"Full Coverage": Similar Shapes (including area/volume)

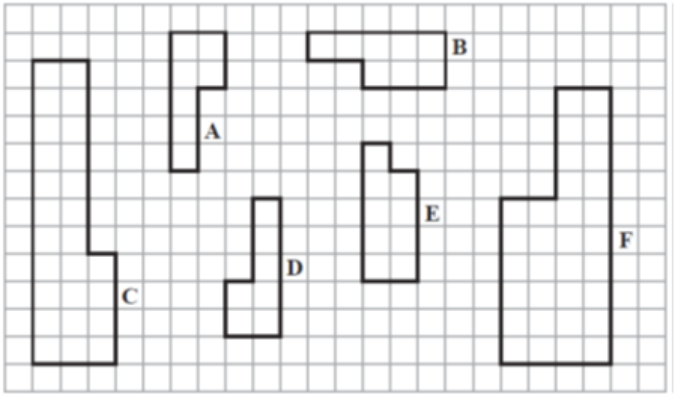
This worksheet is designed to cover one question of each type seen in past papers, for each GCSE Higher Tier topic. This worksheet was automatically generated by the DrFrostMaths Homework Platform: students can practice this set of questions interactively by going to www.drfrostmaths.com/homework, logging on, *Practise → Past Papers/Worksheets* (or *Library → Past/Past Papers* for teachers), and using the 'Revision' tab.

Question 1

Categorisation: Understand under what conditions shapes are 'similar'.

[Edexcel GCSE Jun2016-1F Q3b]

Six shapes are drawn on the grid of squares.



One of the shapes is **similar** to shape **F**.

Write down the letter of this shape.

[ ] A

[ ] B

[ ] C

[ ] D

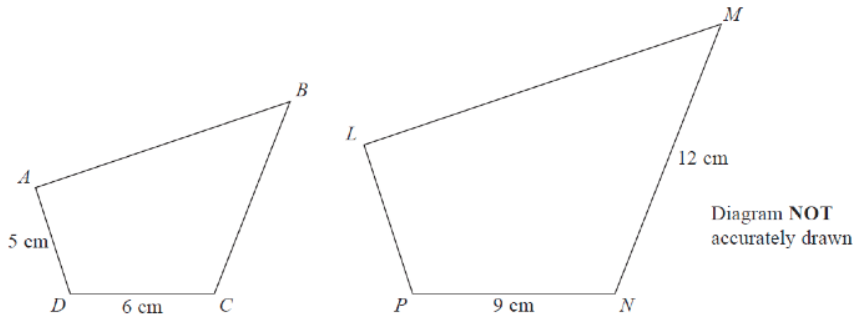
[ ] E

[ ] F

Question 2

Categorisation: Determine simple lengths in similar shapes when one pair of lengths is explicitly given.

[Edexcel GCSE June2014-2H Q17a]



Quadrilaterals *ABCD* and *LMNP* are mathematically similar.

Angle *A* = angle *L* Angle *B* = angle *M*
Angle *C* = angle *N* Angle *D* = angle *P*

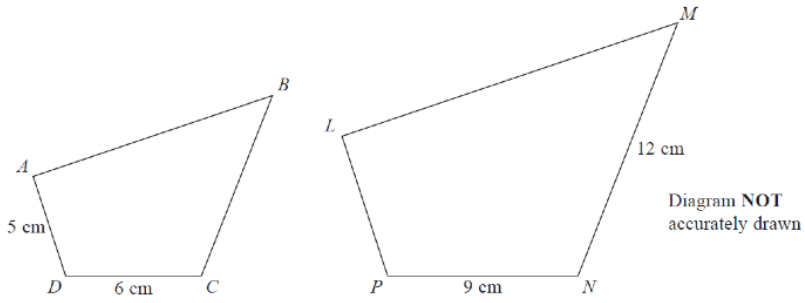
Work out the length of LP.

..... cm

Question 3

Categorisation: As above, but finding a length in the smaller shape, e.g. by division by the scale factor.

[Edexcel GCSE June2014-2H Q17b]



Quadrilaterals *ABCD* and *LMNP* are mathematically similar.
Angle *A* = angle *L* Angle *B* = angle *M*
Angle *C* = angle *N* Angle *D* = angle *P*

Work out the length of *BC*.

..... cm

Question 4

Categorisation: Determine lengths in similar shapes when the length of one of the shapes is not explicitly given (e.g. in the case of embedded shapes)

[Edexcel IGCSE May2015(R)-4H Q13a]

PQRS and *PLMN* are similar quadrilaterals.
PN = 12 cm, *NS* = 8 cm, *PL* = 9 cm and *RS* = 13.5 cm.
LM is parallel to *QR* and *MN* is parallel to *RS*.

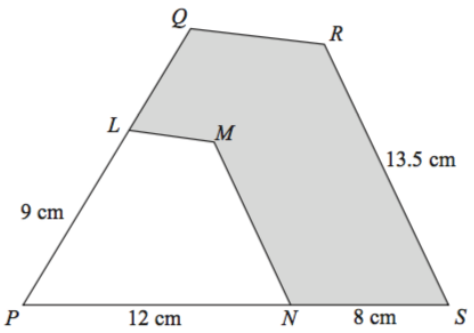


Diagram **NOT** accurately drawn

Work out the length of *MN*.

..... cm

Question 5

Categorisation: Recognise the need to subtract lengths within similar shapes (particularly in the case of embedded shapes)

[Edexcel IGCSE May2016-4H Q12b]

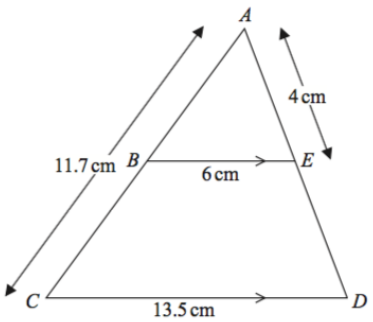


Diagram **NOT** accurately drawn

The diagram shows triangle ACD.
B is a point on AC and E is a point on AD so that BE is parallel to CD.
AE = 4 cm AC = 11.7 cm BE = 6 cm CD = 13.5 cm

Calculate the length of ED.

..... cm

Question 6

Categorisation: Recognise when a triangle has 'flipped' due to alternate angles.

[Edexcel GCSE Nov2005-4I Q18i, Nov2005-6H Q6i]

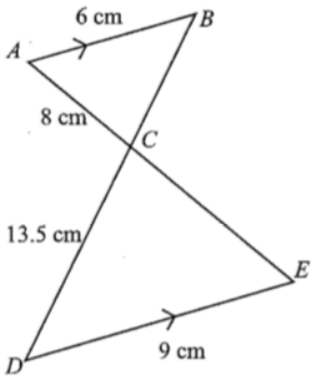


Diagram **NOT** accurately drawn

AB is parallel to DE. ACE and BCD are straight lines. $AB = 6$ cm, $AC = 8$ cm, $CD = 13.5$ cm, $DE = 9$ cm.
Work out the length of CE .

..... cm

Question 7

Categorisation: Find lengths in similar 3D shapes.

[Edexcel IGCSE May2015-4H Q14a]

L and **M** are two mathematically similar prisms.

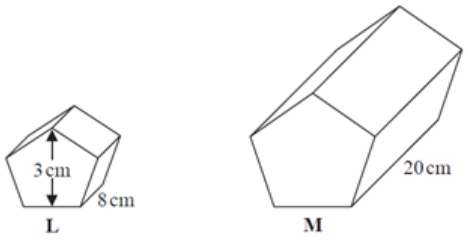


Diagram **NOT** accurately drawn

Prism **L** has length 8 cm. Prism **M** has length 20 cm.
Prism **L** has height 3 cm.

Work out the height of prism **M**.

..... cm

Question 8

Categorisation: Find lengths in similar shapes when neither of the lengths in an equivalent pair are explicitly given, e.g. by using an algebraic method.

[Edexcel GCSE March2013-2H Q15b]

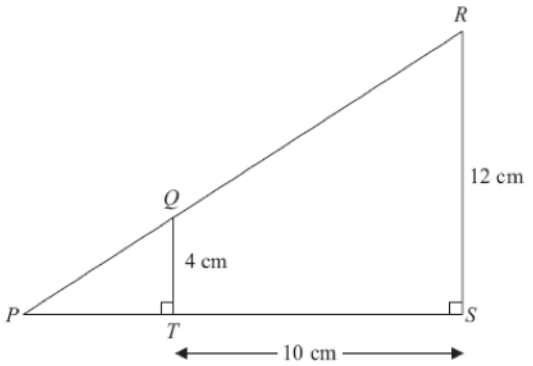


Diagram **NOT** accurately drawn

PQR and *PTS* are straight lines.
Angle *PTQ* = Angle *PSR* = 90°
QT = 4 cm *RS* = 12 cm *TS* = 10 cm

Work out the length of *PT*.

$PT =$ ..... cm

Question 9

Categorisation: Split a length in a ratio determined by identifying the scale factor of similar shapes.

[Edexcel GCSE March2012-3H Q17b]

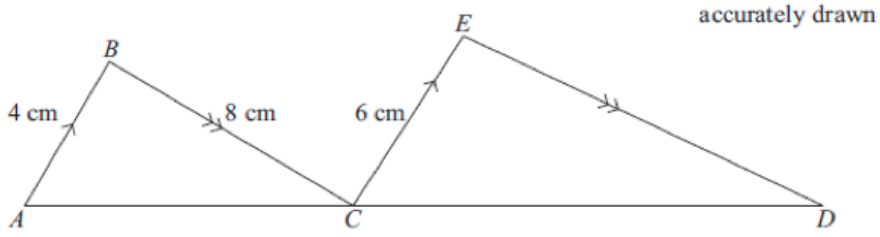


Diagram **NOT** accurately drawn

ACD is a straight line. *AB* is parallel to *CE*. *BC* is parallel to *ED*.
AB = 4 cm. *CE* = 6 cm. *BC* = 8 cm. *AD* = 25 cm.
Calculate the length of *AC*.

..... cm

Question 10

Categorisation: Find the perimeter of a shape formed from other similar shapes.

[Edexcel GCSE June2003-4I Q19b, June2003-6H Q8b]

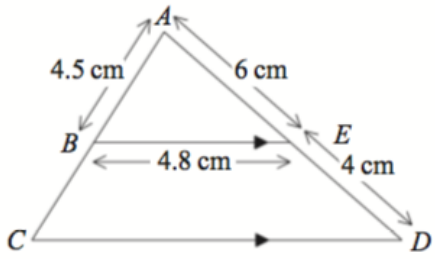


Diagram **NOT** accurately drawn

BE is parallel to CD.
AE=6 cm, ED=4 cm, AB=4.5 cm, BE=4.8 cm.

Calculate the perimeter of the trapezium EBCD.

..... cm

Question 11

Categorisation: Construct similar triangle proofs (recognising that we need only justify that only two pairs of angles are the same)

[Edexcel GCSE Nov2005-5H Q24a]

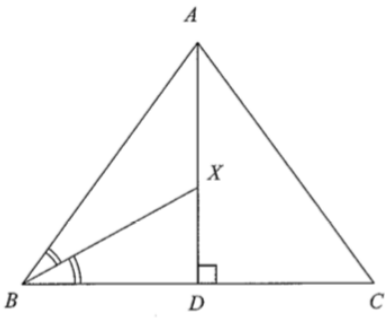


Diagram **NOT** accurately drawn

ABC is an equilateral triangle. AD is the perpendicular bisector of BC. BX is the angle bisector of angle ABC .

Show that triangle BXD is similar to triangle ACD .

Question 12

Categorisation: Be careful in finding similar lengths when the shape has been rotated.

[Edexcel GCSE Nov2005-5H Q24b Edited]

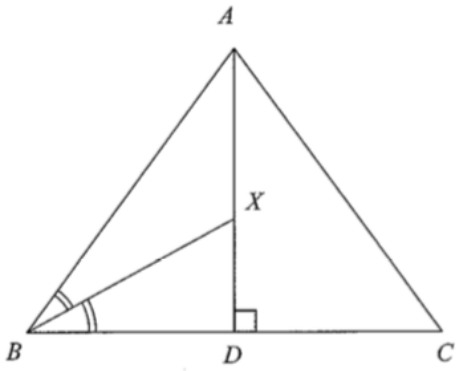


Diagram **NOT** accurately drawn

ABC is an equilateral triangle. AD is the perpendicular bisector of BC. BX is the angle bisector of angle ABC. The triangles BXD and ACD are mathematically similar.
In triangle ACD, $AC = 2$ cm, $AD = \sqrt{3}$ cm.

Find the length XD .

$XD =$ .....

Question 13

Categorisation: Use Pythagoras to subsequently determine a length in similar shapes.

[Edexcel GCSE Nov2014-2H Q16]
The diagram represents a metal frame.

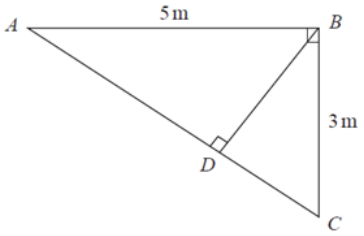


Diagram **NOT** accurately drawn

The frame is made from four metal bars, AB , AC , BC and BD.
Angle $ABC =$ angle $ADB = 90^{\circ}$ $AB = 5$ m, $BC = 3$ m

Work out the total length of the four metal bars of the frame.
Give your answer correct to 3 significant figures.

..... m

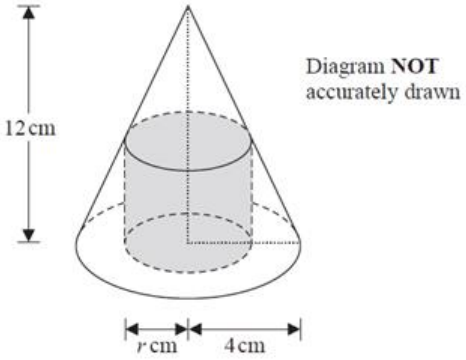
Question 14

Categorisation: Find algebraic lengths in similar triangles and use in the context of surface area or volume of solids.

[Edexcel IGCSE Jan2016(R)-3H Q15b Edited]

Key Formula: The curved surface area of a cone with radius r and slant height l is πrl .

The diagram shows a cylinder inside a cone on a horizontal base.
The cone and the cylinder have the same vertical axis.
The base of the cylinder lies on the base of the cone.
The circumference of the top face of the cylinder touches the curved surface of the cone.



The height of the cone is 12 cm and the radius of the base of the cone is 4 cm.

The cylinder has radius r and volume V .

Find the volume V of the cylinder in the form $a\pi r^2 + b\pi r^3$, where a and b are constants to be found.

.....

Question 15

Categorisation: Determine lengths in similar shapes in context.

[Edexcel GCSE June2014-1H Q20]

Steve has a photo and a rectangular piece of card.

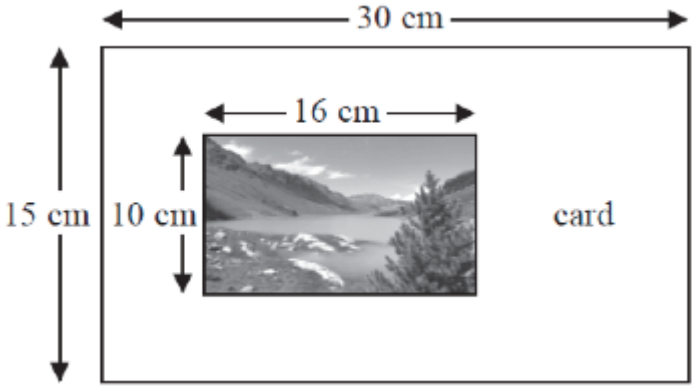
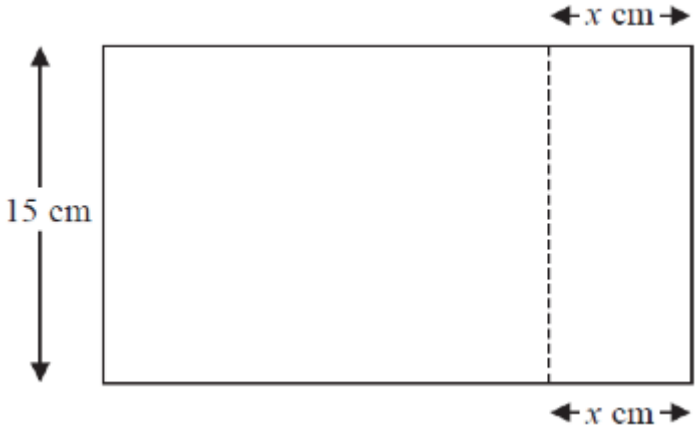


Diagram **NOT** accurately drawn

The photo is 16 cm by 10 cm.
The card is 30 cm by 15 cm.

Steve cuts the card along the dotted line shown in the diagram below.



Steve throws away the piece of card that is 15 cm by x cm.

The piece of card he has left is mathematically similar to the photo.

Work out the value of x .

$x =$ ..... cm

Question 16

Categorisation: Find the surface area of a similar solid when a pair of lengths are given.

[Edexcel GCSE June2003-6H Q12c]

Two mathematically similar frustums have heights of 20 cm and 30 cm.

The surface area of the smaller frustum is 450 cm^2 .

Calculate the surface area of the larger frustum.

..... cm^2

Question 17

Categorisation: Find the volume of a similar solid when a pair of lengths is given.

[Edexcel GCSE Nov2012-1H Q25a]

The diagram shows two similar solids, A and B.

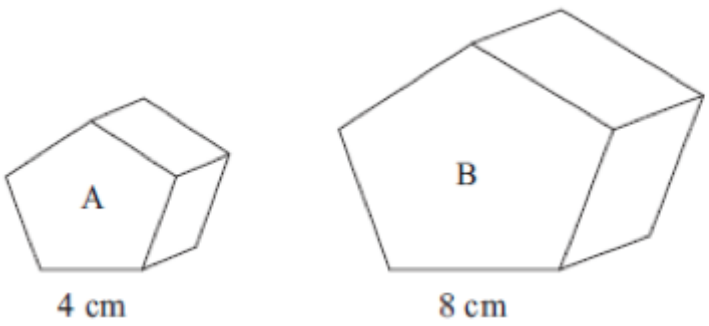


Diagram **NOT** accurately drawn

Solid A has a volume of 80 cm^3 .
Work out the volume of solid B.

..... cm^3

Question 18

Categorisation: Recognise when areas need to be subtracted after determining the area of a similar shape.

[Edexcel GCSE Nov2014-1H Q18b]

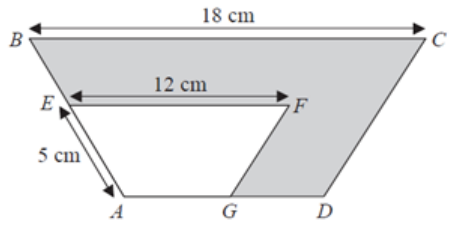


Diagram **NOT** accurately drawn

Trapezium $AEFG$ has an area of 36 cm^2.

Work out the area of the shaded region.

..... cm ^{2}

Question 19

Categorisation: Find the scale factor of area of similar shapes.

[Edexcel IGCSE May2015(R)-4H Q13c]

PQRS and *PLMN* are similar quadrilaterals.
PN = 12 cm, *NS* = 8 cm, *PL* = 9 cm and *RS* = 13.5 cm.
LM is parallel to *QR* and *MN* is parallel to *RS*.

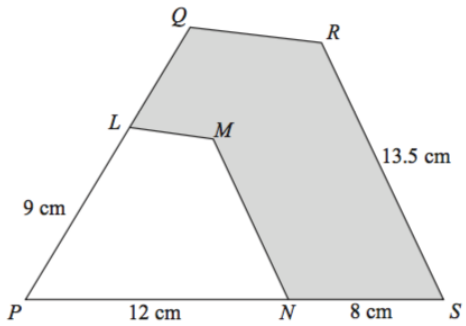


Diagram **NOT** accurately drawn

The area of *PLMN* is A cm^2. The area of *PQRS* is kA cm^2

Find the value of k .

$k =$ .....

Question 20

Categorisation: Form an equation involving areas (possibly involving subtraction).

[Edexcel IGCSE May2016(R)-3H Q17c]

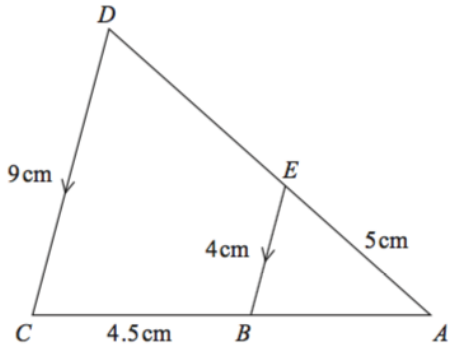


Diagram **NOT** accurately drawn

Triangle *ABE* is similar to triangle *ACD*. *AED* and *ABC* are straight lines.
EB and *DC* are parallel. *AE* = 5 cm, *BC* = 4.5 cm, *BE* = 4 cm, *CD* = 9 cm

The area of quadrilateral *BCDE* is x cm^2
The area of triangle *ABE* is y cm^2

Find an expression for y in terms of x. Give your answer as simply as possible.

$y =$ .....

Question 21

Categorisation: As above.

[Edexcel IGCSE Jan2016-4H Q14a]

ACE and BCD are straight lines. AB is parallel to DE.

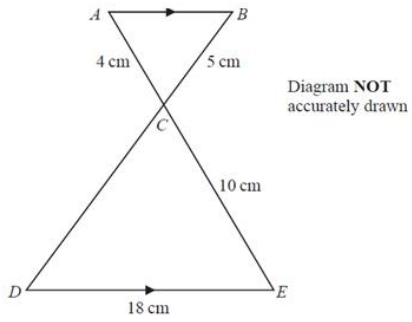


Diagram **NOT** accurately drawn

The area of triangle $ABC = T$ cm^2 Find the area of triangle CDE in terms of T.

.....

Question 22

Categorisation: Identify the surface area/volume of a similar shape/solid when the scale factor of length is given in ratio form.

[Edexcel GCSE Nov2005-5H Q18b]

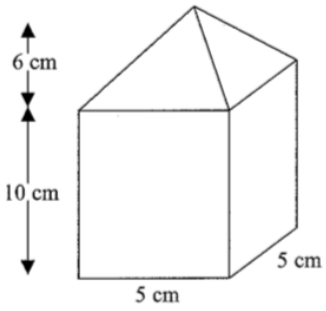


Diagram **NOT** accurately drawn

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.

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

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

..... m^2

Question 23

Categorisation: Determine a surface area/volume of a similar shape/solid when the scale factor of surface area/volume is given in ratio form.

[Edexcel GCSE Nov2007-5H Q21]

The volumes of two mathematically similar solids are in the ratio 27 : 125
The surface area of the smaller solid is 36 cm^2 .
Work out the surface area of the larger solid.

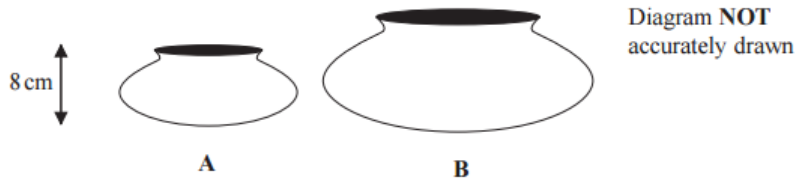
..... cm^2

Question 24

Categorisation: Determine the surface area of a similar solid when the volumes are given.

[Edexcel IGCSE Jan2017-1H Q16b]

The diagram shows two mathematically similar pots, A and B .



A has a volume of $264cm^3$ B has a volume of $891cm^3$

B has a surface area of $459cm^2$

Work out the surface area of pot A .

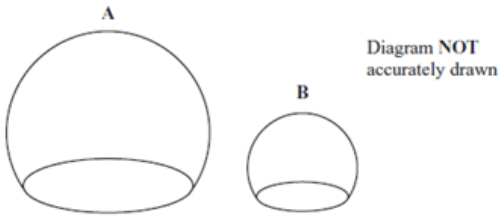
..... cm^2

Question 25

Categorisation: Recognise that, for a fixed density, the scale factor of volume is the same as the scale factor of mass.

[Edexcel GCSE June2010-4H Q23]

A and **B** are two solid shapes which are mathematically similar.
The shapes are made from the same material.



The surface area of **A** is 50 cm^2. The surface area of **B** is 18 cm^2.
The mass of **A** is 500 grams.

Calculate the mass of **B**.

..... grams

Question 26

Categorisation: Give the scale factor of surface area/volume in ratio form.

[Edexcel GCSE(9-1) Mock Set 2 Spring 2017 3H Q15]

Two solid cones are mathematically similar.

Cone **A** has a volume of 120 cm ^{3}
Cone **B** has a volume of 960 cm ^{3}

Work out the ratio of the surface area of cone **A** to the surface area of cone **B** .

..... : .....

Question 27

Categorisation: Recognise when solids are in fact not similar, e.g. the cross-sectional area of a cuboid may be enlarged but the depth not.

[Edexcel GCSE Jun2015-2H Q21]

Fred is making two rectangular flower beds.
The dimensions of the larger rectangle will be three times the dimensions of the smaller rectangle.

There is going to be the same depth of soil in each flower bed.
Fred needs 180 kg of soil for the smaller flower bed.

Work out how much soil Fred needs for the larger flower bed.

..... kg

Question 28

Categorisation: Use similarity to find lengths that enable calculation of volume.

[Edexcel GCSE March2013-2H Q22]

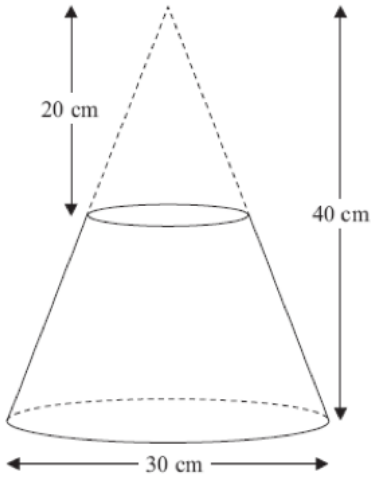


Diagram **NOT** accurately drawn

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.

..... cm^3

Answers

Question 1

B

Question 2

7.5 cm

Question 3

8 cm

Question 4

8.1 cm

Question 5

5 cm

Question 6

12 cm

Question 7

7.5 cm

Question 8

$PT =$ 5 cm

Question 9

10 cm

Question 10

19.8 cm

Question 11

Angle BDX = angle ADC = 90°

Angle BXD = angle ACD = 60°

Hence similar

Question 12

$XD = \frac{1}{\sqrt{3}}$

Question 13

any value in the range 16.4 m to 16.41 m

Question 14

$a = 12$, $b = -3$

Question 15

$x = 6$

Question 16

1012.5 cm^2

Question 17

640 cm^3

Question 18

45 cm ^{2}

Question 19

$k = \frac{25}{9}$

Question 20

$y = \frac{16x}{65}$

Question 21

$6.25T$

Question 22

26.1 m^2

Question 23

100 cm^2

Question 24

204 cm^2

Question 25

108 grams

Question 26

1: 4

Question 27

1620 kg

Question 28

8250 cm^3