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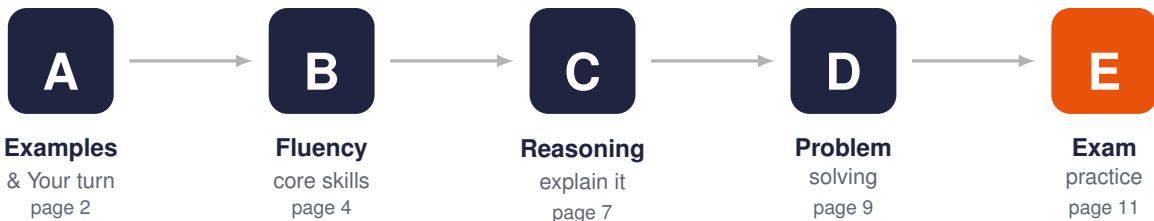
GCSE MATHEMATICS • GEOMETRY

Volume and Surface Area

Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • Calculator allowed

Free Volume and Surface Area worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: work out the volume and surface area of cuboids, prisms and cylinders • find a missing length from a volume • convert between cm^3 , m^3 and litres • use given formulae for spheres and cones •
Higher: cones, hemispheres, composite solids, frustums and recasting.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER Higher only: cones with slant heights, hemispheres, composite solids, frustums and recasting. Grades 6 to 9.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	23	10	13	15
Higher marks	16	14	17	15
My score				

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A**Worked examples & Your turn**

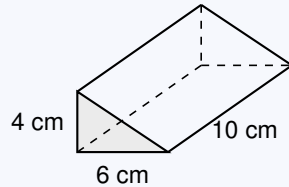
Read each example carefully. Cover it up, then answer the question beside it using the same method. Give answers to 1 decimal place where they are not exact.

FOUNDATION*Everyone starts here***Worked example A1**

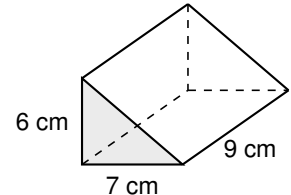
Work out the volume of the triangular prism.

$$\begin{aligned}\text{Volume} &= \text{area of cross-section} \times \text{length} \\ &= \frac{1}{2} \times 6 \times 4 \times 10\end{aligned}$$

$$120 \text{ cm}^3$$

**Your turn A1**

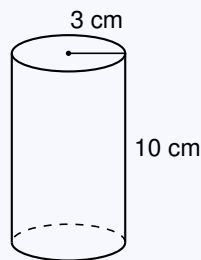
Work out the volume of the triangular prism.

**Worked example A2**

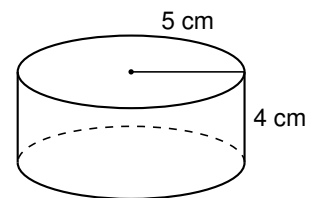
Work out the volume of the cylinder.

$$\pi r^2 h = \pi \times 3^2 \times 10 = 90\pi$$

$$282.7 \text{ cm}^3$$

**Your turn A2**

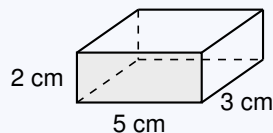
Work out the volume of the cylinder.

**Worked example A3**

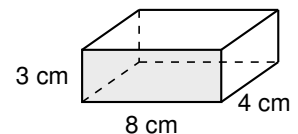
Work out the surface area of the cuboid.

$$\begin{aligned}\text{Three pairs of faces:} \\ 2(5 \times 2 + 5 \times 3 + 2 \times 3)\end{aligned}$$

$$62 \text{ cm}^2$$

**Your turn A3**

Work out the surface area of the cuboid.



HIGHER*Higher only: cones, spheres, frustums and missing lengths***Worked example A4: a cone's curved surface**

Work out the curved surface area of the cone.

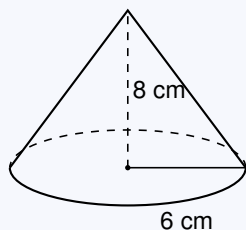
(Curved surface area

$= \pi r l$) *Slant height*

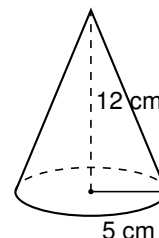
$$l = \sqrt{6^2 + 8^2} = 10.$$

$$\pi \times 6 \times 10 = 60\pi$$

$$188.5 \text{ cm}^2$$

**Your turn A4**

Work out the curved surface area of the cone.

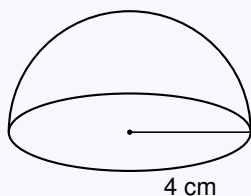
**Worked example A5: spheres and hemispheres**

Work out the volume of the hemisphere.

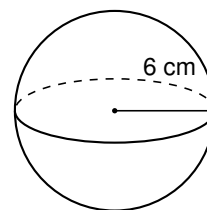
(Sphere: $V = \frac{4}{3}\pi r^3$) *Half a sphere:*

$$\frac{1}{2} \times \frac{4}{3}\pi \times 4^3 = \frac{128}{3}\pi$$

$$134.0 \text{ cm}^3$$

**Your turn A5**

Work out the volume of the sphere.

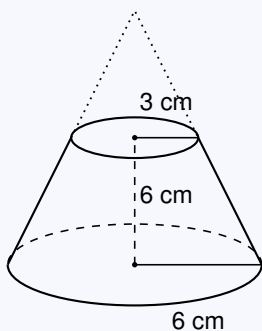
**Worked example A6: a frustum**

The frustum is a cone of radius 6 cm and height 12 cm with the top 6 cm removed. Work out its volume. *Big cone minus small cone:*

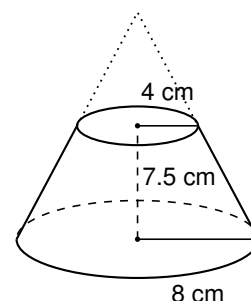
small cone:

$$\frac{1}{3}\pi(6^2 \times 12 - 3^2 \times 6) = 126\pi$$

$$395.8 \text{ cm}^3$$

**Your turn A6**

The frustum is a cone of radius 8 cm and height 15 cm with the top 7.5 cm removed. Work out its volume.

**Worked example A7: a missing length**

A cylinder has volume 500 cm^3 and radius 5 cm. Find its height.

$$\pi \times 5^2 \times h = 500, \text{ so } h = \frac{500}{25\pi}$$

$$6.4 \text{ cm}$$

Your turn A7

A sphere has volume 1000 cm^3 . Find its radius.



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B**Fluency**

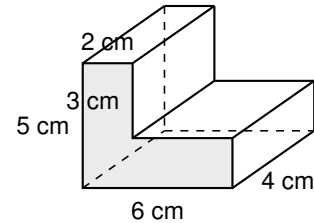
Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

FOUNDATION

Everyone starts here

B1 Work out the volume of each prism.

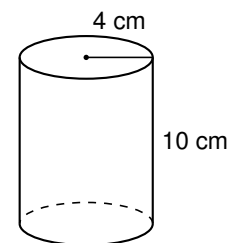
- (a) cross-section area 12 cm^2 , length 5 cm
- (b) a triangle, base 8 cm and height 3 cm, length 7 cm
- (c) a trapezium with parallel sides 4 cm and 6 cm, 3 cm apart, length 10 cm
- (d) the prism in the diagram



[4 marks]

B2 For the cylinder, work out

- (a) its volume
- (b) its curved surface area
- (c) its total surface area
- (d) its volume in litres, to 2 decimal places

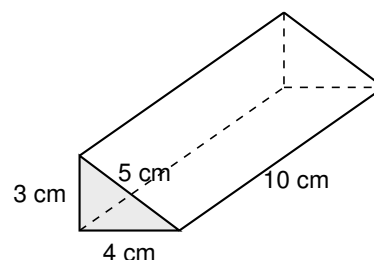


[4 marks]



FOUNDATION*continued: surface area, units, spheres and cones, missing lengths***B3** Work out the surface area of

- (a) a cube of side 5 cm
- (b) a cuboid 6 cm by 4 cm by 2.5 cm
- (c) the triangular prism in the diagram
- (d) an open box (no lid) 10 cm by 6 cm by 4 cm high

**[4 marks]****B4** Convert

- (a) 3 m^3 to cm^3
- (b) 4500 cm^3 to litres
- (c) 2.5 litres to cm^3
- (d) $80\,000 \text{ cm}^3$ to m^3

[4 marks]**B5**

Volume of a sphere = $\frac{4}{3}\pi r^3$	Volume of a cone = $\frac{1}{3}\pi r^2 h$	Surface area of a sphere = $4\pi r^2$
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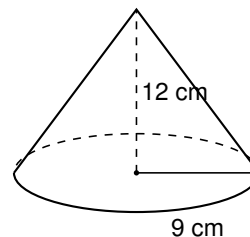
Work out, to 1 decimal place,

- (a) the volume of a sphere of radius 3 cm
- (b) the volume of a cone with radius 3 cm and height 4 cm
- (c) the surface area of a sphere of radius 4 cm

[3 marks]**B6** (a) A cuboid has volume 120 cm^3 and a base 5 cm by 4 cm. Find its height.(b) A prism has volume 300 cm^3 and cross-section area 25 cm^2 . Find its length.(c) A cylinder has volume $250\pi \text{ cm}^3$ and radius 5 cm. Find its height.(d) A cube has volume 343 cm^3 . Find the length of a side.**[4 marks]**

HIGHER*Higher tier only*

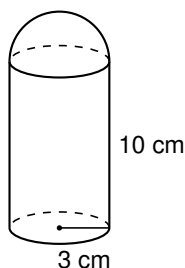
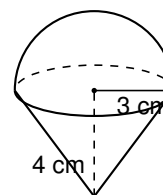
- B7** For the cone, work out
- (a) its slant height
 - (b) its volume
 - (c) its curved surface area
 - (d) its total surface area

**[4 marks]**

- B8**
- (a) Work out the volume of a sphere of diameter 10 cm
 - (b) Work out the volume of a hemisphere of radius 6 cm
 - (c) Work out the total surface area of a solid hemisphere of radius 6 cm
 - (d) A sphere has surface area $400\pi \text{ cm}^2$. Find its radius.

[4 marks]

- B9**
- (a) Work out the volume of solid *P*
 - (b) Work out the total surface area of solid *P*
 - (c) Work out the volume of solid *Q*
 - (d) Work out the total surface area of solid *Q*

*P*: a cylinder with a hemisphere on top*Q*: a cone with a hemisphere on top**[4 marks]****HIGHER***continued: exact answers and algebra*

- B10** Give exact answers.
- (a) A cube has volume 64 cm^3 . Find its surface area.
 - (b) A sphere has volume $36\pi \text{ cm}^3$. Find its surface area in terms of π
 - (c) A cone has volume $100\pi \text{ cm}^3$ and radius 5 cm. Find its height.
 - (d) A cylinder has height $2r$ and volume $54\pi \text{ cm}^3$. Find r

[4 marks]

C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

- C1** A cylinder has radius 3 cm and height 5 cm. Tom writes $\text{volume} = \pi \times 3 \times 5$
Explain Tom's mistake, and find the volume in terms of π [2 marks]
- C2** Sam says, " 2 m^3 is the same as 200 cm^3 ." Explain why Sam is wrong. [2 marks]
- C3** Explain why doubling every length of a cuboid multiplies its volume by 8 [3 marks]
- C4** Container *A* is a cuboid 20 cm by 10 cm by 10 cm. Container *B* is a cylinder with radius 6 cm and height 15 cm.
Which holds more? Show your working. [3 marks]



HIGHER*Higher tier only*

- C5** A cone has radius 6 cm and height 8 cm. Jo writes curved surface area = $\pi \times 6 \times 8$
Explain Jo's mistake, and find the correct curved surface area in terms of π [3 marks]
- C6** Show that a hemisphere of radius r and a cone of radius r and height $2r$ have the same volume. [3 marks]
- C7** Explain why the total surface area of a solid hemisphere of radius r is $3\pi r^2$ [3 marks]
- C8** A cylinder and a sphere have the same radius r and the same volume.
(a) Find the height of the cylinder in terms of r
(b) Which has the bigger surface area, and by how much? Give your answer in terms of π and r [5 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step.

FOUNDATION

Everyone starts here

- D1** A fish tank is a cuboid 60 cm long, 30 cm wide and 40 cm high. It is filled to $\frac{3}{4}$ of its height.
How many litres of water are in the tank? [3 marks]
- D2** A box 2 m by 1.5 m by 1 m is painted on every face. One litre of paint covers 5 m^2
Paint is sold in 1-litre tins. How many tins are needed? [4 marks]
- D3** A full cylinder of water, radius 5 cm and height 20 cm, is poured into an empty tank with a rectangular base 20 cm by 15 cm.
How deep is the water in the tank? Give your answer to 1 decimal place. [3 marks]
- D4** A concrete path is 12 m long, 1.5 m wide and 0.1 m deep. Concrete costs £90 per m^3
Work out the cost of the concrete. [3 marks]



HIGHER*Higher tier only*

- D5** A solid metal sphere of radius 6 cm is melted down and recast as a solid cylinder of radius 4 cm.

Work out the height of the cylinder.

[4 marks]

- D6** A bucket is a frustum. Its base has radius 10 cm, its top has radius 15 cm and it is 20 cm tall.

How many litres does it hold? Give your answer to 1 decimal place.

Hint: extend it to a full cone.

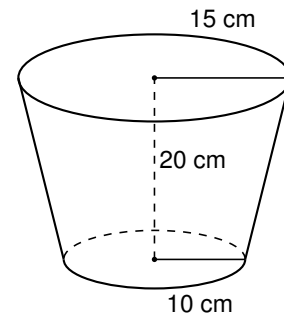


Diagram NOT accurately drawn

[4 marks]

- D7** A cone has volume $120\pi \text{ cm}^3$ and height 10 cm.

Work out its exact curved surface area.

[4 marks]

- D8** A sphere fits exactly inside a cylinder: it touches the top, the bottom and the curved side.

(a) What percentage of the cylinder's volume is outside the sphere?

(b) Show that the curved surface area of the cylinder equals the surface area of the sphere.

[5 marks]



E**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION*Foundation and Higher crossover*

E1 Work out the volume of the cuboid.

.....

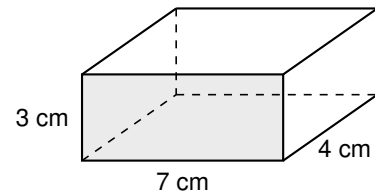


Diagram NOT accurately drawn

(Total for Question E1 is 2 marks)

E2 The diagram shows a prism. Work out its volume.

.....

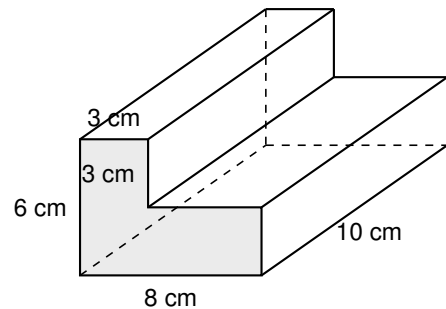


Diagram NOT accurately drawn

(Total for Question E2 is 3 marks)

E3 Work out the volume of the cylinder. Give your answer to 1 decimal place.

.....

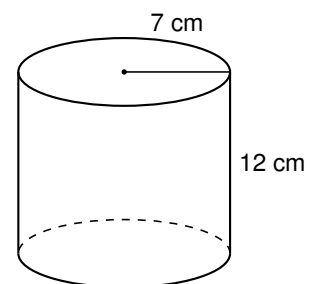


Diagram NOT accurately drawn

(Total for Question E3 is 2 marks)



- E4** The diagram shows a triangular prism. Work out its total surface area.

.....

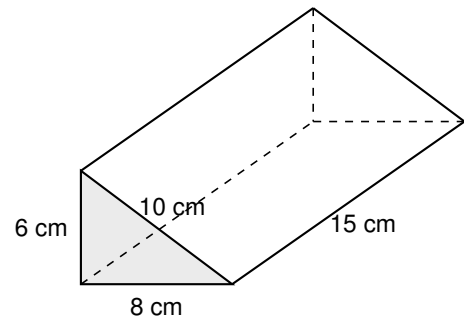


Diagram NOT accurately drawn

(Total for Question E4 is 3 marks)

- E5** A water tank holds 1.2 m^3 when full. How many litres is this?

.....

(Total for Question E5 is 2 marks)

- E6** A cylindrical jug has radius 5 cm. It must hold at least 2 litres. Work out the least height of the jug, to 1 decimal place.

.....

(Total for Question E6 is 3 marks)

HIGHER

Higher tier only

- E7** A cone has radius 7 cm and slant height 25 cm. Work out its volume, to 1 decimal place.

.....

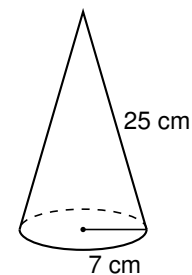


Diagram NOT accurately drawn

(Total for Question E7 is 3 marks)



- E8** A solid is a cylinder with a hemisphere on top. Work out its volume, to 1 decimal place.

.....

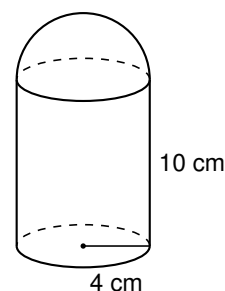


Diagram NOT accurately drawn

(Total for Question E8 is 3 marks)

- E9** The frustum is a cone of radius 12 cm and height 16 cm with the top 8 cm removed. Work out its volume, to 1 decimal place.

.....

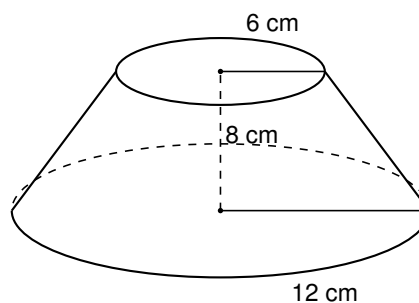


Diagram NOT accurately drawn

(Total for Question E9 is 4 marks)

- E10** A solid metal cylinder has radius 6 cm and height 10 cm. It is melted and recast into solid spheres.

(a) Show that exactly 80 spheres of radius 1.5 cm can be made.

(2)

(b) Instead, spheres of radius 2 cm are made. How many whole spheres can be made, and what percentage of the metal is left over?

.....

(3)

(Total for Question E10 is 5 marks)

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