Name	Date started	Target end date

WJEC GCSE Mathematics and Numeracy (Double Award) — Question Pack

Surface area and volume of cuboids, prisms, cylinders, cones, pyramids and spheres, including composite solids. Sourced from legacy WJEC GCSE Mathemat

REVISE
.wales

3.13 — Surface area & volume of 3D solids

Spec 3.6.3 — Unit 3 (calculator allowed)

Surface area and volume of cuboids, prisms, cylinders, cones, pyramids and spheres, including composite solids. Sourced from legacy WJEC GCSE Mathematics and Mathematics-Numeracy Higher calculator-allowed papers, organised for revision under the 2025 spec.

2025 SPECIFICATION

Estimated time for entire question pack: ~8 hours 32 minutes

*Derived from the GCSE Higher pace of **~1.5 min/mark** (341 marks across 74 questions).*

*You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **focused single-topic practice pack**, not a single mock paper. Questions are organised against the 2025 specification. Questions are ordered chronologically by sitting, with custom-written and SAM questions at the end.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working — method marks are awarded for clear setup.

A calculator is allowed on every question in this pack (Unit 3 is the calculator-allowed paper).

Surface area & volume of 3D solids — what the new spec asks

WJEC GCSE Mathematics (first teaching 2025) · Unit 3: calculator-allowed.

Surface area & volume of 3D solids 3.6.3

- Volume of cuboid lwh; prism = cross-section $\times$ length; cylinder $\pi r^2 h$; sphere $\frac{4}{3}\pi r^3$; cone $\frac{1}{3}\pi r^2 h$.
- Surface area as the sum of face areas; cylinder curved SA $= 2\pi rh$; sphere SA $= 4\pi r^2$; cone curved SA $= \pi rl$.
- Decompose composite solids; quote cubed units for volume, squared for surface area.

Crib sheet »

Surface area & volume of 3D solids in one page

Quick-reference notes — revisit before each question. Don't use during the questions.

Cuboid & cube

$$V = l \times w \times h$$

Surface area $= 2(lw + lh + wh)$ — sum of the six faces in pairs.

For a cube, all edges equal: $V = a^3$, SA $= 6a^2$.

Prism volume

$$V = \text{cross-section area} \times \text{length}$$

A prism has the same cross-section all along its length (triangular, trapezoidal, L-shaped …).

SA = perimeter of cross-section × length + two end faces.

Cylinder

$$V = \pi r^2 h \qquad \text{SA} = 2\pi r^2 + 2\pi r h$$

Curved surface $= 2\pi r h$ (a rectangle of width $2\pi r$ when unrolled).

Total SA includes the two circular ends if it's closed.

Sphere

$$V = \tfrac{4}{3}\pi r^3 \qquad \text{SA} = 4\pi r^2$$

Hemisphere: half the volume, curved SA $= 2\pi r^2$, plus the flat circular face πr^2 if closed.

Cone & pyramid

$$V_{\text{cone}} = \tfrac{1}{3}\pi r^2 h \qquad V_{\text{pyramid}} = \tfrac{1}{3} \times \text{base} \times h$$

Cone curved SA $= \pi r l$ where l is the slant height; total SA $= \pi r l + \pi r^2$.

For pyramid SA, add the base area and triangular faces.

Composite solids

Split into known shapes (e.g. cylinder + hemisphere = a capsule).

Add volumes; for SA, take care to *exclude* faces that are hidden inside the join.

Hollow pipe: outer cylinder volume minus inner cylinder volume.

Units & rounding

Volume: cm^3, m^3 — cubed units.

SA: cm^2, m^2 — squared units.

$1\,\text{m}^3 = 1\,000\,000\,\text{cm}^3$; 1 litre $= 1\,000\,\text{cm}^3$.

Keep π on the calculator; round only at the final step.

Common traps

- Using diameter where radius is required (or vice versa).
- Forgetting the $\frac{1}{3}$ for cones and pyramids.
- Mixing slant height and vertical height for cones — need Pythagoras to convert.
- Forgetting to subtract the hidden face when joining solids.

Examiner only

1. The scale diagram opposite shows an Eisteddfod camping field.

The camping field is 100 metres long and 80 metres wide.

A river runs along the side *AB*.
There is a hedge along *AD*.
There is a fence along *BC*.
DC is an opening with access to the Eisteddfod camping field.

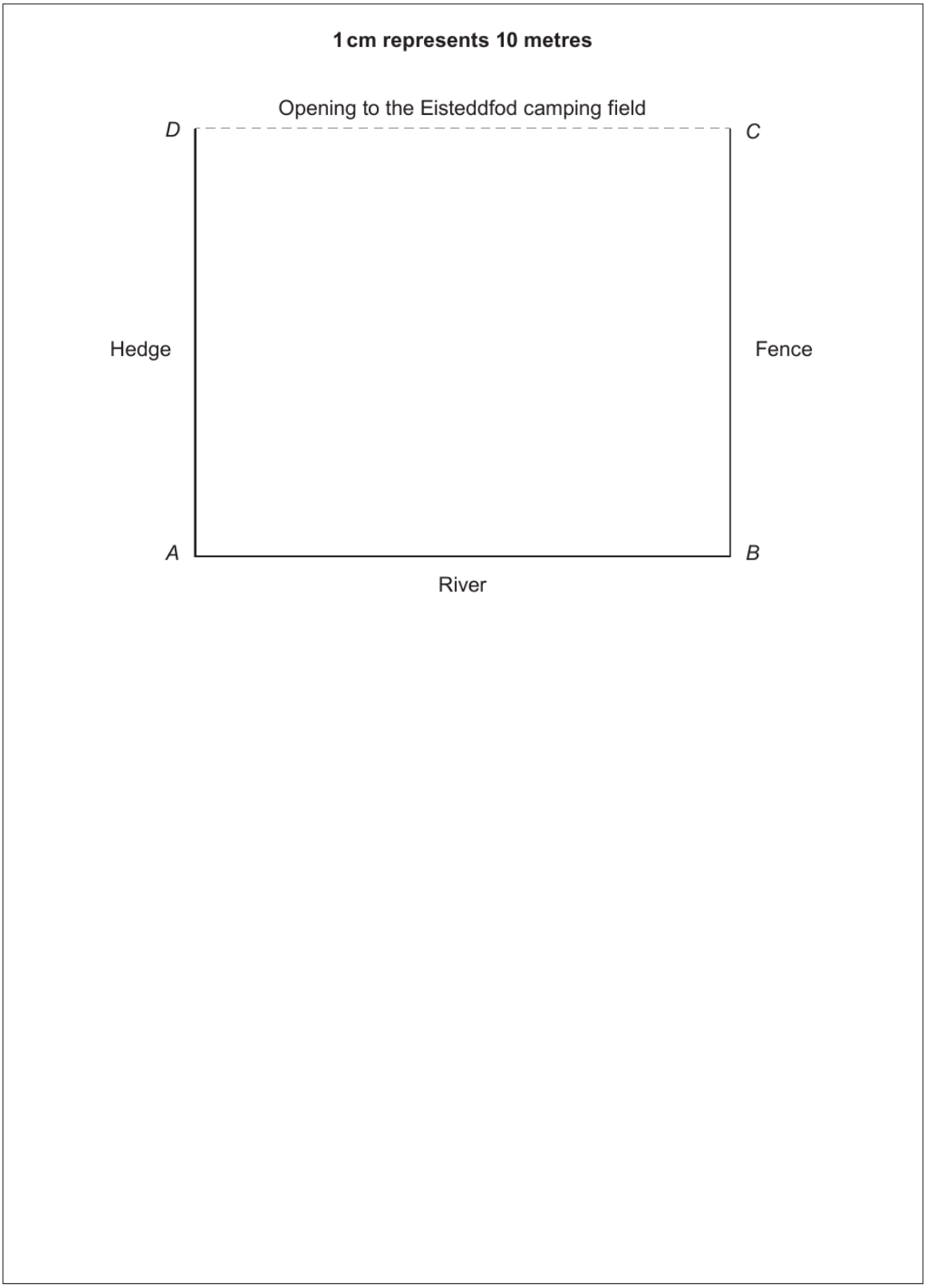
The scale used is **1 cm represents 10 metres**.

A barbecue area is to be built on the camping field.

The barbecue area must be
- nearer to the river than to the opening to the Eisteddfod camping field,
- nearer to the river than to the hedge,
- more than 30 metres from the corner of the field where the hedge meets the river.

Draw suitable lines on the diagram and shade the region where the barbecue area could be built. [5]

Examiner only



Examiner only

1. *(a)* The Headteacher of Ysgol Bro Gwyn investigates building a new bike shed.

Bike sheds are built on a rectangular base of width x metres and length y metres.

The Headteacher is given a formula for working out the number of bikes, b, that can be stored in a bike shed that has a base of width x metres and length y metres.

He is told the formula only works when
- x and y are whole numbers
- x is greater than 3
- y is greater than 5

The formula is as follows:

$$b = \frac{6xy}{5}$$

According to the details the Headteacher has been given, what is the formula for calculating the length, y metres, of a bike shed x metres wide that can hold b bikes?
Circle your answer. [1]

$y = \frac{b-5}{6x}$ $x = \frac{6b}{5y}$ $y = \frac{b+5}{6x}$ $y = \frac{5b}{6x}$ $y = \frac{6x}{5b}$

Examiner only

(b) The Headteacher decides to place signs around the school site to stop pupils using their bikes on grassed areas.

He introduces a new sign to pupils in the school newsletter.
The size of the sign in the newsletter is shown below.

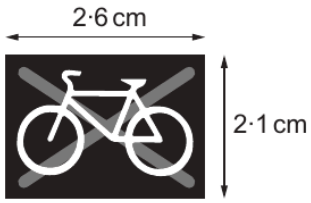


Diagram not drawn to scale

A mathematically similar new sign is placed near the side of the playing field.

Diagram not drawn to scale

It is 33·6 cm high.
How wide is this sign? [2]

Width is ..... cm

Examiner only

9. A metal round-headed nail can be thought of as a cone sitting on top of a cylinder, which sits on top of a hemisphere.
A company produces round-headed nails of different sizes, but made of the same metal.
Each nail has the following dimensions:

- height of cone = $9r$,
- height of cylinder = $15r$,
- radius of the hemisphere = $12r$,

where r is the radius of the cylinder and the base radius of the cone.

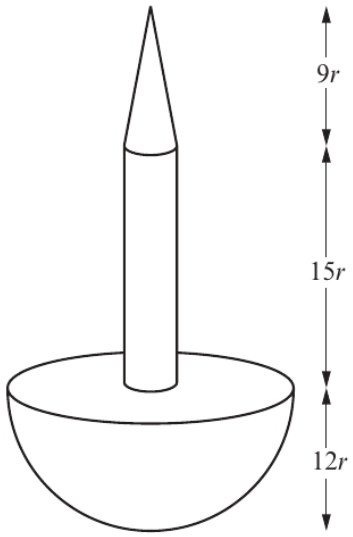


Diagram not drawn to scale

A metal cuboid of volume 18 000 mm^3 is melted down, and re-cast to form round-headed nails of size A, where r = 0·4 mm.

(a) Calculate the greatest number of round-headed nails of size A that can be produced. [6]

Examiner only

(b) Circle either TRUE or FALSE for each statement given below. [2]

STATEMENT		
A nail double the height of a size A nail will have a total height of 28·8 mm.	TRUE	FALSE
A nail double the height of a size A nail will be 8 times the weight of a size A nail.	TRUE	FALSE
A nail 3 times the height of a size A nail will have a total surface area 6 times that of a size A nail.	TRUE	FALSE
When r = 0·8 mm, the number of nails that could be produced from the same metal cuboid will be double the number of size A nails.	TRUE	FALSE

Examiner only

9. Circle the correct answer for each of the following statements.

(a) $9^{-\frac{1}{2}}$ is equal to

-3 $-\frac{1}{3}$ $\frac{1}{4\frac{1}{2}}$ $-4\frac{1}{2}$ $\frac{1}{3}$ [1]

(b) $8^{\frac{2}{3}}$ is equal to

$5\frac{1}{3}$ 4 6 $8\frac{2}{3}$ $\frac{16}{24}$ [1]

10. The radius of a hemisphere and the radius of a cylinder are equal.
The hemisphere and cylinder have equal volumes.

Calculate the ratio of the height of the cylinder to the radius of the cylinder. [3]

height of cylinder : radius of cylinder

= ..... : .....

Examiner only

1.

(a) Jasmine entered herself, Sophie and Bryn as a group in a talent contest.
Bryn only had a minor part.

Bryn, Sophie and Jasmine won the contest.
They shared the prize money in the ratio 2 : 6 : 7, with Bryn getting the smallest share.
Jasmine won £560, the largest share.

How much money did Bryn and Sophie each win? [4]

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Bryn receives £ .....

Sophie receives £ .....

Examiner only

(b) *In this part of the question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

The talent contest is held once a year.
Every year, the cost of putting on the talent contest increases by 10% of the previous year's cost.
In summer 2014 the cost was £6600.

Calculate the cost of putting on the summer 2017 talent contest.
You must show all your working. [3 + 2 OCW]

Examiner only

6. In the following formulae, each measurement of length is represented by a letter.

Consider the dimensions implied by the formulae.
Write down, for each case, whether the formula could be for a length, an area, a volume or none of these.

The first one has been done for you. [3]

Formula	Formula could be for
$d^3 - 3{\cdot}14r^2h$	volume
$d^2 + hw$	.....
$d + w + h$	.....
$2\pi r - \pi r^2$	.....
$(d + h)w$	.....
$d^3 + dwh$	.....

Examiner only

6. *In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

Elin's old fish tank is leaking.

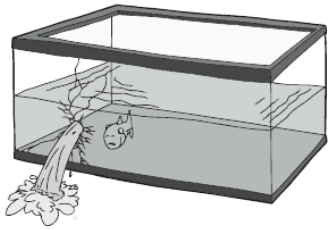

Diagram not drawn to scale

This old fish tank is in the shape of a cuboid.
The base of this tank measures 60 cm by 40 cm.
Before the leak, the height of the water level in Elin's old fish tank was 45 cm.

Elin decides to replace her fish tank with a cylindrical one.

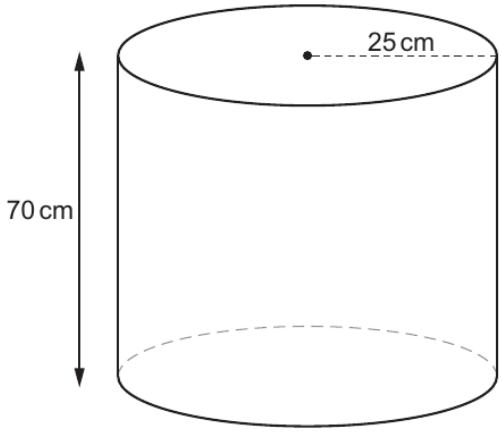

Diagram not drawn to scale

She selects a new cylindrical fish tank that has a radius of 25 cm and a height of 70 cm.

Will all the original contents, including the water and the fish, fit into this cylindrical tank?
You must show all your working. [4 + 2 OCW]

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Examiner only

11. The diagram below shows a wooden end-piece for a curtain pole.
It is in the shape of a cone with measurements as shown in the diagram.

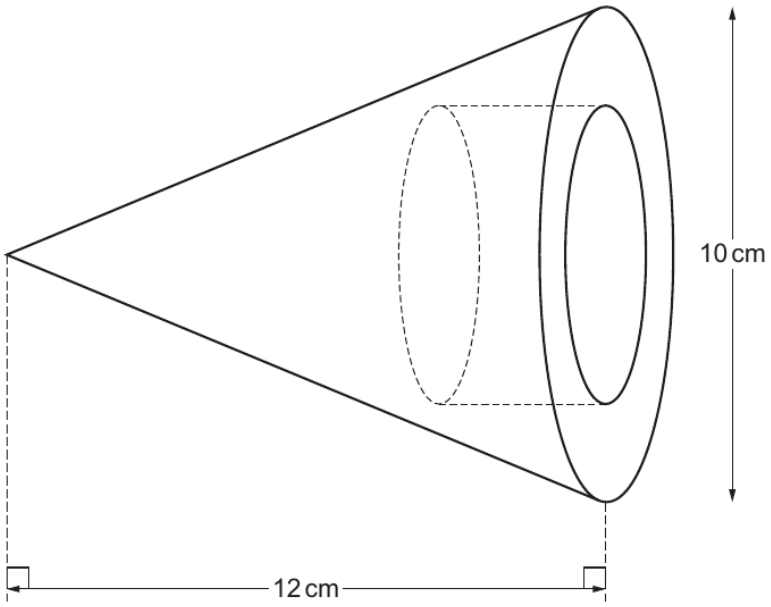

Diagram not drawn to scale

The curtain pole sits in a cylindrical hole that has been drilled into the end-piece.
The hole is of radius 3 cm and depth 4 cm.

(a) Show that the volume of wood that remains is $64\pi\,\text{cm}^3$. [4]

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Examiner only

(b) The surface area of the end-piece is to be painted, except for the area inside the hole.
Calculate the surface area that is to be painted.
Give your answer in terms of π. [6]

END OF PAPER

Examiner only

19. By considering algebraic expressions, show that it will never be possible for the surface area of a sphere of radius r to be equal to the surface area of a cube with sides of length r. [2]

END OF PAPER

Examiner only

1. *(a)* Ysgol Fron Isa and Ysgol Caewen are two very different high schools.
One school is large, and in a rural area. The other is a small school in a town.
The town in which the small school is situated has many traffic-free cycle routes.

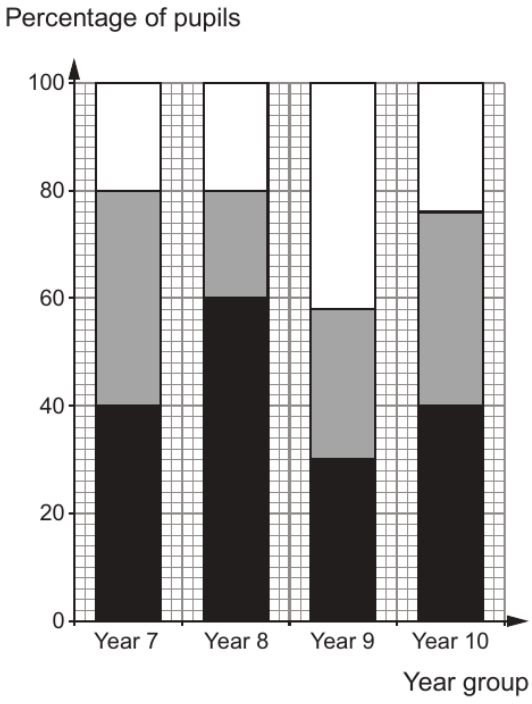
All of the pupils in Years 7 to 10 were surveyed in both of these schools.
They were asked the following questions.

Do you cycle to school?	Yes ☐	No ☐
If you answered 'no', would you like to cycle to school?	Yes ☐	No ☐

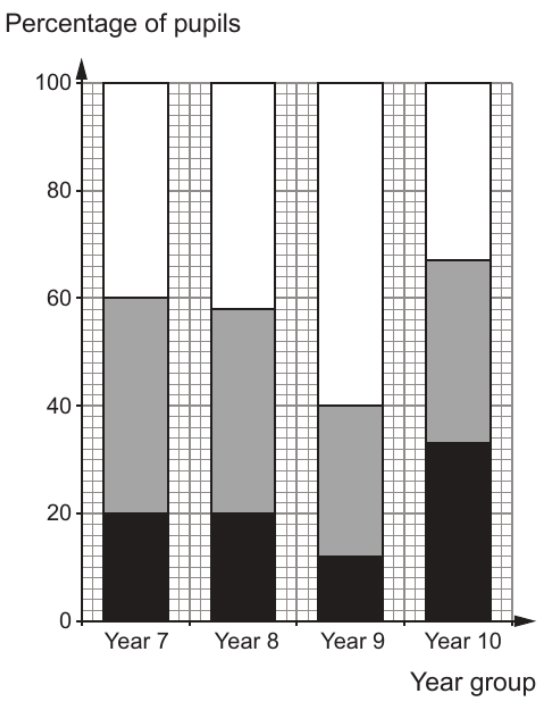
The results were displayed in graphs, as shown below.

Key: Cycle; Would like to cycle; Others

Ysgol Fron Isa



Ysgol Caewen



Examiner only

(i) Which school and year group has an approximately equal split between the 3 categories:
- pupils who cycle to school,
- pupils who would like to cycle to school, and
- other pupils? [1]

School: ..... Year Group: .....

(ii) Circle either TRUE or FALSE for each of the following statements. [3]

There are definitely more pupils in Ysgol Fron Isa who cycle to school than in Ysgol Caewen.	TRUE	FALSE
Both schools have pupils in each year group with no interest in cycling to school.	TRUE	FALSE
The questions asked were biased.	TRUE	FALSE
Approximately 20% of the pupils surveyed in Ysgol Caewen cycle to school.	TRUE	FALSE
It is more likely that it is Ysgol Fron Isa that is the small school situated in a town.	TRUE	FALSE

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3310U501 05

(b) In January 2011, there were 1200 miles of National Cycle Network (NCN) routes in Wales. In January 2016, there were 1400 miles of NCN routes in Wales.

(i) If the number of miles of NCN routes in Wales were to continue to increase by the same number of miles per year, how many miles of cycle routes would there be in January 2018? [2]

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(ii) Why is your answer in (i) unlikely to be an accurate estimate of the number of miles of NCN routes in Wales in January 2018? [1]

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Examiner only

1. Alptai is a ski resort.
The daily snowfall for January is given in the table below.

Daily snowfall, s (cm)	Number of days
$0 \leqslant s < 5$	10
$5 \leqslant s < 10$	16
$10 \leqslant s < 20$	4
$20 \leqslant s < 30$	0
$30 \leqslant s < 50$	1

(a) Calculate an estimate for the mean daily snowfall for the 31 days of January. [4]

(b) Circle either TRUE or FALSE for each of the following statements. [2]

The table above shows that there definitely was snowfall on each of the 31 days in January.	TRUE	FALSE
There were 16 days when the daily snowfall was less than 10 cm.	TRUE	FALSE
There was only 1 day with snowfall greater than or equal to 20 cm.	TRUE	FALSE
The modal group also contains the median daily snowfall.	TRUE	FALSE

Examiner only

(c) For the 28 days of February, the mean daily snowfall in Alptai was 9 cm.
On 1st February, the snowfall recorded in Alptai was 63 cm.
Calculate the mean daily snowfall for the 27-day period 2nd to 28th February. [3]

Examiner only

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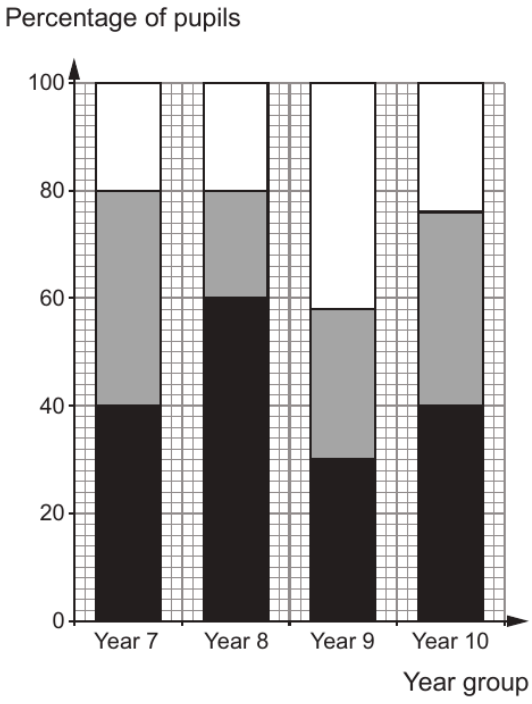
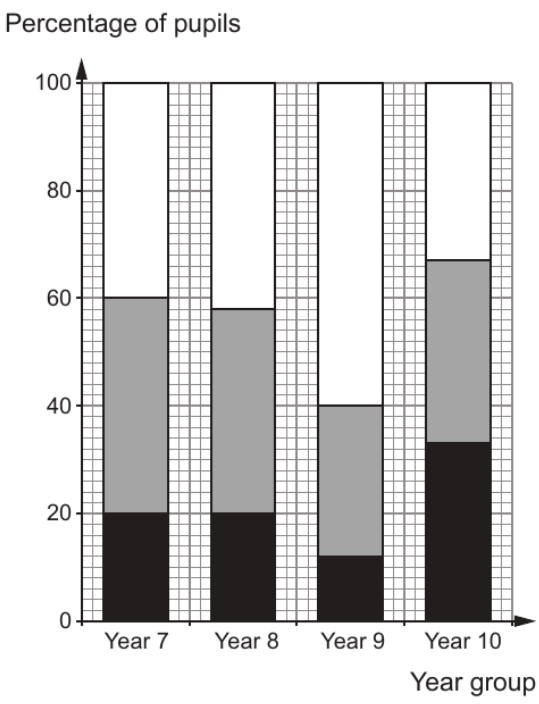


Ysgol Caewen



Examiner only

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3310U501 05

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Examiner only

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Examiner only

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Examiner only

4. A triangular prism of length 2 metres is shown below.

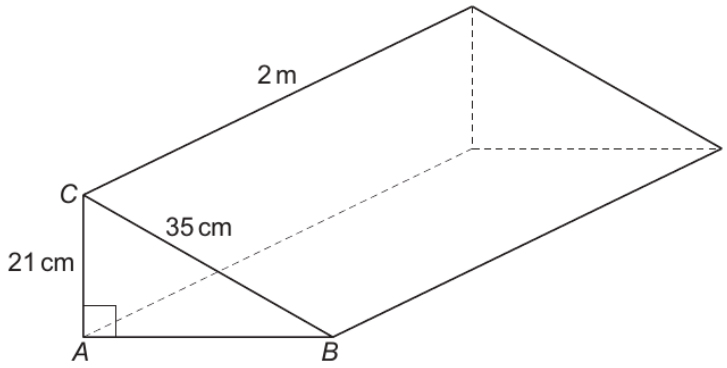


Diagram not drawn to scale

$AC = 21$ cm, $BC = 35$ cm and $B\hat{A}C = 90°$.

(a) *In this part of the question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

Calculate the area of triangle *ABC*.
Give your answer in cm^2.
You must show all your working. [5 + 2 OCW]

Examiner only

(b) Calculate the volume of the prism.
You must give the units of your answer. [3]

Examiner only

10. A cylinder just fits inside a hollow cube with sides of length m cm.

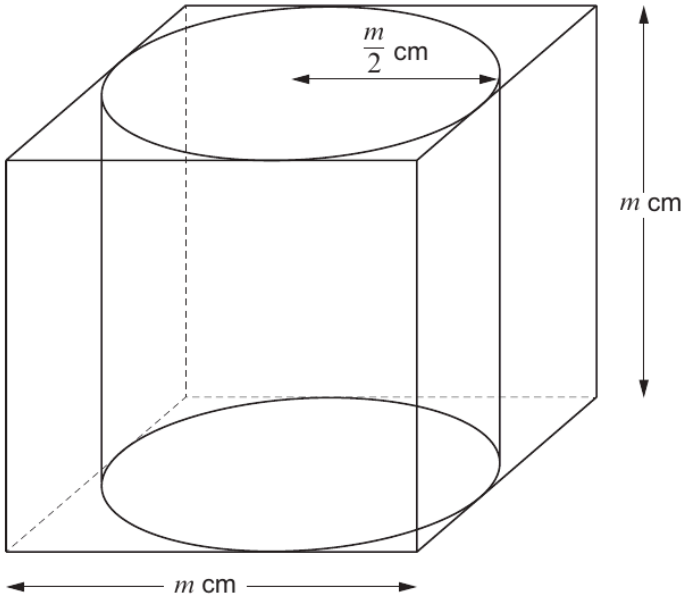


Diagram not drawn to scale

The radius of the cylinder is $\frac{m}{2}$ cm.

The height of the cylinder is m cm.

The ratio of the volume of the cube to the volume of the cylinder is given by

volume of cube : volume of cylinder

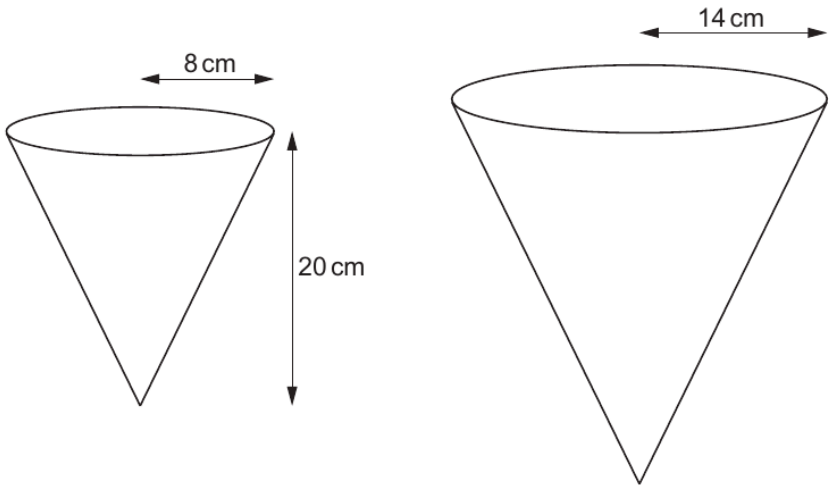
$= k : \pi,$

where k is a number.

Find the value of k.
You must show all your working. [4]

Examiner only

10. The diagram below shows two **similar** flasks for measuring liquid.



Diagrams not drawn to scale

The flasks are in the shape of cones.
The smaller flask has a base radius of 8 cm and a vertical height of 20 cm.
The larger flask has a base radius of 14 cm.

(a) Calculate the vertical height of the larger flask. [2]

Examiner only

(b) The larger flask is now partly filled with liquid up to a vertical height of 15 cm.

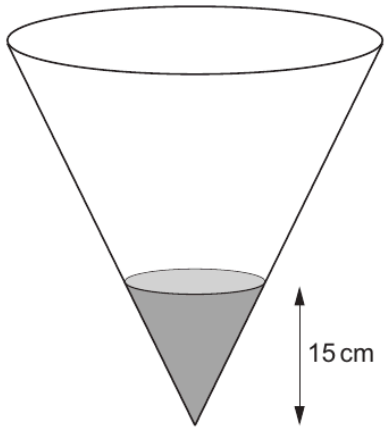


Diagram not drawn to scale

Calculate the volume of liquid in the flask.
Give your answer in terms of π. [4]

Examiner only

11. A cone is joined to a cylinder, as shown below.
The cone has a base radius of 11 cm and a slant height of 13 cm.
The cylinder has the same radius, 11 cm, and a height of 17 cm.
Calculate the **total** surface area of the composite solid. [4]

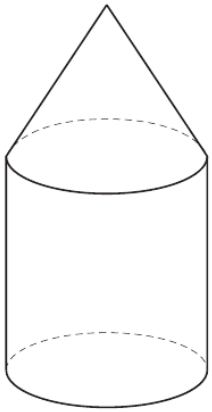


Diagram not drawn to scale

Total surface area = ... cm^2

Examiner only

1. (a) *In this part of the question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

The concrete base of Miss Morgan's new bungalow is shown below.

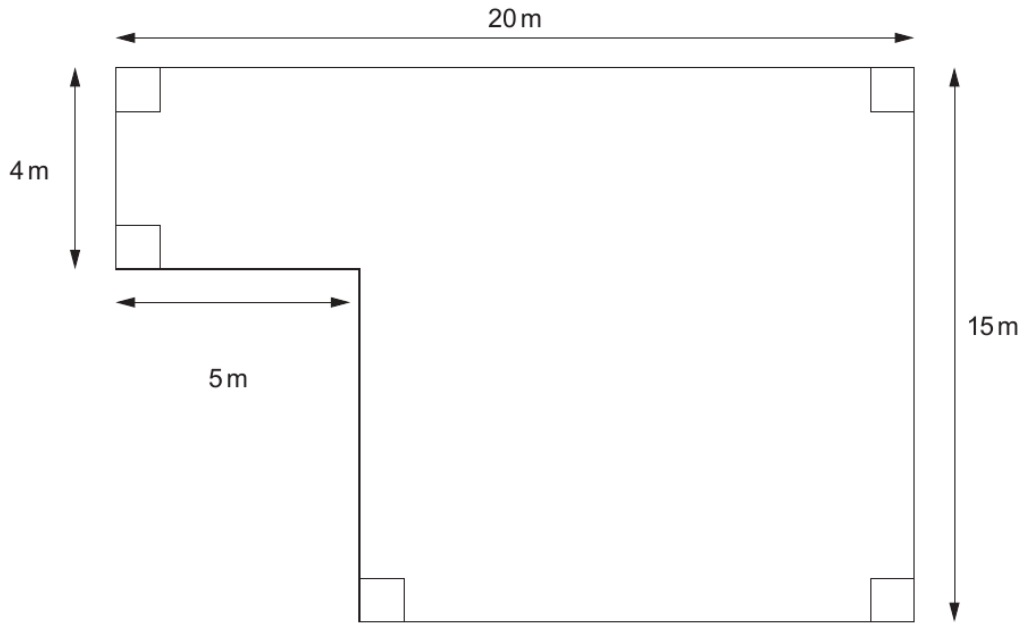


Diagram not drawn to scale

The concrete base of Miss Morgan's bungalow is 0·2 m thick.

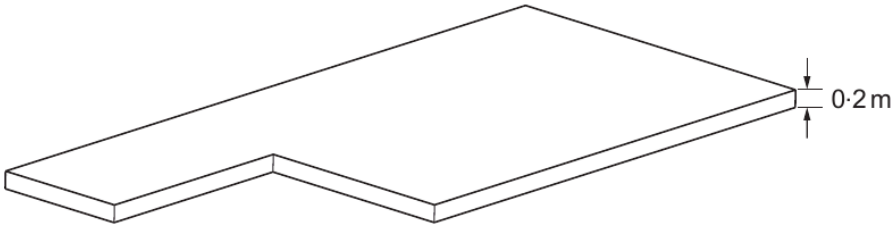


Diagram not drawn to scale

Calculate the volume of the concrete base.
You must show all your working. [4 + 2 OCW]

Examiner only

(b) Mr Graham is building a garage.

A concrete mixer lorry holds a maximum load of 6 m^3 of concrete.
There is a fixed standard delivery charge of £35 per load.
The concrete costs £45 per m^3.

Mr Graham orders $\frac{2}{3}$ of the maximum load of concrete for the base of his garage floor.

What is the total cost of Mr Graham's order? [4]

Total cost is £ .....

5. Hot water is often stored in cylinders.
The water in the cylinder is heated for use in the shower.

A plumbing engineer wants to calculate how long a shower can be used continuously before the water runs cold. He uses the following formulae:

$$C = \frac{H(X - M)}{M - Y} \quad \text{and} \quad T = \frac{C + H}{F}$$

Where:

C is the additional volume of water that feeds into the cylinder, in litres.

H is the volume of hot water that the cylinder holds, in litres.

M is the temperature of the water in the shower, in °C.

X is the temperature of the hot water in the cylinder, in °C.

Y is the temperature of the cold water that feeds into the cylinder, in °C.

T is the time spent using the shower before the water runs cold, in minutes.

F is the rate of flow of water in the shower, in litres per minute.

Daisy's cylinder holds 300 litres of hot water.
The temperature of the hot water in her cylinder is 60°C.
The temperature of the cold water that feeds into Daisy's cylinder is 8°C.

The water in Daisy's shower is set at a temperature of 32°C.
Her shower has a rate of flow of 26 litres per minute.

Examiner only

Use the formulae to calculate

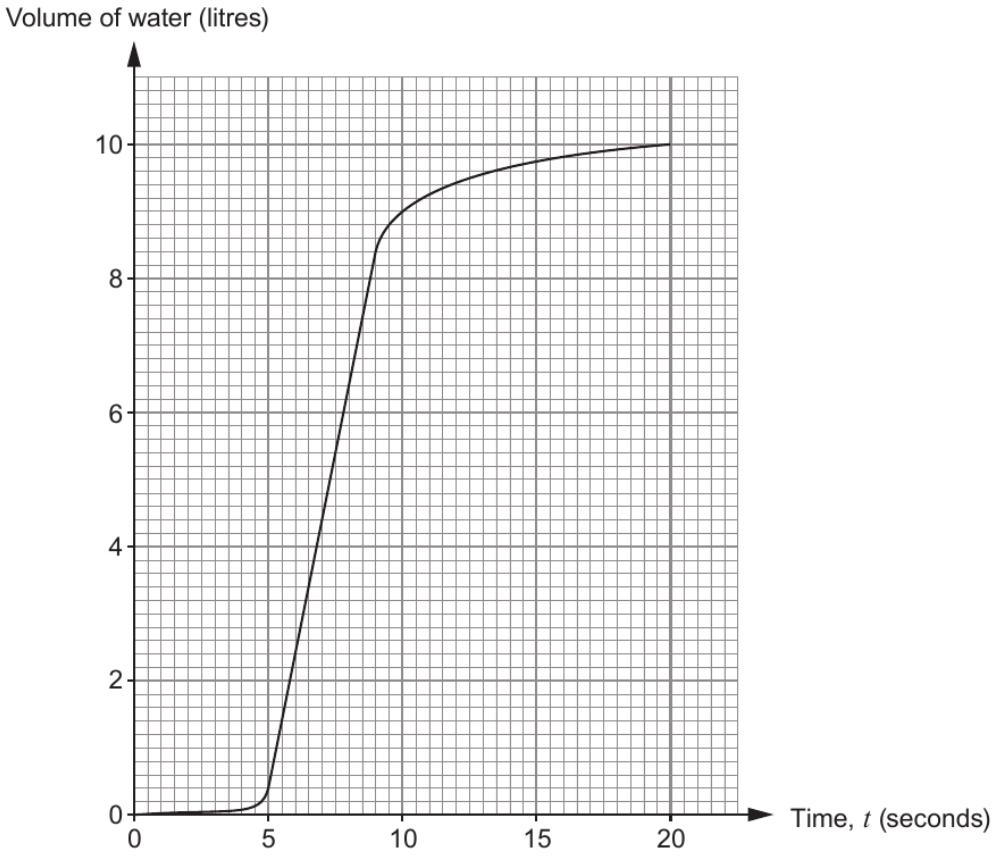
- the additional volume of water that feeds into Daisy's cylinder, in litres,
- the number of minutes Daisy's shower will run continuously before the water runs cold.

[5]

Examiner only

7. Gwen fills a 10-litre bucket with water from a tap.
She turns the tap until it is fully open. The bucket fills up with water, and when Gwen thinks it is close to being full, she slowly closes the tap.
The bucket is full after 20 seconds.

The graph below shows the volume of water in the bucket during the 20 seconds.



(a) After how many seconds did Gwen start to close the tap? [1]

.....

(b) Estimate at what rate water is entering the bucket at time t = 10 seconds.
Give your answer in litres per second. [3]

.....

.....

.....

.....

.....

Examiner only

(c) When the tap is fully open, water flows out at 2 litres per second.

(i) Express 2 litres per second in **gallons per minute**.
You must show all your working. [3]

Remember
1 gallon = 8 pints

(ii) Can a fully open tap fill a 90-gallon tank in under $3\frac{1}{2}$ minutes?
You must show all your working. [2]

Examiner only

10. *(a)* A company makes plastic shelf supports for use in kitchen cupboards.
A shelf support is made by attaching a cylinder to a right-angled triangular prism.

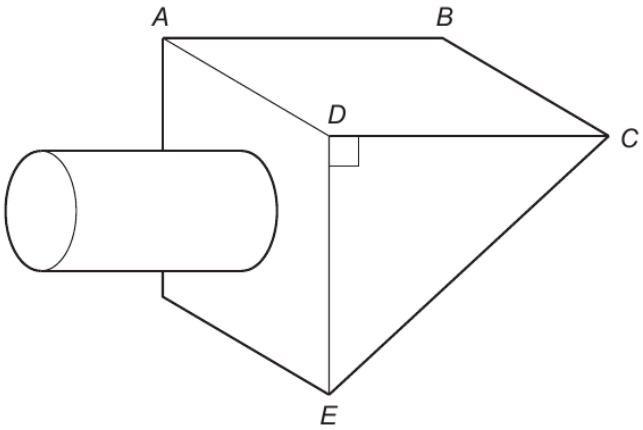


Diagram not drawn to scale

The cylinder has a diameter of 6 mm and a length of 9 mm.
The prism has dimensions CD = 8 mm, DE = 8 mm, CE = 11·3 mm and BC = 10 mm.

The company sells the shelf supports in packs of 500.
It needs to know the volume of plastic in 500 shelf supports.
Calculate the volume of 500 shelf supports. [4]

Volume of 500 shelf supports = ...

Examiner only

(b)

The company also makes metal door handles for kitchen cupboards.
One of the door handles it makes is shown below.
It is formed by joining two cylinders.
One of the cylinders has a diameter of 4 cm and a length of 1·2 cm.
The other cylinder has a diameter of 1·8 cm and a length of 3 cm.

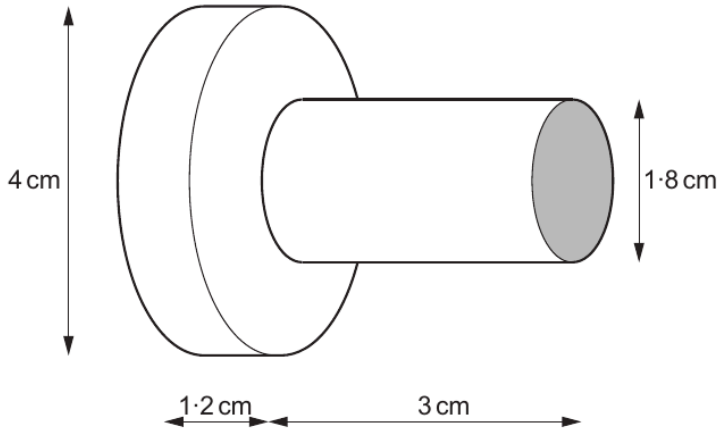


Diagram not drawn to scale

At present, the company paints **all** the surfaces of the handle with a protective finish **after** the two cylinders have been joined together.

The shaded circular face is pressed against a cupboard door when fitted.
In future, the company is not going to paint this shaded circular face. This is to reduce costs.

Calculate the percentage reduction in the area that is painted. [6]

Examiner only

10. Factorise $4m^2 - 289$. [2]

11. Calculate the volume of a pyramid with a base area of 13 200 cm^2 and a perpendicular height of 460 cm.
Give your answer in m^3. [3]

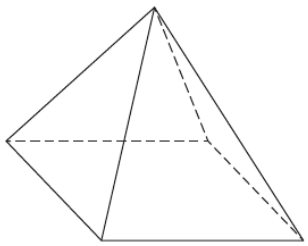


Diagram not drawn to scale

Volume = ... m^3

Examiner only

1. *(a)* Mold is on a bearing of 065° from Ruthin.
What is the bearing of Ruthin from Mold?
Circle your answer. [1]

245° 095° 295° 125° 315°

(b) When it is 19:40 in Cardiff, it is 23:40 in Dubai.

(i) What time is it in Dubai when it is 13:30 in Cardiff?
Circle your answer. [1]

15:30 10:30 09:30 17:30 19:30

(ii) What time is it in Cardiff when it is 02:10 in Dubai?
Circle your answer. [1]

20:10 06:10 22:10 10:10 00:10

Examiner only

4. The diagram below shows an empty cylinder, with radius 10 cm and height 20 cm.

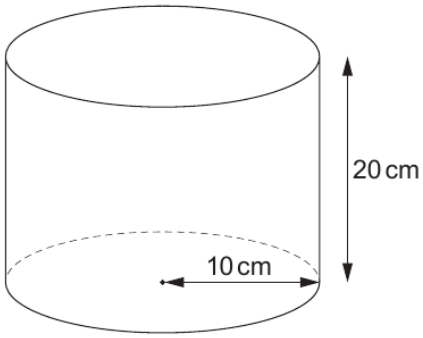


Diagram not drawn to scale

(a) Using $\pi = 3{\cdot}14$, calculate the volume of the cylinder. [2]

.....

.....

.....

.....

(b) What is the greatest **whole** number of litres that this cylinder can hold? [1]

.....

..... litres

Examiner only

4. *(a)* *In this part of the question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

Jade is planning a weekend break to celebrate her 21st birthday.
The weekend break costs £350.
Jade's father says,

'If you save 21% of your earnings each week for the next 20 weeks, I will give you the rest of the money you need.'

Jade earns £72 per week.
How much is Jade's father offering to pay towards her weekend break?
You must show all your working. [4 + 2 OCW]

Examiner only

(b) (i) Jade's new suitcase weighs 3 kg.
When it is packed, her suitcase must not weight more than 25 kg altogether.
What percentage of the 25 kg does Jade have left for packing? [2]

(ii) Which one of the following formulae could be used to work out the volume of Jade's new suitcase?
a, b and c are measurements of the 3 dimensions of the suitcase.
Circle your answer. [1]

$a + b^2 + c$ $\quad 2a^2c - 4\pi b^2$ $\quad abc + \pi a^2 c$ $\quad a^3 - b^2 + c$ $\quad a + b^3 + c$

(c) Jade needs a new passport photograph.
A passport photograph must be 45 mm high by 35 mm wide.

Jade has a mathematically similar photograph that she could reduce in size to use as her new passport photograph.
The height of this photograph is 9 cm.
Calculate the width of this photograph. [2]

Examiner only

5. Cycle frames are made from steel, aluminium or carbon fibre.
The table below gives the density of steel, aluminium and carbon fibre.

Material	Density (g/cm^3)
Steel	7·8
Aluminium	2·7
Carbon fibre	1·6

Owain has a cycle frame made from aluminium.
His cycle frame has a mass of 9450 g.

(a) Calculate the volume of aluminium in Owain's cycle frame.
Give your answer in cm^3. [3]

Volume of aluminium in Owain's cycle frame is ..... cm^3

(b) Bethan has a cycle frame that is identical to Owain's cycle frame.
However, her cycle frame is made from carbon fibre.
Calculate the mass of this frame.
Give your answer in grams. [3]

Mass of this cycle frame is ..... g

Examiner only

8. Heledd is the captain of a cargo ship. She is planning her next voyage.

(a) Heledd has been employed to deliver 3×10^5 tonnes of sand.

Heledd needs to know the volume of the sand before the sand can be loaded on to the ship.
She has been given the following information about the sand:

Mass of a grain of sand	Volume of a grain of sand
$1{\cdot}2 \times 10^{-3}$ grams	$0{\cdot}32\,\text{mm}^3$

(i) Calculate the number of grains of sand in 3×10^5 tonnes of sand.
Give your answer in standard form. [3]

(ii) Calculate the volume of the 3×10^5 tonnes of sand in $\mathbf{m^3}$. [3]

..... m^3

Examiner only

(b) Heledd has been given the following instructions for her voyage:

- From port *A*, sail 200 km due south to port *B*.
- From port *B*, sail due east to port *C*.
- From port *C*, sail on a bearing of 318° back to port *A*.

Use the space below to draw a sketch of the ship's voyage.

Calculate the distance from port *C* directly back to port *A*. [4]

.....

.....

.....

.....

.....

.....

Examiner only

(c) The last time the cargo ship was unloading sand in port *B*, it took 3 cranes 45 hours to unload 250 000 tonnes of sand.

Port *B* now has 5 cranes.
Calculate the time it will take 5 cranes to unload 300 000 tonnes of sand.

You can assume that all cranes unload sand at the same rate, and that all other conditions remain the same.

Give your answer in **hours** and **minutes**.
You must show all your working.

[4]

Time it will take is ..... hours and ..... minutes

Examiner only

10. Gardeners can apply weedkiller to large areas of land by using a spray gun. Weedkiller is stored in a large bottle that gardeners carry on their backs, and this feeds the spray gun.

A gardening company has designed the bottle shown below.
It consists of a hollow cylinder and cone that are joined.

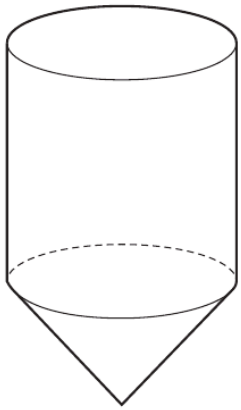


Diagram not drawn to scale

The base radius of the cone and the radius of the cylinder are both 9 cm.
The height of the cylinder is four times the vertical height of the cone.

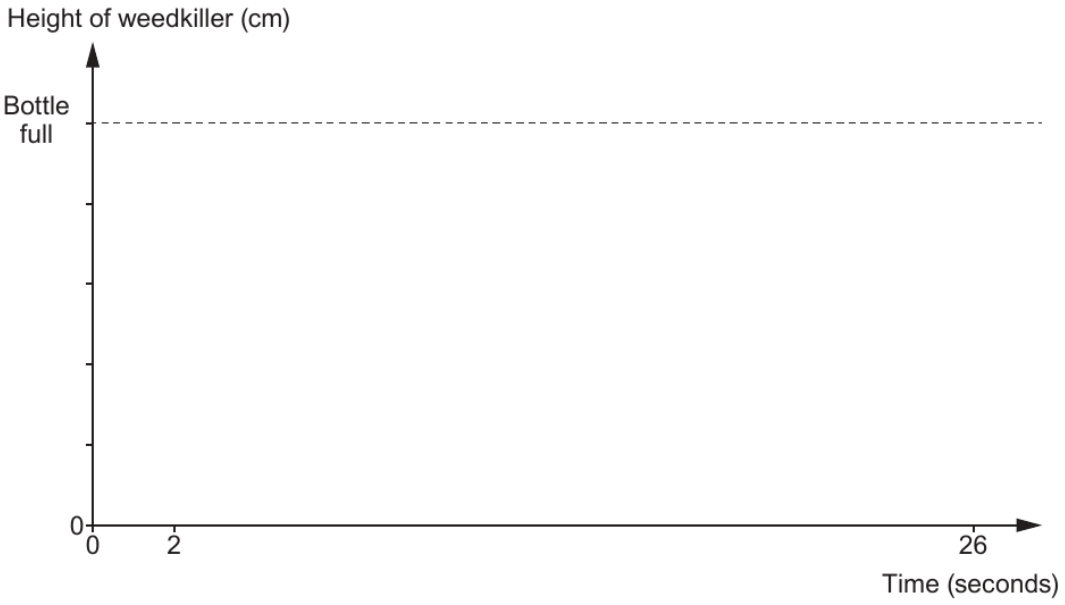
The bottle has been designed so that it has a capacity of 10 litres.

(a) Calculate the total height of the bottle. [7]

Total height of the bottle = ... cm

Examiner only

(b) Weedkiller is poured into the bottle at a constant rate.
The cone is full of weedkiller after 2 seconds.
The bottle as a whole is full after 26 seconds.
Using the axes below, sketch a graph of the height of weedkiller in the bottle during the 26 seconds it takes to fill. [2]



END OF PAPER

Examiner only

12. Calculate the **total** surface area of a solid hemisphere with a base radius of 29 cm. [4]

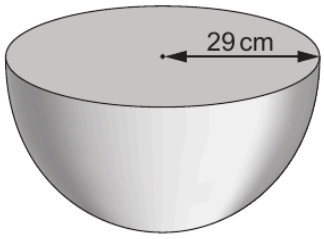


Diagram not drawn to scale

Total surface area = ... cm^2

Examiner only

13. Taryn made a birthday cake for her brother Carwyn, and placed it on a cake stand.
She made a cylindrical cake of radius 12 cm and height 10 cm.
To make the birthday cake look like the letter 'C' for Carwyn, she cut out a large slice.

The cake she has left has a uniform cross-section in the shape of a sector of a circle with sector angle 300º.

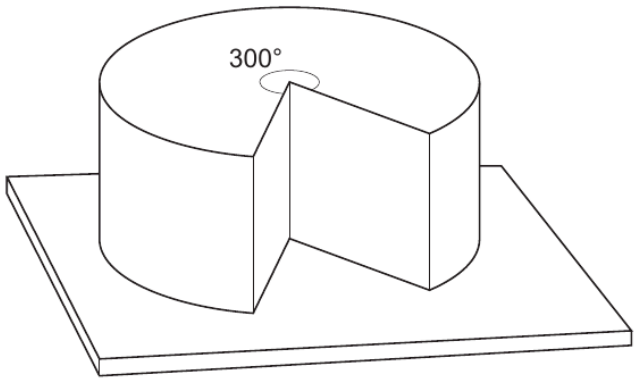


Diagram not drawn to scale

Taryn wants to put icing on all the visible surfaces of the cake.
Calculate the surface area that needs to be covered with icing.
Give your answer, **in its simplest form**, in terms of π. [5]

Examiner only

1. *Rupert Shoes* sells shoes online.
Pairs of shoes are packed in shoeboxes.
The dimensions of the shoebox used are given on the diagram below.

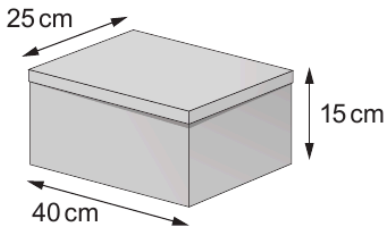
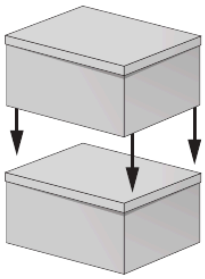


Diagram not drawn to scale

A customer orders 2 pairs of shoes.

The package for sending the shoes to the customer is made by:
- placing one box on top of the other, and
- taping the two boxes together.

This is shown in the diagram.



The cost for sending the package is calculated using the formula below.
All dimensions are measured in cm.

$$\text{Cost in £} = \frac{1}{5} \times (S + F) \times 0{\cdot}02$$

S = value of the sum of the 3 dimensions of the package
F = value of the area of one of the **largest** faces of the package

How much does it cost *Rupert Shoes* to send the package?
Give your answer in pounds.
You must show all your working. [5]

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03

Examiner only

2. *(a)* (i) The internal measurements of a tin of baked beans are:

- radius 3·6 cm,
- height 9·3 cm.

Calculate the internal volume of the tin. [2]

(ii) Every 1 cm^3 of baked beans in a tin has a mass of 1 g.
A portion of baked beans is $\frac{1}{2}$ a tin.
What is the mass of a portion of baked beans? [1]

A portion of baked beans has a mass of ..... g

(b) A mathematically similar tin of baked beans has a radius of 4·2 cm.

Diagram not drawn to scale

Calculate the height of the larger tin of beans. [2]

Examiner only

(c) In a portion of baked beans there is:
- 1·85 g of salt,
- 11·7 g of sugar.

For women, the recommended daily allowance of:
- salt is 6 g,
- sugar is 90 g.

Consider a portion of baked beans.
Is it salt or sugar that provides the greater proportion of the recommended daily allowance for women?
You must show all your working. [3]

Examiner only

5. You are given that:
1 gigalitre = 1 000 000 m^3
1 megalitre = 1 million litres

Lake Vyrnwy is a reservoir in mid Wales.

(a) Lake Vyrnwy can release between 25 and 45 megalitres of water per day from the dam.

The lake also supplies water through underground pipes to another reservoir at a rate of 230 000 m^3 per day.

(i) How many litres are there in 25 megalitres?
Circle your answer. [1]

25×10^8 25×10^{-6} 25×10^7 $2{\cdot}5 \times 10^6$ $2{\cdot}5 \times 10^7$

(ii) Which is the best estimate for the volume of water passing through the underground pipes **per hour**?
Circle your answer. [1]

8500 m^3 9600 m^3 10 040 m^3 10 400 m^3 11 000 m^3

Examiner only

(b) Lake Vyrnwy has a surface area of approximately $4\,540\,000\,m^2$.
Lake Vyrnwy contains 59·7 gigalitres of water.

Calculate an estimate of the average depth of the lake.
Give your answer in metres.

[3]

Estimate of average depth is ..... m

Examiner only

8. Bronwen is investigating the increase in the growth of algae on the surface of a pond.
The surface area covered by the algae is measured in cm^2.
She finds the surface area covered by the algae t **days** after the start of her investigation is given by the following expression.

$$400 + 4^{\frac{t}{2}}$$

(a) What surface area was covered by algae at the start of her investigation?
Circle your answer. [1]

$404\,cm^2$ $401\,cm^2$ $4\,cm^2$ $402\,cm^2$ $400\,cm^2$

(b) Bronwen calculated the surface area covered by the algae 5 days after the start of the investigation.
She also calculated the surface area 7 days after the start of the investigation.
By how much did the surface area covered by the algae increase between these two times? [3]

Examiner only

8. A company makes buckets in two sizes. Both sizes are in the shape of a frustum of a cone. Bucket A has the dimensions shown in the diagram below.

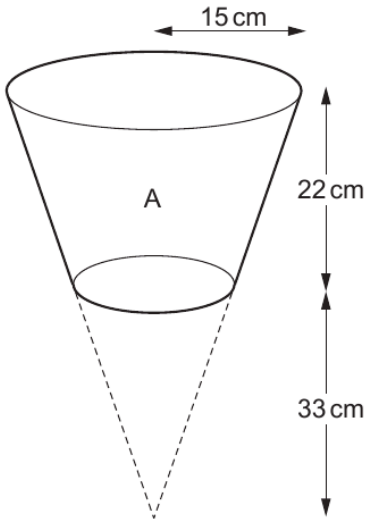


Diagram not drawn to scale

(a) Show that:

- the radius of the base of the bucket is 9 cm,
- the volume of the bucket is $3234\pi\,\text{cm}^3$. [5]

Examiner only

(b) Bucket B is shown below. It is mathematically similar to Bucket A.

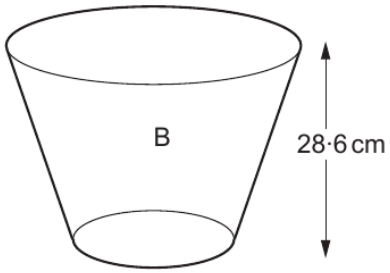


Diagram not drawn to scale

Calculate the number of **gallons** Bucket B can hold when full. [6]

Remember:

1 gallon = 8 pints

Examiner only

8. Bronwen is investigating the increase in the growth of algae on the surface of a pond.
The surface area covered by the algae is measured in cm^2.
She finds the surface area covered by the algae t **days** after the start of her investigation is given by the following expression.

$$400 + 4^{\frac{t}{2}}$$

(a) What surface area was covered by algae at the start of her investigation?
Circle your answer. [1]

$404\,cm^2$ $401\,cm^2$ $4\,cm^2$ $402\,cm^2$ $400\,cm^2$

(b) Bronwen calculated the surface area covered by the algae 5 days after the start of the investigation.
She also calculated the surface area 7 days after the start of the investigation.
By how much did the surface area covered by the algae increase between these two times? [3]

Examiner only

11. *(a)* Alun is a jeweller.
He is designing a symmetrical pendant, as shown below.

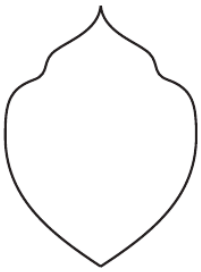
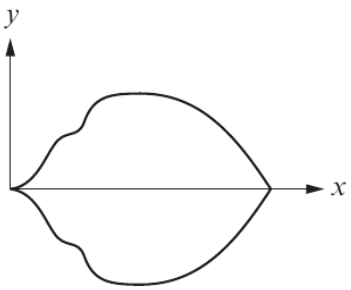
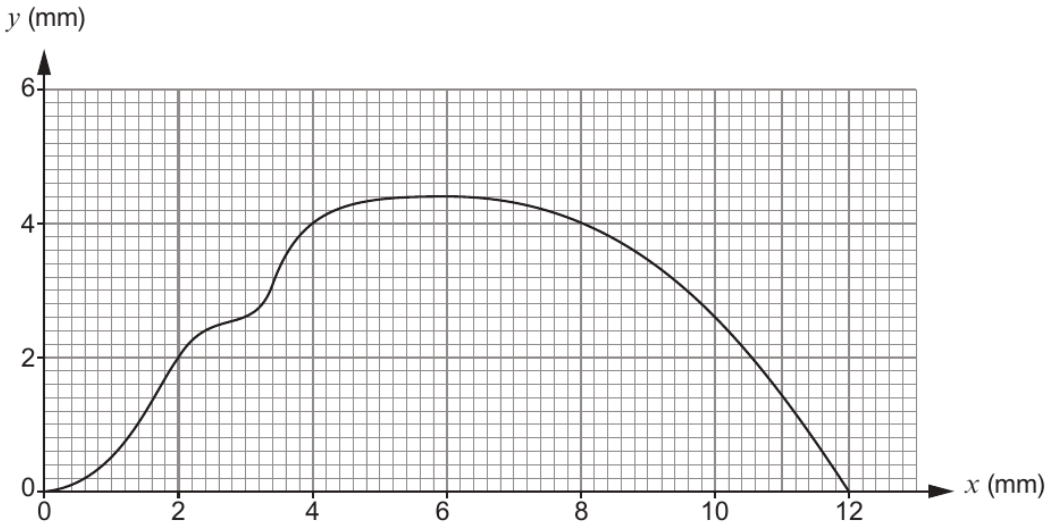


Diagram not drawn to scale

The pendant will be made from solid silver, with a uniform thickness of 3 mm.
In order to calculate the cost of making the pendant, Alun wants to calculate an estimate of the volume of the pendant.
He has accurately drawn one of the symmetrical halves of the shape on graph paper.



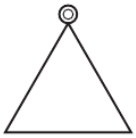
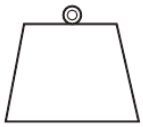


Examiner only

Calculate an estimate of the volume of the whole pendant.
Use the graph opposite, with 6 strips of equal width. [5]

Examiner only

(b) Alun makes pendants that are mathematical shapes.
The following table shows the pendants and the number of these pendants that Alun made last month.

	Triangle	Circle	Rectangle	Trapezium
Pendant				
Number made last month	52	96	30	62

At the end of last month, Alun took a stratified sample of 30 of these 240 pendants to check their quality.

Calculate how many pendants of each shape were in Alun's sample.
You must show all your working. [4]

Pendant	Triangle	Circle	Rectangle	Trapezium
Number in sample				

Examiner only

(c) Alun has 5 identical metal cylinders, each of length 40 mm.

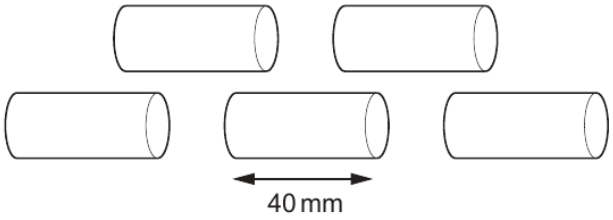


Diagram not drawn to scale

He has been asked to make a solid sphere of radius 30 mm.

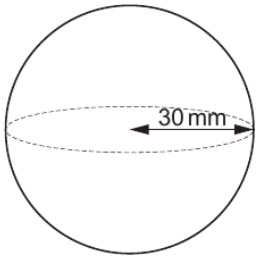


Diagram not drawn to scale

He melts the 5 cylinders and recasts all the metal to make the sphere.

Calculate the radius of each of the cylinders.

Give your answer in mm, in the form $a\sqrt{b}$, where a and b are integers, and b is as small as possible. [6]

Examiner only

16. The diagram shows a cylinder.
The cylinder has a base of radius r and a height of $\frac{r}{6}$.

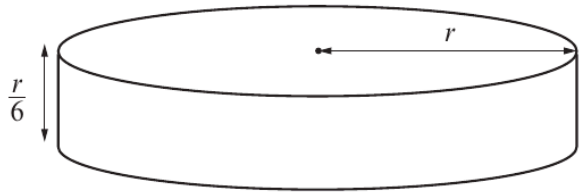


Diagram not drawn to scale

A sphere has radius R.
The volume of the sphere is equal to the volume of the cylinder.
Find R in terms of r.
Give your answer in its simplest form. [4]

Examiner only

20. Two **similar** solids have base areas of $47\,cm^2$ and $199\,cm^2$, as shown below.
The volume of the smaller solid is $350\,cm^3$.

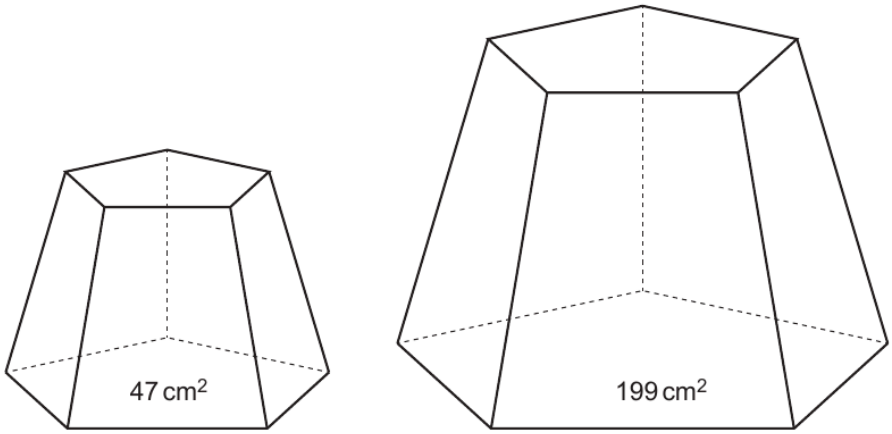


Diagram not drawn to scale

Calculate the volume of the larger solid. [4]

END OF PAPER

Examiner only

7. In the following formulae, each measurement of length is represented by a letter.

Consider the dimensions implied by the formulae.
For each case, write down whether the formula could be for a **length**, an **area**, a **volume** or **none of these**.

The first one has been done for you. [3]

Formula	Formula could be for
$3{\cdot}14r^2 - dw$	area
$w^3 + r^2d$	.....
$3w + 2d + h$	.....
$dhr + 5d^3$	.....
$4d + \pi r^2$	.....
$\frac{dwh}{r}$	.....

Examiner only

7. A solid object is made by drilling a cylindrical hole of radius 4 cm through a cuboid measuring 20 cm by 15 cm by 10 cm as shown below.

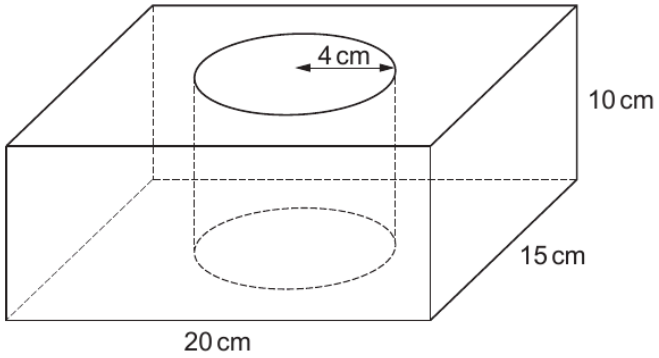


Diagram not drawn to scale

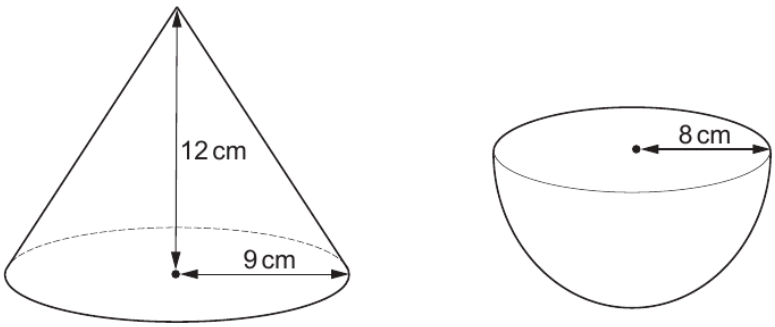
(a) Calculate the volume of the object.
Give your answer in cm^3. [3]

Volume = ... cm^3

Examiner only

10. *In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

The diagrams below show a solid cone and a solid hemisphere.



Diagrams not drawn to scale

The cone has a base radius of 9 cm and a vertical height of 12 cm.
The hemisphere has a radius of 8 cm.

Which of the two solids has the greater **curved** surface area?
You should express any areas in terms of π.
You must show all your working. [7 + 2 OCW]

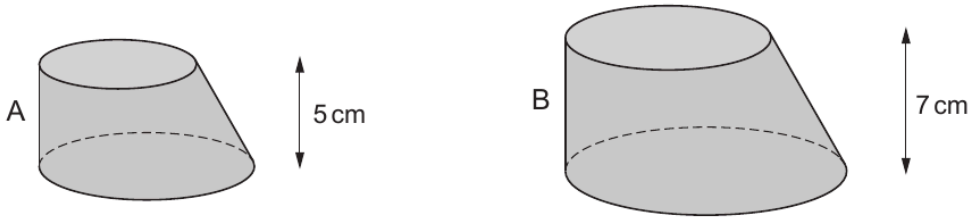
Examiner only

11. Write 16^{100} in the form 2^n. [2]

12. Calculate the perpendicular height of a cone with a volume of $5533\,\text{cm}^3$ and a base area of $825\,\text{cm}^2$. [3]

Examiner only

11. Two **similar** solids are shown below.



Diagrams not drawn to scale

Solid A has a height of 5 cm.
Solid B has a height of 7 cm.

Mari claims that the surface area of solid B is more than double the surface area of solid A.
Is Mari correct?
You must justify your answer. [2]

Examiner only

15. A solid object is made out of a hemisphere and a cylinder.

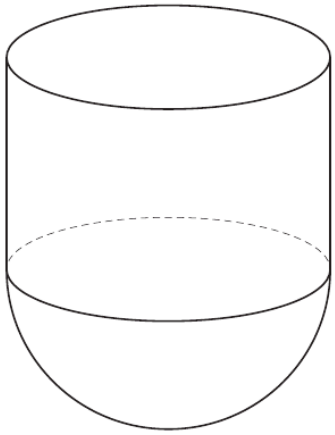


Diagram not drawn to scale

The radius of the common circular surface is 3 cm.
The volume of the whole object is $63\pi\,\text{cm}^3$.

Calculate the total height of the object. [5]

Examiner only

2. (a) Make m the subject of the formula $w = 8m - 3$. [2]

(b) Expand and simplify $(y + 5)(y - 4)$. [2]

3. The height of a cylinder is 24·8 cm.
The ratio of the **diameter** of the cylinder to the height of the cylinder is 3 : 2.

Find the volume of the cylinder.
Give your answer correct to 2 significant figures.
You must show all your working. [5]

Examiner only

9. Calculate the **total** surface area of a **solid** hemisphere with a radius of 34 cm. [4]

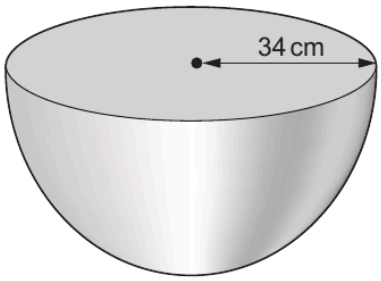


Diagram not drawn to scale

Total surface area = ... cm^2

Examiner only

17. Solid A and Solid B are **similar**.

Solid A has a volume of $8000\,cm^3$ and a height of 30 cm.
Solid B has a volume of $4913\,cm^3$.

Calculate the height of Solid B. [3]

Height of Solid B = ... cm

END OF PAPER

Examiner only

1. *In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

Last year, Viktor's total income before tax was 28000 euros.

The tax bands, taxable income and tax rates for last year were as follows:

Band	Taxable income	Tax rate
Personal allowance	Up to 10000 euros	0%
Basic rate	10000 euros to 25000 euros	22%
Higher rate	Over 25000 euros	35%

Viktor has already paid 3600 euros towards his income tax bill for last year.
Calculate how much income tax Viktor still owes.
You must show all your working. [7 + 2 OCW]

Examiner only

1. (a) *In this part of the question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

Malik has two orchards.
He has apple trees and pear trees in his north orchard.
He has pear trees and cherry trees in his west orchard.

In the north orchard,
- Malik has a total of 35 trees
- number of apple trees : number of pear trees = 4 : 3.

In the west orchard,
- Malik has twice as many **pear** trees as he has **pear** trees in the north orchard
- number of pear trees : number of cherry trees = 5 : 11.

How many **cherry** trees does Malik have?
You must show all your working. [5 + 2 OCW]

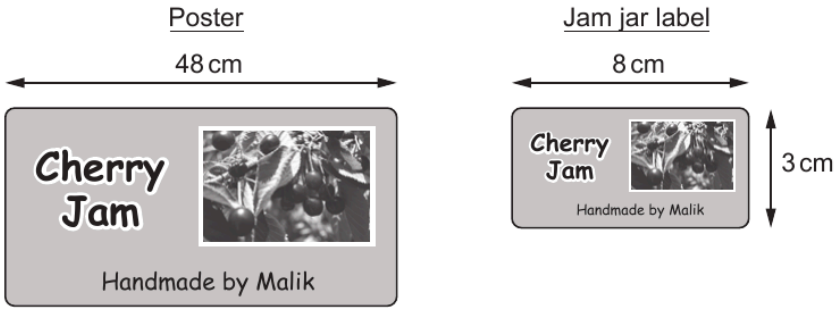
Examiner only

(b) Malik's crop of apples this year has a total mass of 5280 pounds.
He makes apple juice from $\frac{1}{6}$ of the mass of his apple crop.
Malik makes 2 litres of apple juice from every 5 kg of apples.

Calculate the number of litres of apple juice Malik makes. [6]

Examiner only

(c) Malik makes cherry jam using some of the fruit from his trees.
Malik makes a poster to advertise his jam.
He also makes labels for the jars.
The poster and the labels are mathematically similar.



Diagrams not drawn to scale

Calculate the height of the poster. [2]

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Examiner only

4. Melin is a company that packages flour for sale in supermarkets.
It packages the flour in cylindrical bags.
The area of the cross-section of each of these bags is $25\,cm^2$.

(a) Write down an expression, in terms of π, for **the radius of the base** of each of these bags. [2]

(b) Each bag has a volume of $500\,cm^3$.

(i) Currently the bags are filled with flour at a rate of $\frac{1}{4}$ of a bag per second.
Complete the following statement. [2]

Melin packages bags of flour at a rate of ..... cm^3 per minute.

(ii) A new cylindrical bag is designed to have the same capacity and to be more stable.

Melin decides to increase the area of the cross-section of its original bags by 100%.
Calculate the height of this new bag. [2]

Examiner only

6. In the following formulae, each measurement of length is represented by a letter.
Consider the dimensions implied by each formula.
For each case, write down whether the formula could be for a length, an area, a volume or none of these.

The first one has been done for you. [3]

Formula	Formula could be for
$7a^3 - abc$	volume
$7ab - 5b^2 + \frac{a^2b}{c}$	.....
$5abc - 6bc + b^2$	.....
$4a^2b + 4b^2a$	.....
$3a + 8b + 2c$	.....
$a^2 - abc$	.....

Examiner only

7. (a) The Great Pyramid of Giza, in Egypt, is the oldest of the Seven Wonders of the Ancient World.

It is a square-based pyramid of base length 230 m.
It stands on horizontal ground.
Each of the sloping **edges** of the pyramid has a length of 217 m.

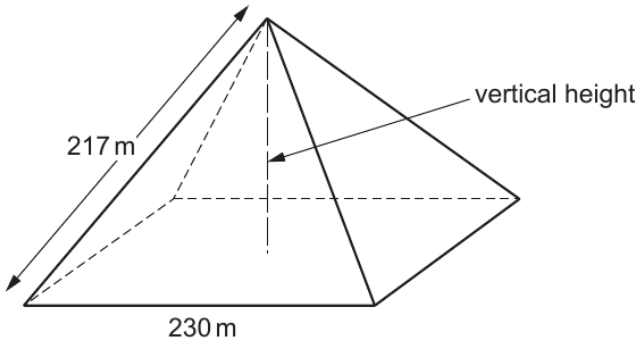


Diagram not drawn to scale

Calculate the volume of the Great Pyramid of Giza. [7]

Examiner only

(b) (i) A gift shop in Giza makes souvenir pyramids.
They are based on the Great Pyramid.
The shop paints all the faces of the souvenir pyramids.
The base length of a souvenir pyramid is related to the total surface area to be painted by the formula:

$$b = \sqrt{\frac{A}{1 + \tan 58^\circ}}$$

where:
- b is the base length
- A is the total surface area to be painted.

Calculate the total surface area to be painted of a souvenir pyramid that has a base length of 12 cm. [3]

(ii) The Sphinx is another ancient monument that sits next to the Great Pyramid.
The shop sells two sizes of Sphinx souvenirs that are mathematically similar.

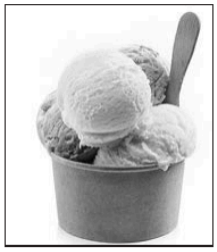
Diagrams not drawn to scale

The small souvenir has a length of 15 cm and a total surface area to be painted of 400 cm^2. The large souvenir has a length of 31·5 cm.
Calculate the total surface area to be painted of the large souvenir. [3]

Examiner only

Estimate of the volume of water in the pond = ... m^3

9. (a) Gerallt owns 2 ice cream shops.



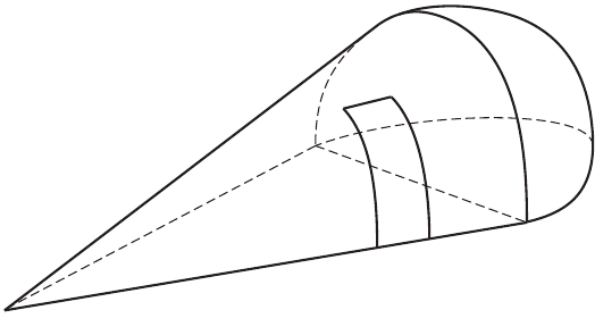
On a sunny Saturday, Gerallt sold 400 ice creams in total in 4 hours in the 2 shops.

Gerallt is considering opening another ice cream shop.
He expects the sales per hour in each of the 3 shops to be the same.

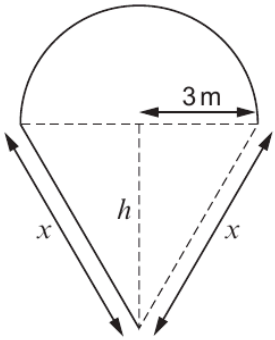
His ice cream shops will be open for 5 hours a day.
Calculate how many ice creams Gerallt would expect to sell in total on a sunny Saturday in 5 hours in the 3 shops.
You must show all your working. [3]

Examiner only

(b) Gerallt has decided to open a new ice cream shop at his local seafront.
He has designed his new ice cream shop to look like half an ice cream cone.
The design consists of half a hollow cone connected to half a hollow hemisphere, as shown below.



Plan view



Diagrams not drawn to scale

The radius of the base of the half hemisphere is 3 m.
The perpendicular height of the cone is shown as h on the diagram above.

Gerallt designed the shop so that the volume of the half cone is equal to the volume of the half hemisphere.

Calculate the length x. Give your answer in the form $a\sqrt{b}$, where a and b are both integers and b is as small as possible. [8]

Examiner only

11. A cone is joined to a hemisphere, as shown below.
The cone has a base radius of 8 cm and a slant height of 17 cm.
The hemisphere has the same radius as the cone.
Calculate the **surface area** of the composite solid. [3]

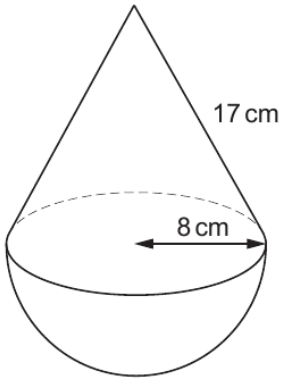


Diagram not drawn to scale

Examiner only

16. A cone and a cylinder have equal volumes.
The cone has a base radius of r cm and a height of h cm.

The cylinder has a base radius of r cm and a height of $\frac{3}{2}r$ cm.

Find h in terms of r.
You must express your answer in its simplest form. [3]

Examiner only

8. In the following formulae, each measurement of length is represented by a letter.

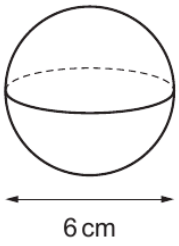
Consider the dimensions implied by each formula.
For each case, write down whether the formula could be for a length, an area, a volume or none of these.

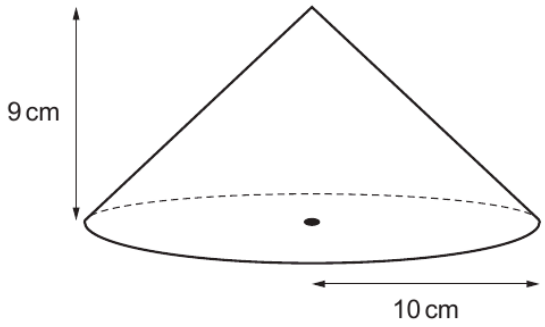
The first one has been done for you. [3]

Formula	Formula could be for
$4d + r - 2w$	length
$w(l + b + h)$	.....
$d^3 + 3 \cdot 14r$	.....
$\frac{w^3}{d^2}$	.....
$3 \cdot 14r^3 - lbh$	.....
$\frac{4w^2}{d}$	.....

Examiner only

12. A sphere has a diameter of 6 cm.
A cone has a base radius of 10 cm and a height of 9 cm.





Diagrams not drawn to scale

Find the ratio of the volume of the sphere to the volume of the cone.
Give your answer in its simplest form. [4]

Volume of the sphere : Volume of the cone

= ..... : .....

Examiner only

1. Rhodri is organising a 21st birthday party.

(a) Confetti for the party is packed in small boxes.
Each box is in the shape of a triangular prism.
The cross-section of each box is an isosceles triangle.
The measurements are shown on the diagram below.

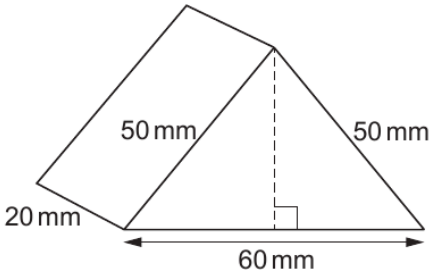


Diagram not drawn to scale

(i) Show that the perpendicular height of the cross-section of a confetti box is 40 mm.
You must show all your working. [3]

(ii) This is the label on a confetti box..

> The volume of this box is at least 20000 mm^3.

Calculate the volume of a confetti box to show that the statement on the label is correct. [3]

Examiner only

2.

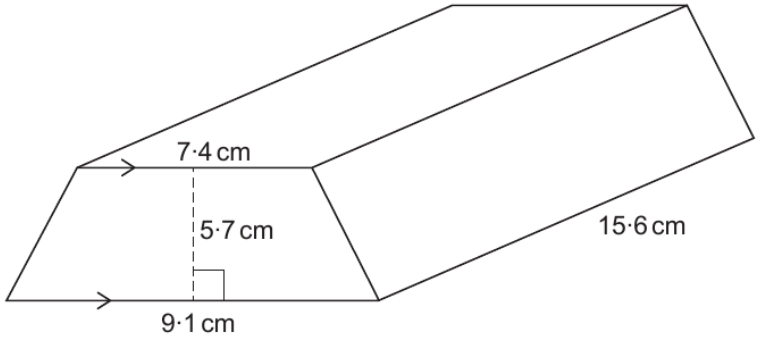


Diagram not drawn to scale

(a) Find the volume of the solid prism shown above. [3]

(b) The solid prism is made of gold.
Gold has a density of 19·3 g/cm^3.

Calculate the mass of the prism.
Give your answer in **kilograms**. [3]

Mass of the prism = ... **kg**

Examiner only

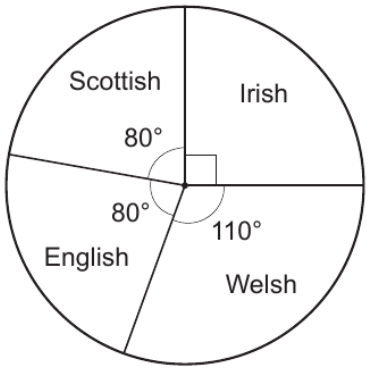
14. A solid has a height of 225 cm.
A larger, mathematically **similar** solid has a height of 855 cm.
The surface area of the smaller solid is 5300 cm^2.

Calculate the surface area of the larger solid. [3]

Examiner only

1. *In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

7200 spectators at a sports event were asked their nationality.
The results are displayed in the pie chart below.



For the Welsh spectators, the ratio of the number of adults to the number of children was 6 : 5.
How many adult Welsh spectators were at the event?
You must show all your working. [4 + 2 OCW]

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Examiner only

2. *In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

The right-angled triangle ABC is a cross-section of a prism, as shown below.

$AB = 9\,\text{cm}$, $BC = 10\,\text{cm}$ and $A\hat{B}C = 90°$.
The length of the prism is 20 cm.

Calculate the volume of the prism.
You must show all your working. [4 + 2 OCW]

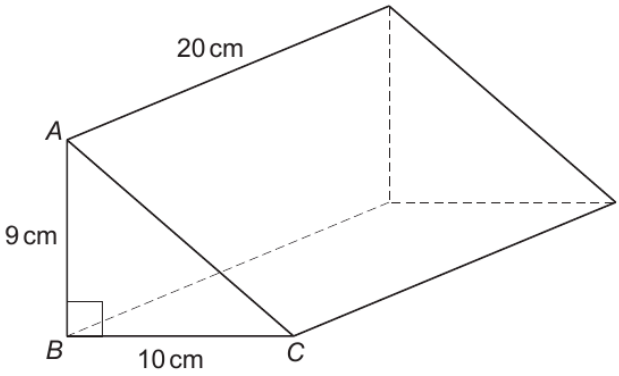


Diagram not drawn to scale

Examiner only

4. *In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

The diagram below shows a water container.
It is formed from an open rectangular tank with a solid cylinder attached to its base inside the tank.

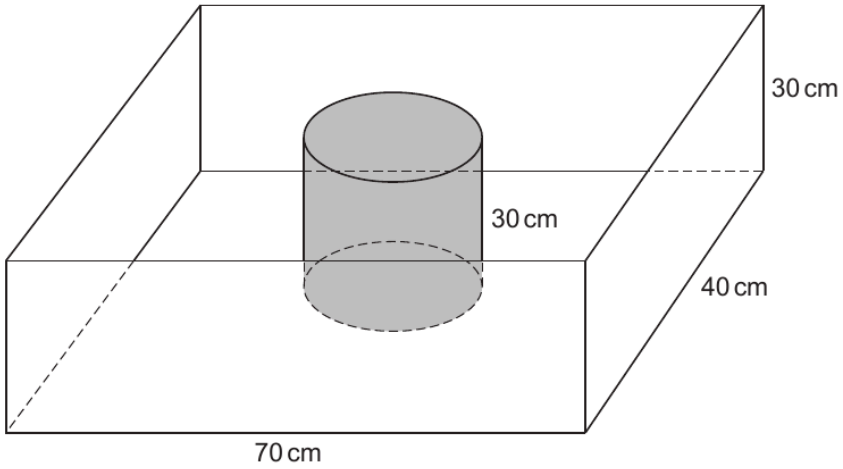


Diagram not drawn to scale

The base radius of the cylinder is 10 cm.
The height of the cylinder is 30 cm.

How many **litres** of water can the container hold?
You must show all your working. [6 + 2 OCW]

Examiner only

6. Most aircraft are held together with metal rivets.

(a) The rivet used on one type of aircraft is shown below. It can be thought of as a cylinder connected to a hemisphere.

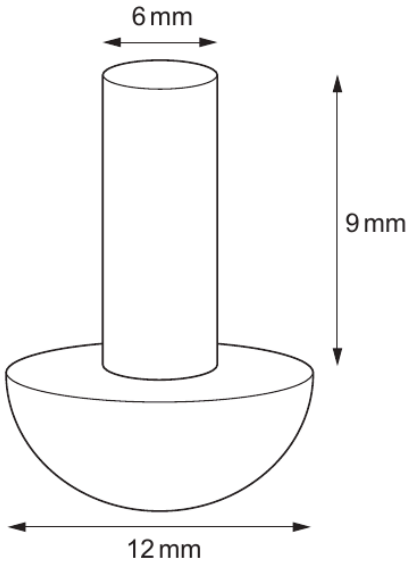


Diagram not drawn to scale

The cylinder has a diameter of 6 mm and a length of 9 mm.
The hemisphere has a diameter of 12 mm.

(i) Calculate the volume of the rivet.
Give your answer in terms of π in its simplest form. [4]

Examiner only

(ii) The manufacturer plans to reduce the length of the cylindrical part of the rivet from 9 mm to 8 mm.
Calculate the fractional reduction in the volume of a rivet this would produce. [2]

Fractional reduction in the volume of a rivet = ...

(b) For another type of rivet, the manufacturer plans to reduce the volume by $0{\cdot}16\dot{1}$ of its original volume.
Write $0{\cdot}16\dot{1}$ as a fraction.
Give your answer in its simplest form. [3]

Examiner only

12. The pyramid below has a horizontal rectangular base *ABCD*.
The point *O* is the top of the pyramid. It is vertically above the point *A*.
OC = 113 cm, *AB* = 72 cm and *CB* = 84 cm.

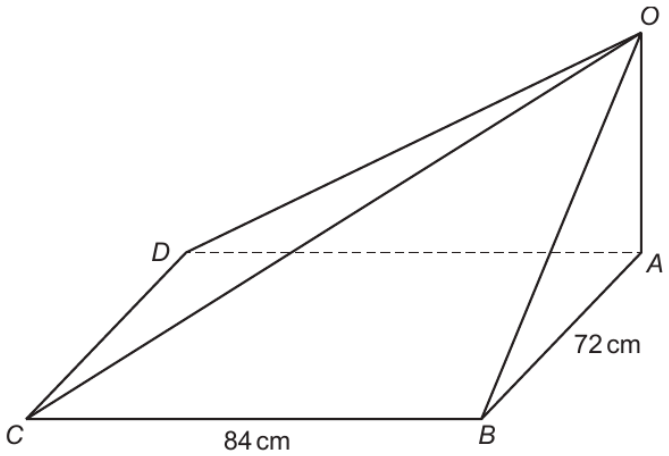


Diagram not drawn to scale

(a) Calculate the length of *OA*, the vertical height of the pyramid. [4]

(b) Calculate the volume of this pyramid. [2]

Examiner only

1. *In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

Geralllt is planning to go to the Maldives.

His local exchange shop:

- sells **20 Maldivian rufiyaa** (MVR) for **£1**
- takes all possible British notes and coins
- sells MVR notes, but only has 500 MVR and 1000 MVR notes available.

Geralllt has £360 to buy Maldivian rufiyaa (MVR).

Calculate:

- the maximum number of Maldivian rufiyaa (MVR) that Geralllt can buy
- how much this will cost him.

You must show all your working. [5 + 2 OCW]

Examiner only

4. A fire surround is made from concrete.

The fire surround has a uniform cross-section.
The edges of the fire surround are all either horizontal or vertical, as shown in the diagram.

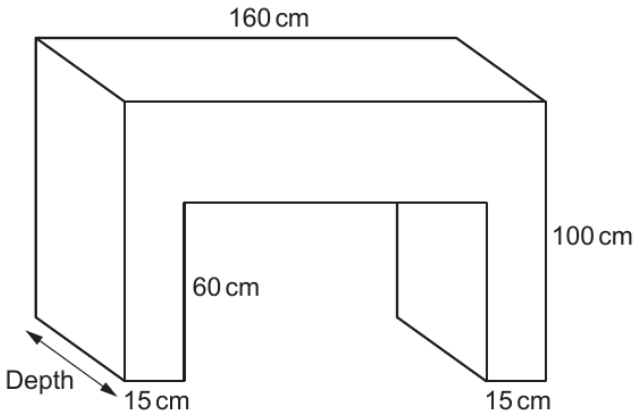


Diagram not drawn to scale

The volume of the concrete in the fire surround is 164 000 cm^3.

Calculate the depth of the fire surround.
Give your answer in centimetres.
You must show all your working. [5]

Depth of fire surround is ..... cm

Examiner only

7. Isaac and his sister Mari are both going to open savings accounts.

(a) Isaac decides to invest some of his savings in the Hereford Saver account.
Details of the account are shown below.

Hereford Saver account

Monthly interest rate 0·26%

Calculate the AER that the Hereford Saver account offers.
Give your answer as a percentage. [2]

Examiner only

(b) Mari invests £3000 in the Silver Plus savings account.
Details of the account are shown below.

Account name	Nominal annual rate	Interest paid
Silver Plus	2·48%	Quarterly

Mari does not withdraw any money or make any further payments into the account.
Mari closes the account after 10 years.

Calculate the percentage increase in the value of her investment.
You must show all your working. [5]

Examiner only

8. The diagram shows a **solid** cylinder with radius 10 cm.
The total **surface area** of the solid cylinder is 1570·8 cm^2.

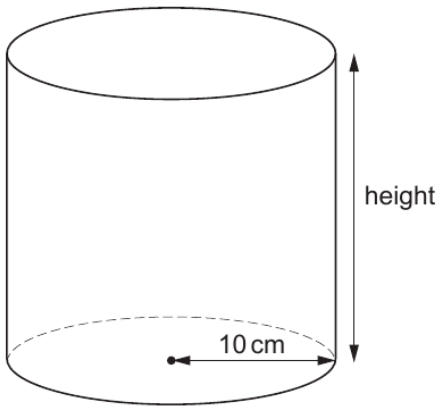
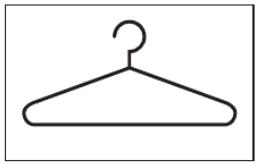


Diagram not drawn to scale

Find the height of the cylinder. [5]

Examiner only

9. Hang-Up is a company that makes clothes hangers.
One type of hanger is made from a single length of metal wire that is bent to form the hanger.



(a) (i) The design for the main part of the hanger is shown below.
This part of the hanger is symmetrical.
It has straight sections of length 24 cm and 38 cm.
It also has curved sections that are arcs of a circle of radius 3 cm.

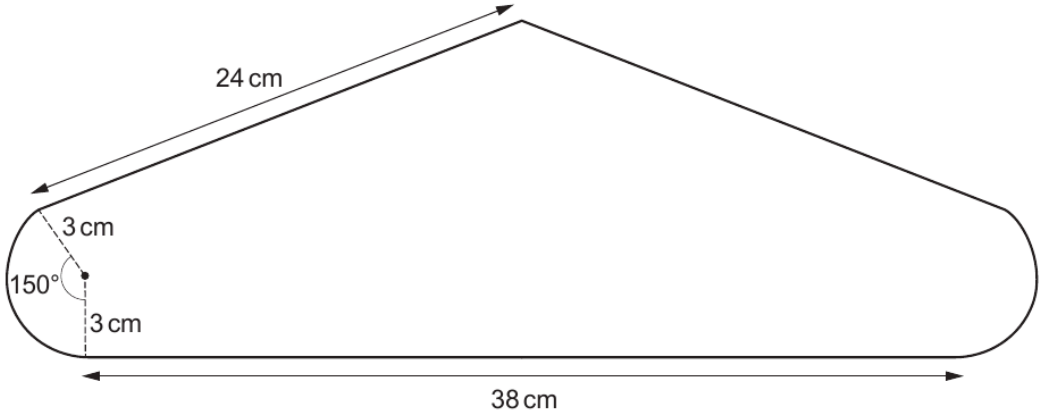


Diagram not drawn to scale

Calculate the length of metal wire needed for the main part of the hanger.
Give your answer in terms of π in its simplest form. [4]

.....

.....

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Examiner only

(ii) The length of wire needed for the hooked part of this hanger is $0\dot{1}\dot{3}$ of the total length of wire needed for a hanger.

Write $0\dot{1}\dot{3}$ as a fraction in its simplest form. [3]

(b) Hang-Up makes metal hangers in batches of 80.
Every 3 hours, it randomly samples 8 hangers from one batch of 80 for quality assurance.

The following numbers are taken from a table of random digits.

299986 890791 810130 955579 268884 301244

Use these numbers to choose 8 hangers from a batch of 80 hangers.
You must start with the first number in the list.
Describe clearly how you use the numbers to select the sample. [3]

Hangers chosen:

....

Examiner only

(c) Hang-Up also makes plastic hangers of various sizes.
Two of its plastic hangers have main parts that are mathematically similar.
These are shown below.

Diagram not drawn to scale

The total surface area of the larger hanger is 1·44 times the total surface area of the smaller hanger.

The height of the smaller hanger is 9 cm.
Calculate the height of the larger hanger. [3]

Examiner only

11. A solid has a height of 11 cm.
A **similar** solid has a height of 23 cm.
The volume of the smaller solid is 107 cm^3.
Calculate the volume of the larger solid. [3]

12. The solid shown below is a quarter of a sphere with radius 7·3 cm.

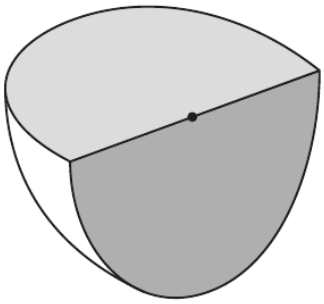
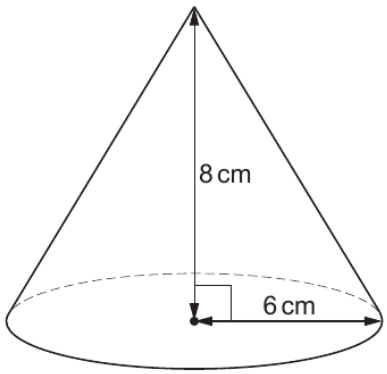


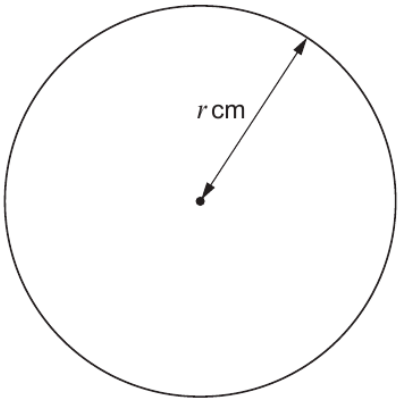
Diagram not drawn to scale

Calculate the volume of this solid.
Give your answer correct to 3 significant figures. [3]

Examiner only

12. The diagrams below show a solid cone and a circle.





Diagrams not drawn to scale

The cone has a base radius of 6 cm and a vertical height of 8 cm.
The circle has a radius of r cm.

The **curved** surface area of the cone equals the area of the circle.

By expressing any areas in terms of π, find the value of r.
Give your answer in the form $a\sqrt{b}$, where a and b are integers, and b is as small as possible.

[6]