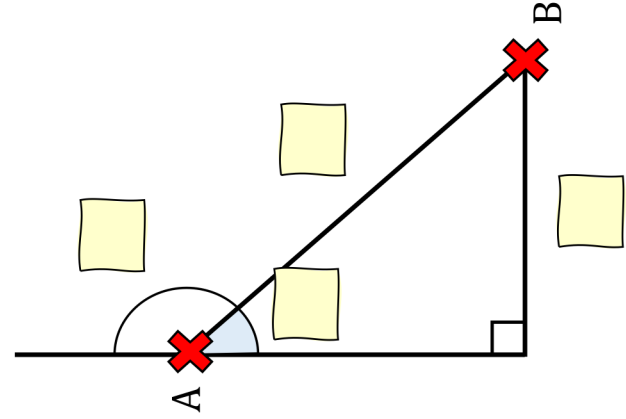
Q3

A ship travels from A to B on a bearing of 130 degrees for a distance of 5km. How far south did it travel?



Q4

A ship travels from A to B on a bearing of 145 degrees for a distance of 19km. How far east did it travel?

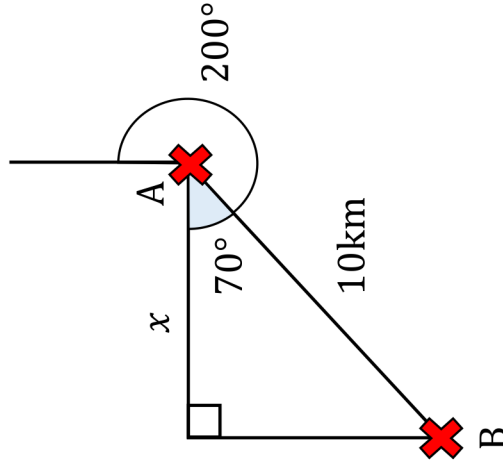


Purposeful Practice

(diagrams not to scale!)
Give your answers to 1 d.p.

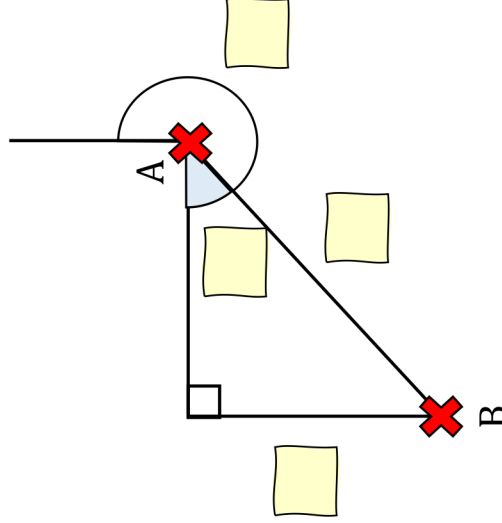
Q5

A ship travels from A to B on a bearing of 200 degrees for a distance of 10km. How far west did it travel?



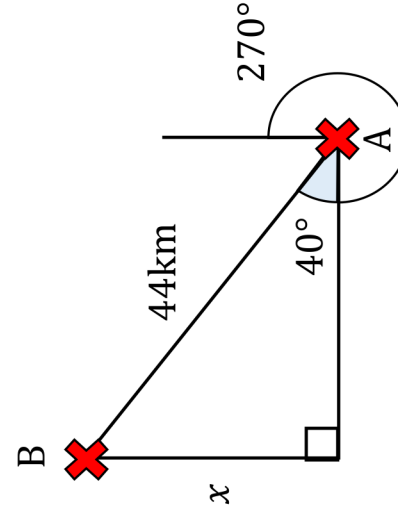
Q6

A ship travels from A to B on a bearing of 210 degrees for a distance of 17km. How far south did it travel?



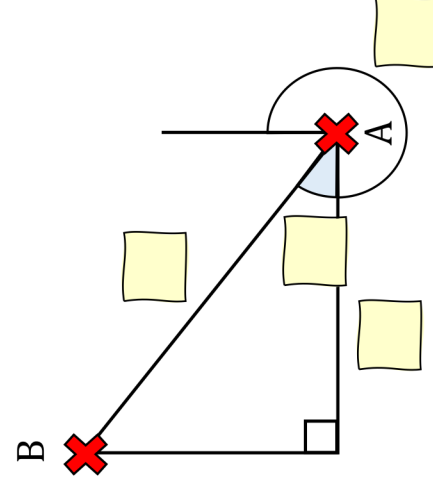
Q7

A ship travels from A to B on a bearing of 310 degrees for a distance of 44km. How far north did it travel?



Q8

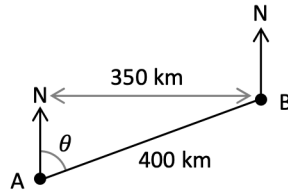
A ship travels from A to B on a bearing of 302 degrees for a distance of 49km. How far west did it travel?



Purposeful Practice

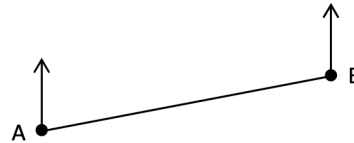


- ① Point B is 400 km away from point A.
Point B is 350 km east of A.
Find the bearing of B from A.



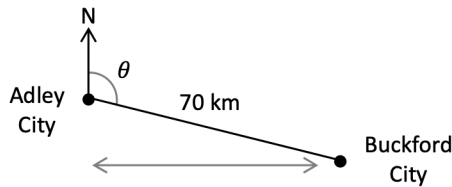
Finding Bearings using Trigonometry

- ② Point B is 12 km north of point A.
Point B is 150 km from A.
Find the bearing of B from A.

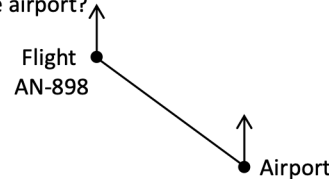


- ③ Point B is 18 km east of point A.
Point B is 7 km north of A.
Find the bearing of B from A.

- ④ Buckford is 60 km east of Adley. The cities are 70 km away from each other.
Find the bearing of Buckford from Adley.

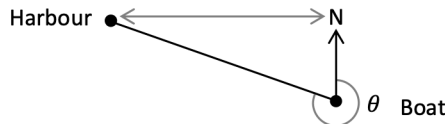


- ⑤ Flight AN-898 is 58 km from its destination airport. The plane is 40 km west of the airport.
What bearing does the plane need to fly on to reach the airport?



- ⑥ A plane flies 100 km south and a strong wind also pushes the plane 8 km east.
On what bearing does the plane actually travel?

- ⑦ A boat will travel 77 km direct to its harbour. The boat is currently 56 km east of the harbour.
On what bearing should the boat travel?



- ⑧ A cruise ship heads 12 km south but an ocean current from the east pushes the boat west. In total the cruise ship travels 16 km. On what bearing did the ship actually travel?



- ⑨ Delia hikes from Whitclif to Mardsden. At the end of the day they are 4 times further south than they are west.
What bearing did they hike on?

5 Answers	313.3	121.0	175.4
	085.4	061.0	

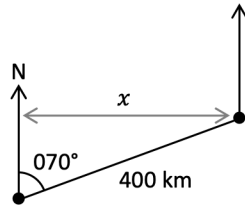
Purposeful Practice

Trigonometry with Bearings

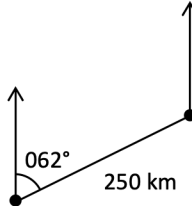
not to scale



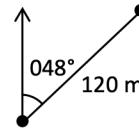
- ① A ship travels on a bearing of 070° for 400 km.
How far west does it travel (x)?



- ② A plane flies 250 km on a bearing of 062° .
How far west does it travel (x)?



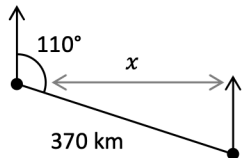
- ③ A boat sails on a bearing of 048° for 120 metres.
How far north does it travel?



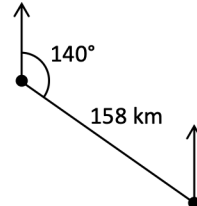
- ④ Point B is 217 metres away from point A on a bearing of 075° .
How far north is point B from point A?



- ⑤ A satellite travels 370 km on a bearing of 110° .
How far east does it travel (x)?



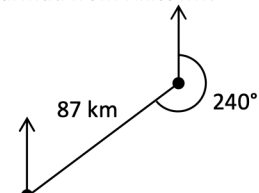
- ⑥ A runway is 158 km from flight GA-226 on a bearing of 140° .
How far south is the runway?



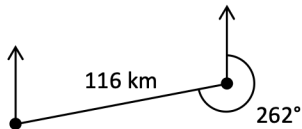
- ⑦ Middleford is 87 km north, and 121 km east of Gredwich.
What is the distance between the two cities?



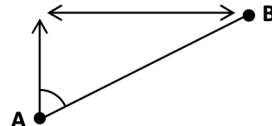
- ⑧ Yarmud is 87 km away from Hilltown on a bearing of 240° .
How far east is Yarmud from Hilltown?



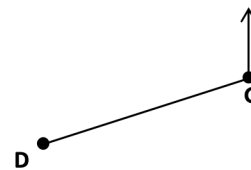
- ⑨ A ship travels 116 km on a bearing of 262° .
How far west does it travel?
How far south does it travel?



- ⑩ Point B is 150 m north of point A and on a bearing of 065° .
How far east is point B from point A?



- ⑪ Drekham is 300 km west of Greyford on a bearing of 251° .
How far south is Drekham from Greyford?



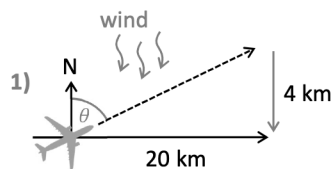
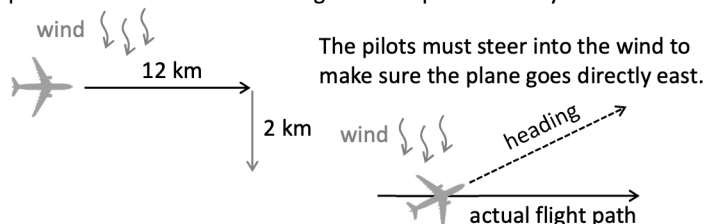
- ⑫ Waypoint ZOLOT is 400 km east of BETTA on a bearing of 075° .
How far north is ZOLOT from BETTA?

8 Answers	221	103	102	80
	149	348	115	376

Purposeful Practice

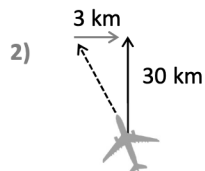
Wind

An airplane heads (aims) 12 km directly east but a northerly wind pushes the plane 2 km south. What bearing does the plane actually travel on?



Over 20 km a northerly wind will push a plane 4 km south.

On what bearing should the pilots fly (their heading) so the flight path is directly east?



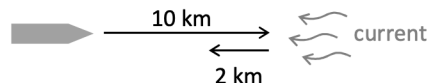
Memphis airport is 30 km directly north of flight AT-808 but a westerly wind will push the plane 3 km east. On what bearing should the pilots fly to reach the airport?

3) Dallas airport is 58 km away from flight AX-377 on a bearing of 270° . The wind is at 180° and will push the plane 7 km off course. Find the required heading to reach the airport.

4) A plane heads directly south for 17 km, but the wind pushes the plane 3 km west. What bearing does the plane actually fly on? How far does the plane travel above the ground?

Current

A motorboat travels up a river. The engines push the boat forward 10 km, but the current of the river pushes the boat backwards by 2 km. How far does the boat actually travel?



If the boat uses 100 ml of fuel per km. How much fuel does it use?

- 5) On the open ocean a motorboat heads 27 km due east but is pushed 8 km north by the current. Find the direction and distance of the boat's path.
- 6) A boat's safe harbour is 24 km due west. The current will push the boat 2 km off course to the south. Find the required heading to reach safety. The boat uses 2 litres of fuel per kilometre. How much fuel will it use to reach the harbour?
- 7) A speedboat heads south at 10 m/s. The current pushes the boat east at 1 m/s. On what bearing does the boat travel? How far does the boat travel in 3 seconds?
- 8) A boat heads east but is pushed 3 km north by the current. In total the boat travels 31 km. On what bearing did the boat travel?
- 9) A boat's engines propel it at 10 m/s west. With the current pushing the boat north it actually travels at 14 m/s. On what bearing does the boat travel? How fast is the current?

Purposeful Practice

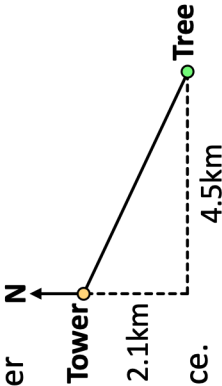
Q1 A scout troop are hiking in a forest. Starting from their base, they walk 4.2km south followed by 7.1km west. They want to walk the shortest distance back to their base.
On what bearing should the scouts walk?

Q2 A dragon has been wreaking havoc in a local village. It is then chased away by a knight. The dragon flies 3 miles due south followed by 4 miles due west.

[a] Work out the distance between the dragon and the village.

[b] Find the bearing of the dragon from the village to the nearest degree.

Q3 The diagram shows the positions of a tower and a tree. The tree is 2.1km South of the tower and 4.5km East of the tower.



[a] Work out the distance between the tower and the tree to one decimal place.

[b] Work out the bearing of the tree from the tower to the nearest degree.

Q4 A aeroplane flies 22 miles due south followed by 34 miles due east.
On what bearing is the aeroplane's starting position from its current position to the nearest degree?

Q5 A buoy is located 214m west and 185m south of a ship. Calculate the bearing of the buoy from the ship to the nearest degree.

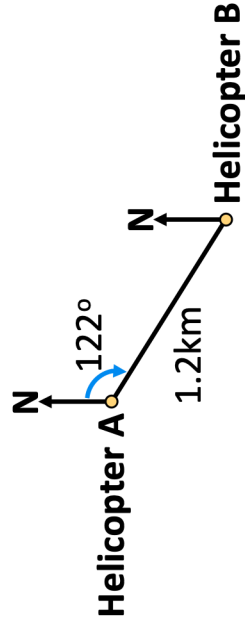
Q6 Two ships sail away from port. Ship A sails 6.4miles due south followed by 12.4miles due west. Ship B sails 3miles due south followed by 10.1 miles due east.

[a] Work out the distance between the two ships to one decimal place.

[b] Work out the bearing of Ship B from Ship A to the nearest degree.

Purposeful Practice

Q1 The following diagram represents the positions and bearings of two helicopters. Helicopter B is 1.2km away from helicopter A on a bearing of 122° . How far north is helicopter A from helicopter B?



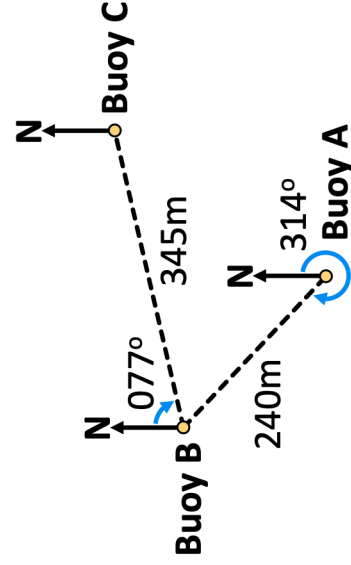
Q2 Animal conservationists are tracking the position of a polar bear. The polar bear's position is 3km in an eastward direction and is on a bearing of 104° . What is the shortest distance between the polar bear and the conservationists.

Q3 The following diagram represents the positions and bearings of three buoys floating in the ocean.

[a] How far west is Buoy B from Buoy C.

[b] How far east is Buoy A from Buoy B.

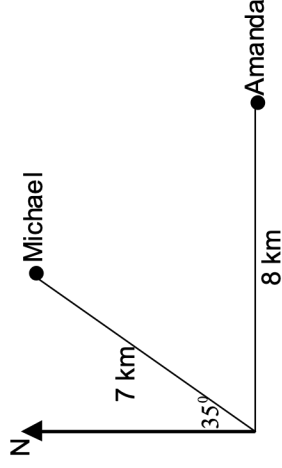
[c] How far north is Buoy C from Buoy A.



Q4 A ship sails on a bearing of 074° for 10 miles followed by a bearing of 131° for 15 miles. Work out the bearing of the ship from its starting position to the nearest degree.

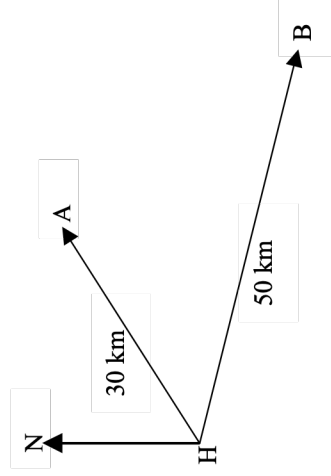
Purposeful Practice

1. Amanda and Michael leave the same campsite and set off in different directions.
Michael walks 7 kilometres on a bearing of 035° and Amanda walks 8 kilometres due east.



How far apart are Amanda and Michael?

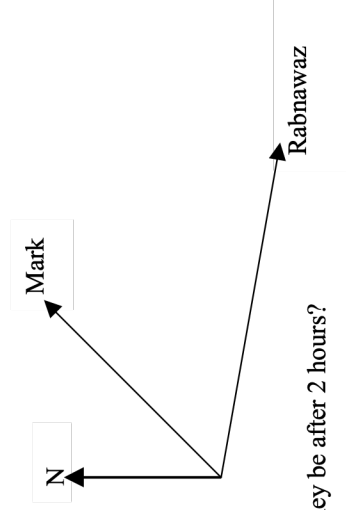
2. Two yachts leave harbour H.
Yacht A sails on a bearing of 072° for 30 km and then stops.
Yacht B sails on a bearing of 140° for 50 km and then stops



How far apart are the two yachts when they both have stopped?

3. Debbie is taking part in an orienteering walk. She leaves checkpoint A and walks 6.8 km due south to checkpoint B.
From B she walks 4.7 km on a bearing of 080° .

How far is Debbie from checkpoint A?

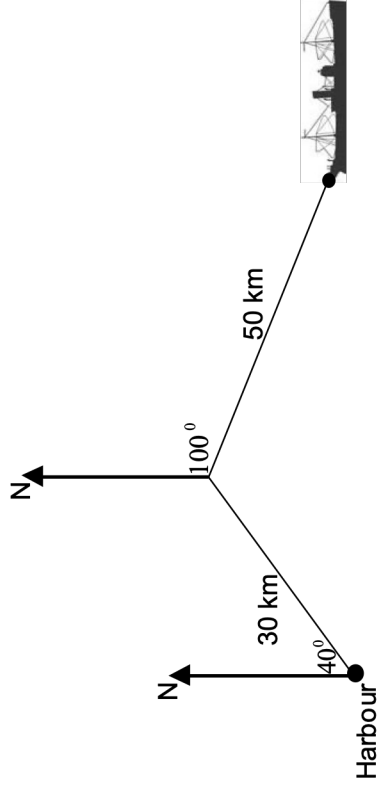


4. Mark and Rabnawaz leave a hostel at the same time.
Mark walks on a bearing of 045° at a speed of 4.4 kmph.
Rabnawaz walks on a bearing of 100° at a speed of 4.8 kmph.

If both walk at steady speeds, how far apart will they be after 2 hours?

Purposeful Practice

5. The sketch below shows the journey of a ship from a harbour.

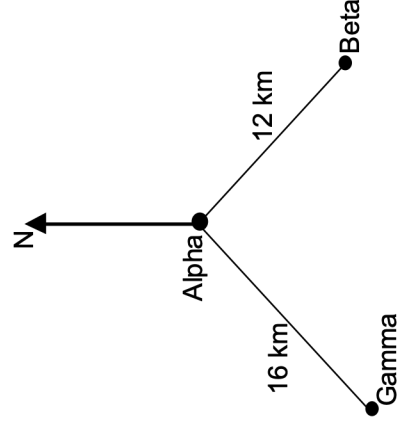


The ship leaves the harbour and sails 30 km on a bearing of 040° and then sails 50 km on a bearing of 100° .

Calculate the distance the ship is from the harbour.

6. Two ships leave Liverpool at the same time.
One of them travels north-west at an average speed of 10.5 kmph while the other travels at an average speed of 14 kmph on a bearing of 280° .

How far apart are these ships after 3 hours?

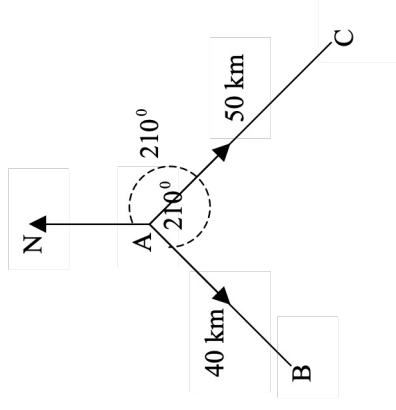


7. Three oil platforms, Alpha, Beta and Gamma are situated in the North Sea.
Beta is 12 km from Alpha and is on a bearing of 145° from Alpha.
Gamma is 16 km from Alpha and is on a bearing of 220° from Alpha.

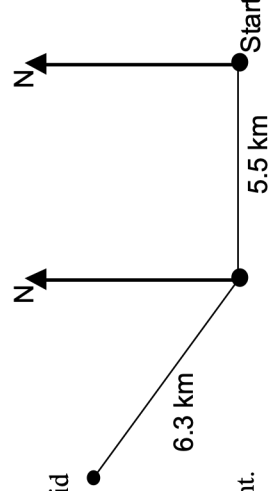
Find the distance of Beta from Gamma.

Purposeful Practice

8. A submarine is positioned at A.
 Its radar detects another ship 50 km away on a bearing of 145° , at C.
 The submarine informs its base at B, 40 km away on a bearing of 210° , of this ship.
 The base informs the submarine to intercept this ship.
 How far is the ship at C from the base B?

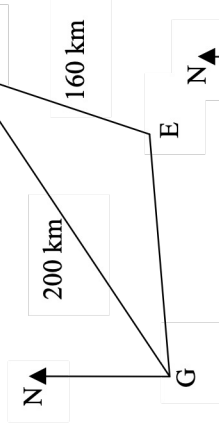


9. David takes part in a cross-country race.
 He leaves the starting point of the race and runs due west for 5.5 km before changing direction and running 6.3 km in a north-west direction.



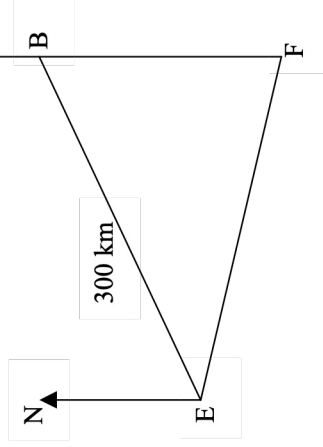
Calculate how far David is from the starting point.

10. The diagram shows the position of 3 airports, A, E and G.
 G is 200 km from A.
 E is 160 km from A.
 From G the bearing of A is 052° .
 From A the bearing of E is 216° .



How far apart are airports G and E?

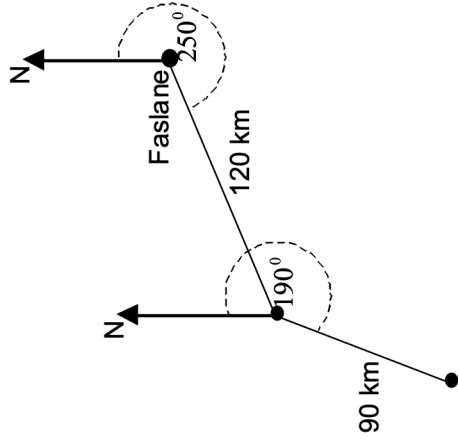
11. The diagram shows the position of 3 towns E, B and F.



B is 300 km from E and is on a bearing of 046° from E.
 From E, the bearing of F is 116° .
 F is due south of B.
 Calculate the distance from E to F.

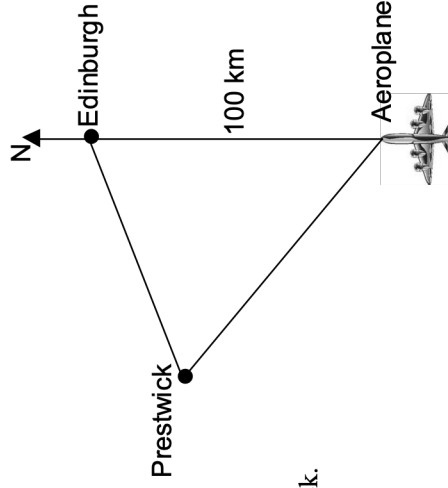
Purposeful Practice

12. A submarine leaves Faslane in Scotland and sails into the Atlantic Ocean on a bearing of 250° for a distance of 120 km before changing course and sailing on a bearing of 190° for 90 km.



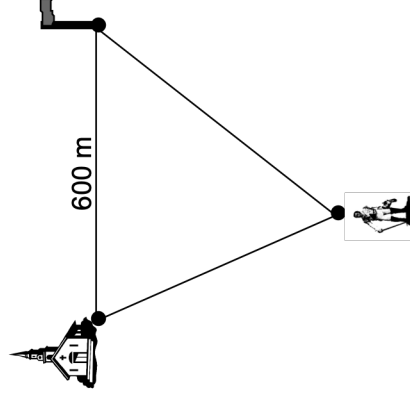
Calculate the distance the submarine is from Faslane.

13. An aeroplane flying to Edinburgh is 100 km due south of Edinburgh when the pilot is told to change direction because of fog. He is told to fly to Prestwick on a bearing of 320° . The bearing of Prestwick from Edinburgh is 240° .



- (a) Find the distance of the aeroplane from Prestwick.
(b) Find the bearing of Edinburgh from Prestwick.

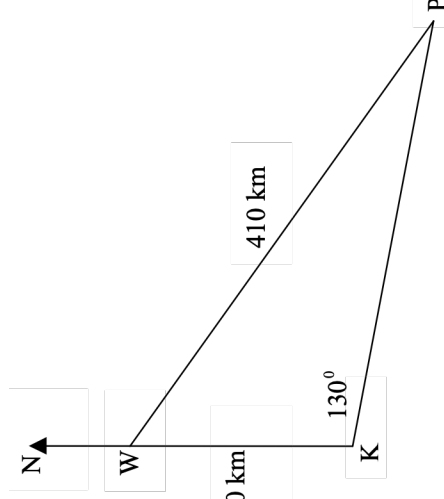
14. A church is 600 metres due west of a flagpole. A statue is on a bearing of 160° from the church and on a bearing of 220° from the flagpole.



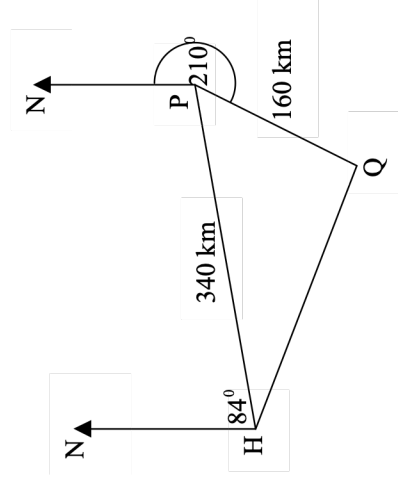
Find the distance of the church from the statue.

Purposeful Practice

15. Three radio masts, K, W and P are situated in the Australian outback.
 K is 250km due south of W. W is 410km from P.
 P is on a bearing of 130° from K.
 Calculate the bearing of P from W.



16. A ship sails from harbour H on a bearing of 084° for 340km until it reaches point P.
 It then sails on a bearing of 210° for 160km until it reaches point Q.

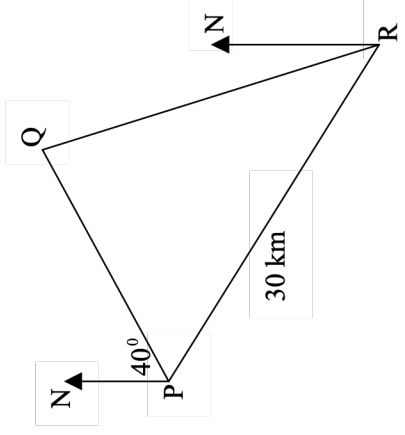


Calculate the distance between the point Q and the harbour.

17. Two ships A and B are anchored at sea. B is 65km due east of A. A lighthouse is positioned on a bearing of 055° from A and on a bearing of 310° from B.
 Calculate how far the lighthouse is from ship B.

Purposeful Practice

18. A ship, at position P, observes a lighthouse at position Q on a bearing of 040° . The ship travels 30km on a bearing of 125° to position R. From position R, the ship observes the lighthouse on a bearing of 340° .

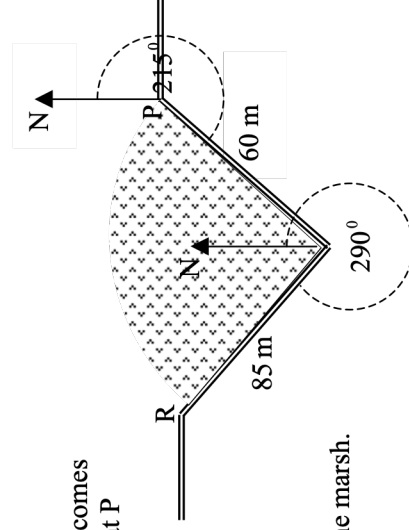


- Find the bearing of R from the lighthouse.
- Calculate the distance from R to the lighthouse

19. A boat sails on a bearing of 160° for 600km before changing course and sailing 700km on a bearing of 050° .

- How far the boat is from its starting point?
- Find the bearing the ship is from its starting point.

20. A surveyor is walking due west when he comes to a marsh. To avoid the marsh he turns at P and walks for 60m on a bearing of 215° and then for 85m on a bearing of 290° .



Calculate PR the direct distance across the marsh.