Worksheet - Area, volume, surface area, arcs and sectors

Year: Year 10 · 20

Show your working.

Question 1

Question 1 – Areas of 2D shapes *(Section A · Skills practice)*

Calculate the area of each shape. For the circle, use the π button on your calculator and give the answer to 1 decimal place.

a. a parallelogram with base 9 cm and perpendicular height 6 cm
b. a triangle with base 14 cm and perpendicular height 8 cm
c. a trapezium with parallel sides 7 cm and 13 cm and distance between them 5 cm
d. a circle with radius 6 cm

Question 2

Question 2 – Compound shapes *(Section A · Skills practice)*

An L-shaped floor is made from a rectangle 8 m by 5 m with a rectangle 3 m by 2 m cut out of one corner.

a. Work out the area of the floor.
b. Work out the perimeter of the floor.
c. Carpet costs £14.50 per square metre. Work out the cost of carpeting the floor.
d. Explain why the perimeter is the same as that of the full 8×5 rectangle.

Question 3

Question 3 – Volume of prisms and cylinders *(Section A · Skills practice)*

Work out the volume of each solid. Give circle answers to 1 decimal place.

a. a cuboid 12 cm by 5 cm by 4 cm
b. a triangular prism whose cross-section has area 24 cm² and whose length is 10 cm
c. a cylinder with radius 4 cm and height 10 cm
d. a cylinder with diameter 10 cm and height 6 cm

Question 4

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

Work out the total surface area of each solid.

a. a cuboid 8 cm by 5 cm by 3 cm
b. a cylinder of radius 3 cm and height 8 cm (to 1 decimal place)
c. a cube of side 7 cm
d. a triangular prism: the triangle has sides 3 cm, 4 cm, 5 cm, and the prism is 10 cm long

Question 5

Question 5 – Converting units of area and volume *(Section A · Skills practice)*

Non-calculator. Convert each measurement. Remember that $1\ \text{m}^2 = 10\,000\ \text{cm}^2$, $1\ \text{cm}^2 = 100\ \text{mm}^2$, $1\ \text{m}^3 = 1\,000\,000\ \text{cm}^3$ and $1\ \text{litre} = 1000\ \text{cm}^3$.

a. $2.5\ \text{m}^2$ into cm²
b. $3\ \text{cm}^2$ into mm²
c. $4500\ \text{cm}^3$ into litres
d. $0.6\ \text{m}^3$ into litres

Question 6

Question 6 – Arcs and sectors *(Section A · Skills practice)*

A sector has radius r and angle θ. Arc length $= \dfrac{\theta}{360} \times 2\pi r$ and sector area $= \dfrac{\theta}{360} \times \pi r^2$. Give answers to 1 decimal place.

a. Find the arc length of a sector with radius 12 cm and angle 75°.
b. Find the area of that sector.
c. Find the arc length of a sector with radius 10 cm and angle 144°.
d. Find the area of the sector in part (c).

Question 7

Question 7 – Filling the swimming pool *(Section B · Real-life practice)*

A school swimming pool is a cuboid, 25 m long, 10 m wide and 1.5 m deep. Calculator allowed.

a. Work out the volume of water when the pool is full, in m³ and in litres.
b. The pool is filled at 500 litres per minute. How long does it take, in hours?
c. The floor and four walls are tiled. Work out the area to be tiled.
d. Tiles cost £18 per square metre. Find the cost of the tiles.

Question 8

Question 8 – Soup cans *(Section B · Real-life practice)*

A soup can is a cylinder with radius 3.5 cm and height 10 cm. Twelve cans fit exactly in a box in a 4×3 arrangement, standing upright.

a. Work out the volume of one can to the nearest cm³.
b. Work out the area of the curved label (curved surface only) to 1 decimal place.
c. Write down the length, width and height of the box, then work out its volume.
d. How much empty space is left in the box once the 12 cans are in it?

Question 9

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

A pizza has a diameter of 30 cm and is cut into 8 equal slices. It is sold in a square box of side 32 cm.

a. Find the angle of each slice.
b. Find the area of one slice to 1 decimal place.
c. Find the length of the curved crust of one slice to 1 decimal place.
d. What area of the base of the box is not covered by the pizza?

Question 10

Question 10 – The garden shed *(Section B · Real-life practice)*

The cross-section of a garden shed is a rectangle 3 m wide and 2.2 m high with a triangular roof of height 0.8 m on top. The shed is 2.5 m long (a prism).

a. Work out the area of the cross-section.
b. Work out the volume of the shed.
c. Each sloping roof panel is a rectangle 2.5 m long. Find the slope length of the roof using Pythagoras.
d. Roofing felt costs £4.20 per m². Work out the cost of felt for the two roof panels.

Question 11

Question 11 – The water butt *(Section B · Real-life practice)*

A cylindrical water butt has radius 0.6 m and height 1.4 m.

a. Work out its volume in m³ to 3 decimal places and in litres to the nearest litre.
b. A hose fills the butt at 20 litres per minute. How long does it take to fill (to the nearest minute)?
c. The butt currently holds 900 litres. How deep is the water, to 2 decimal places?
d. Rain adds 1 cm of depth. How many litres is that, to the nearest litre?

Question 12

Question 12 – The running track *(Section B · Real-life practice)*

A running track has two straight sections of 100 m and two semicircular ends, each of radius 36.5 m. Calculator allowed.

a. Work out the length of one lap to 1 decimal place.
b. How many whole laps does Ana need to run 5000 m, and how far does she run if she completes that many laps?
c. Work out the area of the whole region inside the track to the nearest m².
d. Grass costs £3.20 per m². What does it cost to turf the inside of the track?

Question 13

Question 13 – Decorating a room *(Section B · Real-life practice)*

A room is 5 m by 4 m and 2.5 m high. It has one door of area 2 m² and one window 1.5 m by 1.2 m. The walls (not the ceiling) are to be painted with two coats. One litre of paint covers 12 m². Paint is sold in 2.5 litre tins at £22 each.

a. Work out the total area of the four walls.
b. Work out the area to be painted after the door and window.
c. How many litres of paint are needed for two coats, to 1 decimal place?
d. How many tins must be bought, and what is the cost?

Question 14

Question 14 – Which tin is better value? *(Section B · Real-life practice)*

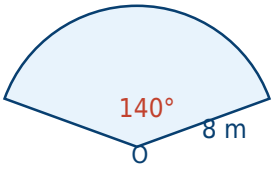
Two cylindrical tins of cat food are on sale. Tin A has radius 4 cm and height 10 cm and costs 89p. Tin B has radius 5 cm and height 7 cm and costs 95p.

a. Work out the volume of each tin to the nearest cm³.
b. Work out the cost per 100 cm³ of food for each tin, to the nearest penny.
c. Which tin is better value?
d. Tin B's manufacturer wants a new tin with the same volume as tin A but a radius of 5 cm. Find its height to 1 decimal place.

Question 15

Question 15 – The lawn sprinkler *(Section C · Problem solving)*

A garden sprinkler waters a sector of lawn. The sprinkler is fixed at O and sprays a distance of 8 m. It turns through an angle of 140°.



a. Work out the area watered, to 1 decimal place.
b. A low fence is put along the curved edge of the watered area. How long is the fence, to 1 decimal place?
c. The perimeter of the watered region is the arc plus the two straight edges. Work it out.
d. The sprinkler turns through a bigger angle until the area watered is 100 m². Find the angle to the nearest degree.

Question 16

Question 16 – Higher: cones, spheres and pyramids *(Section C · Problem solving)*

Higher tier. Use $V = \frac{1}{3}\pi r^2 h$ for a cone, curved surface area $= \pi r l$ (where l is the slant height), $V = \frac{4}{3}\pi r^3$ and $A = 4\pi r^2$ for a sphere, and $V = \frac{1}{3} \times$ base area $\times$ height for a pyramid.

a. A cone has radius 5 cm and vertical height 12 cm. Find the slant height and the volume (1 d.p.).
b. Find the curved surface area of that cone in terms of π, then to 1 d.p.
c. A sphere has radius 6 cm. Find its volume and surface area to 1 d.p.
d. A square-based pyramid has base side 6 cm and height 9 cm. Find its volume.

Question 17

Question 17 – Higher: the grain silo *(Section C · Problem solving)*

Higher tier. A grain store is a cylinder of radius 2 m and height 5 m with a hemisphere of radius 2 m on top.

a. Write the volume of the cylinder in terms of π.
b. Write the volume of the hemisphere in terms of π (half a sphere).
c. Find the total volume to 1 decimal place and in litres.
d. The curved surface of the cylinder and hemisphere is to be painted. Find the area painted to the nearest m².

Question 18

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

A solid metal cube of side 6 cm is melted and recast as a solid cylinder of radius 2 cm.

a. Work out the volume of the cube.
b. Find the height of the cylinder to 1 decimal place.

c. The cube is instead recast into small spheres of radius 1 cm. How many complete spheres can be made?
d. Explain why a real recasting would give slightly fewer spheres than your answer.

Question 19

Question 19 – Circle inside a square *(Section C · Problem solving)*

A circular table top of radius 10 cm is drawn inside the biggest possible square (touching all four sides). A smaller square is then drawn with its corners on the circle.

a. Find the area of the circle in terms of π.
b. The diagonal of the inner square is the diameter of the circle. Show the inner square has area 200 cm².
c. Find the shaded area between the circle and the inner square, as an exact expression and to 1 decimal place.
d. What fraction of the outer square is covered by the circle? Give a percentage to 1 d.p.

Question 20

Question 20 – Challenge: pizza deals *(Section D · Challenge)*

A takeaway sells a 30 cm pizza for £12 and a 20 cm pizza for £7. Calculator allowed.

a. Work out the area of each pizza.
b. Work out the cost per cm² for each, to 3 significant figures.
c. Which is better value? Would two 20 cm pizzas for £14 give more pizza than one 30 cm pizza for £12?
d. What diameter would a pizza need to have to give the same area as two 20 cm pizzas?