Worksheet - Volume and surface area of prisms

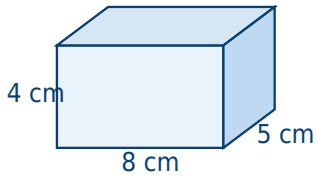
Year: Year 8 · 20

Show your working.

Question 1

Question 1 – Cuboids and cubes *(Section A · Skills practice)*

Find the volume and total surface area of each solid.

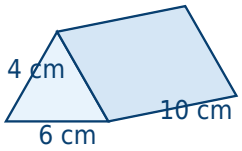


a. A cuboid 8 cm by 5 cm by 4 cm (shown).
b. A cube of side 6 cm.
c. A cuboid 2.5 m by 1.2 m by 0.8 m.
d. A cube has volume 125 cm³. Find its side length and surface area.

Question 2

Question 2 – Volume of a prism *(Section A · Skills practice)*

Volume of a prism = area of cross-section × length. Find the volume of each prism.

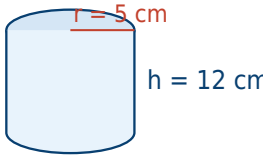


a. A triangular prism with base 6 cm, height 4 cm and length 10 cm (shown).
b. A prism with a right-angled triangle cross-section of sides 3 cm, 4 cm, 5 cm and length 12 cm.
c. A prism with a trapezium cross-section with parallel sides 5 cm and 9 cm, height 4 cm and length 15 cm.
d. A prism has cross-section area 24 cm² and volume 360 cm³. Find its length.

Question 3

Question 3 – Cylinders *(Section A · Skills practice)*

Use $V = \pi r^2 h$ and curved surface area $= 2\pi rh$. Give each answer to 1 decimal place.



a. Find the volume of a cylinder with radius 5 cm and height 12 cm (shown).
b. Find its curved surface area.
c. Find its total surface area (two circles plus the curved part).
d. A cylinder has diameter 8 cm and volume 603 cm³. Find its height.

Question 4

Question 4 – Surface area of a prism *(Section A · Skills practice)*

A triangular prism has a right-angled triangle cross-section with sides 5 cm, 12 cm and 13 cm, and a length of 20 cm.

a. Find the area of one triangular end.
b. Find the area of each of the three rectangular faces.
c. Find the total surface area.
d. Find the volume.

Question 5

Question 5 – Units and capacity *(Section A · Skills practice)*

1 litre = 1 000 cm³ and 1 m³ = 1 000 litres. Convert carefully.

a. A tank is 50 cm by 40 cm by 30 cm. Find its capacity in litres.
b. A pool has a volume of 120 m³. How many litres is this?
c. A bottle holds 1.5 litres. Find its volume in cm³.
d. A cube has side 20 cm. Find its volume in litres.

Question 6

Question 6 – Finding a missing length *(Section A · Skills practice)*

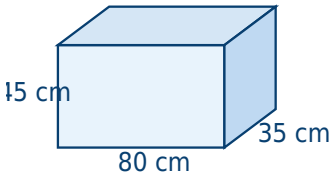
Work backwards from the volume to find the missing length.

a. A cuboid has volume 360 cm³, length 10 cm and width 6 cm. Find the height.
b. A prism has volume 150 cm³ and length 10 cm. Find the area of its cross-section.
c. A triangular prism has volume 252 cm³, triangle base 7 cm and prism length 12 cm. Find the triangle's height.
d. A cylinder has volume 500 cm³ and radius 4 cm. Find its height to 1 decimal place.

Question 7

Question 7 – The fish tank *(Section B · Real-life practice)*

A fish tank is a cuboid 80 cm long, 35 cm wide and 45 cm high. It is filled with water to 5 cm below the top.



a. Find the volume of water in the tank in cm^3.
b. Convert this to litres.
c. A litre of water has a mass of 1 kg. Find the mass of the water.
d. The glass is 6 mm thick on each of the five faces (no top). How many cm^2 of glass are needed for the tank, ignoring thickness?
e. Glass costs £0.012 per cm^2. What is the cost?

Question 8

Question 8 – Painting the garden shed *(Section B · Real-life practice)*

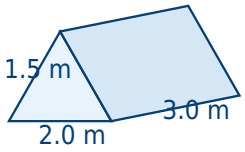
A garden shed is a cuboid 2.4 m long, 1.8 m wide and 2 m high, with a flat roof. Paint is needed for the four walls and the roof but not the floor. There is a door (0.8 m by 1.8 m) and a window (1 m by 0.6 m) that will not be painted.

a. Find the area of the four walls.
b. Find the area of the roof.
c. Find the area to be painted after removing the door and window.
d. One litre of paint covers $6\ m^2$. How many litres are needed? Round up to the next whole litre.
e. Paint costs £14.50 per litre. Find the cost.

Question 9

Question 9 – The camping tent *(Section B · Real-life practice)*

A tent is shaped like a triangular prism. The triangular front has a base of 2.0 m and a height of 1.5 m. The tent is 3.0 m long. The floor is included.



a. Find the volume of air inside the tent.

b. Find the length of each sloping side of the triangle. (Use Pythagoras with half the base.)
c. Find the area of fabric for the two sloping rectangles.
d. Find the total fabric needed, including the floor and the two triangular ends.

Question 10

Question 10 – A concrete path *(Section B · Real-life practice)*

A path is 12 m long, 1.2 m wide and 8 cm thick. It is made from concrete.

a. Convert 8 cm to metres.
b. Find the volume of concrete in m^3.
c. Concrete costs £95 per m^3. Find the cost.
d. The builder rounds up the volume to the nearest 0.25 m^3 for ordering. How much does he order and how much will he pay?

Question 11

Question 11 – Tins of beans *(Section B · Real-life practice)*

A cylindrical tin of beans has a diameter of 7.4 cm and a height of 10.8 cm. The label wraps round the curved surface with no overlap.

a. Find the volume of the tin to the nearest cm^3.
b. How many millilitres is this? (1 cm^3 = 1 ml.)
c. Find the area of the label to the nearest cm^2.
d. A box holds 12 tins. A shop buys 25 boxes. How many litres of beans are in the order, to the nearest litre if the tins are full?

Question 12

Question 12 – Triangular chocolate bar *(Section B · Real-life practice)*

A chocolate bar is a triangular prism with a cross-section that is a triangle of base 3.5 cm and height 3 cm. The bar is 20 cm long. The company wants to compare it with a cuboid bar 3 cm by 3 cm by 20 cm.

a. Find the volume of the triangular bar.
b. Find the volume of the cuboid bar.
c. Which holds more chocolate and by what percentage of the larger? Give 1 decimal place.
d. Chocolate costs 0.9p per cm^3. Find the cost of one triangular bar to the nearest penny.

Question 13

Question 13 – Water trough *(Section B · Real-life practice)*

A farmer has a water trough whose cross-section is a trapezium with parallel sides 40 cm (top) and 30 cm (bottom) and a depth of 25 cm. The trough is 2 m long.

a. Find the area of the trapezium cross-section in cm².
b. Find the volume of the trough in cm³ and in litres.
c. The trough is filled by a tap giving 10 litres per minute. How long does it take to fill? Give your answer in minutes and seconds.
d. A cow drinks 60 litres a day. For how many cows would a full trough last for one day?

Question 14

Question 14 – Garden sandpit *(Section B · Real-life practice)*

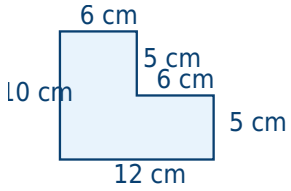
A circular sandpit has a diameter of 2.4 m and is filled with sand to a depth of 0.25 m.

a. Find the radius.
b. Find the volume of sand in m³ to 2 decimal places.
c. A bag of sand contains 0.04 m³. How many bags are needed? Round up.
d. Each bag costs £3.20. Find the cost of filling the sandpit.

Question 15

Question 15 – L-shaped prism *(Section C · Problem solving)*

A block of cheese has an L-shaped cross-section, shown in the diagram, and is 20 cm long.



a. Split the L-shape into rectangles and find its area.
b. Find the volume of the block.
c. Find the perimeter of the L-shape.
d. Find the total surface area of the block.

Question 16

Question 16 – Comparing two containers *(Section C · Problem solving)*

A manufacturer is choosing between two containers for orange juice. Container A is a cuboid 10 cm by 7 cm by 20 cm. Container B is a cylinder with diameter 8 cm and height 20 cm.

a. Find the volume of each in cm³ to the nearest whole number.
b. Which holds more and by how many ml?

c. Find the surface area of each container (closed). Give to the nearest whole number.
d. Cardboard costs 0.4p per cm^2. Which container is cheaper to make?
e. Which container is better value for money overall? Explain.

Question 17

Question 17 – Swimming pool problem *(Section C · Problem solving)*

A school pool is a prism. Its cross-section is a trapezium: the shallow end is 1 m deep, the deep end is 2.5 m deep and the length of the pool is 20 m. The width is 10 m.

a. Find the area of the trapezium cross-section.
b. Find the volume of water in m^3 when full.
c. Convert this to litres.
d. The pool is filled at 6 000 litres per minute. How long does it take to fill? Give your answer in hours and minutes.
e. The tiles for the floor and walls cost £22 per m^2. The floor is a rectangle with slope: find the surface area of the sides and the ends, excluding the top.

Question 18

Question 18 – Melting a metal block *(Section C · Problem solving)*

A metal cuboid measures 12 cm by 9 cm by 5 cm. It is melted down and recast into a cylinder of radius 3 cm.

a. Find the volume of the cuboid.
b. Find the height of the cylinder to 1 decimal place.
c. Find the curved surface area of the cylinder to the nearest cm^2.
d. The metal has density 7.8 g/cm^3. Find the mass of the block in kg.

Question 19

Question 19 – Spot the mistake *(Section C · Problem solving)*

Pupils were asked to find the volume of a triangular prism with a triangle of base 8 cm and height 5 cm, and a prism length of 12 cm. Their answers are in the table.

Pupil	Answer
Ali	240 cm^3
Bea	480 cm^3
Cal	25 cm^3
Dev	60 cm^3

a. Work out the correct volume.
b. Which pupil is correct?

c. Find the error made by each of the other pupils.

Question 20

Question 20 – Challenge: the tin with the smallest surface *(Section D · Challenge)*

A cylinder-shaped tin must hold exactly 500 cm³. Try different radii to find the shape that uses the least metal.

Radius (cm)	Height (cm)	Surface area (cm²)
3	?	?
4	?	?
5	?	?
6	?	?

a. Use $h = \dfrac{500}{\pi r^2}$ to complete the table (1 d.p.).
b. Which radius gives the smallest surface area?
c. Describe the shape when the surface area is smallest, comparing h and $2r$.
d. Why do manufacturers not always use the best shape?