Surface area, volume and measurement - Applications test

16 questions | 49 marks | 60 minutes

Choose suitable measurement models for packaging, paint, tanks and precision decisions.

Equivalent correct methods earn the corresponding marks.

1. A maker wants to estimate the metal needed for a tank wall. Should the calculation use area or volume? State a suitable unit. [1 mark]

Material covering a wall is measured by its surface area.

Answer: Area; square metres or square centimetres.

2. A model package needs 750 cm² of card. Convert this area to square metres. [2 marks]

$750 \div 10000 = 0.075$ m².

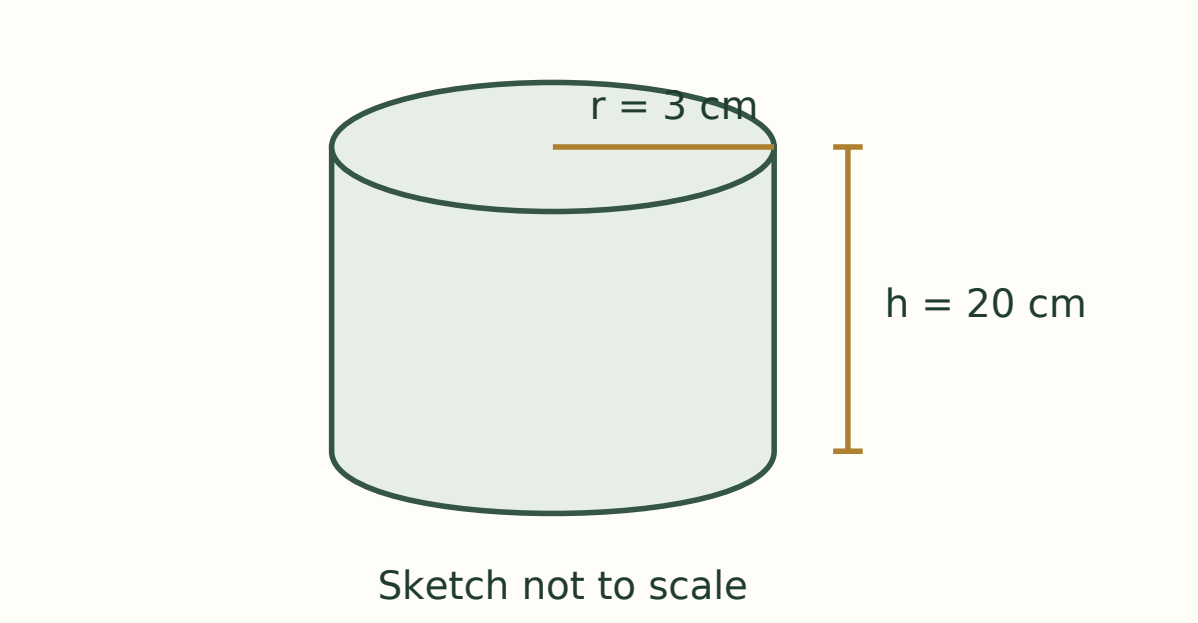
Answer: 0.075 m²

3. A rectangular pond has internal dimensions 2 m by 1.2 m by 0.5 m. Find its full capacity in litres. [2 marks]

$V = 2(1.2)(0.5) = 1.2$ m³ $= 1200$ L.

Answer: 1200 L

4. A cylindrical bottle has internal diameter 6 cm and height 20 cm. Estimate its capacity to the nearest millilitre. [3 marks]



Radius $= 3$ cm. $V = \pi(3^2)(20) = 180\pi \approx 565.49$ cm³, so 565 mL.

Answer: 565 mL

5. A paper sleeve covers the curved face of a can with radius 3 cm and height 10 cm. Allow 5% extra area for overlap. Find the sleeve area to one decimal place. [3 marks]

Curved area $= 2\pi(3)(10) = 60\pi$ cm².

With overlap: $1.05(60\pi) = 63\pi \approx 197.9$ cm².

Answer: 197.9 cm²

6. A square post has cross-section side length 5 cm and length 240 cm. Paint only the four long faces, not the ends. Find the painted area in square metres. [3 marks]

Long-face area $= 4(5)(240) = 4800$ cm².

$4800 \div 10000 = 0.48$ m².

Answer: 0.48 m²

7. A cylindrical tank has internal radius 0.75 m. Water must reach a depth of 0.8 m. It fills from empty at 30 L per minute. Find the filling time to one decimal place. [3 marks]

$V = \pi(0.75^2)(0.8) = 0.45\pi$ m³ $= 450\pi$ L.

Time $= 450\pi/30 = 15\pi \approx 47.1$ minutes.

Answer: 47.1 minutes

8. A closed cylinder has radius 1 m and height 2 m. All surfaces need two paint coats. Paint covers 6 m² per litre per coat and comes in 4 L tins. Find the least number of tins needed. [4 marks]

Area for one coat $= 2\pi + 4\pi = 6\pi$ m²; two coats $= 12\pi$ m².

Paint $= 12\pi/6 = 2\pi \approx 6.28$ L. Two tins provide 8 L.

Answer: 2 tins

9. A calibrated tank holds 160 L. A measuring device reports 157 L. Find its percentage error. Give the unrounded percentage. [2 marks]

Error $= 3$ L. $3/160 \times 100\% = 1.875\%$.

Answer: 1.875%

10. Two rulers record to the nearest 0.1 cm and the nearest 0.01 cm. Compare their maximum rounding errors. [3 marks]

Each maximum rounding error is half the recording step.

Answer: 0.05 cm and 0.005 cm; the second is one-tenth as large.

11. A rectangular container must hold 8 L. Its internal base is 20 cm by 10 cm. Find the minimum internal height. [3 marks]

$8\text{ L} = 8000\text{ cm}^3$. Base area $= 200\text{ cm}^2$.

$h = 8000/200 = 40$ cm.

Answer: 40 cm

12. Each of 12 rectangular cartons has internal dimensions 24 cm by 15 cm by 10 cm. Find their combined capacity in litres and cubic metres. [3 marks]

One volume $= 24(15)(10) = 3600\text{ cm}^3 = 3.6$ L.

Twelve hold 43.2 L; divide by 1000 to obtain 0.0432 m^3.

Answer: 43.2 L; 0.0432 m³

13. A cylindrical container must hold at least 2000 cm³. Its internal radius is 5 cm. Height can be chosen in 0.1 cm steps. Find the smallest suitable height. [3 marks]

$h = 2000/(25\pi) = 80/\pi \approx 25.4648$ cm.

The next available tenth of a centimetre is 25.5 cm. A height of 25.4 cm is too short.

Answer: 25.5 cm

14. A room is 4 m long, 3 m wide and 2.5 m high. Paint the four walls only. Door openings have a total area of 4 m². Find the wall area that needs paint. [3 marks]

Four-wall area $= 2(4 + 3)(2.5) = 35$ m².

Subtract openings: $35 - 4 = 31$ m².

Answer: 31 m²

15. Two closed package designs are available. A is a rectangular prism 6 cm by 5 cm by 4 cm. B is a cylinder with radius 2 cm and height 10 cm. Ignore thickness and joins. [6 marks]

Two closed package designs

Design	Shape	Dimensions
A	Rectangular prism	6 cm × 5 cm × 4 cm
B	Cylinder	radius 2 cm, height 10 cm

(a) Calculate the volume of each design. [2 marks]

$V_A = 6(5)(4) = 120$; $V_B = \pi(2^2)(10) = 40\pi$.

Answer: A: 120 cm³; B: $40\pi \approx 125.7$ cm³.

(b) Calculate the surface area of each design. [2 marks]

$A_A = 2(30 + 24 + 20) = 148$; $A_B = 2\pi(4) + 2\pi(2)(10) = 48\pi$.

Answer: A: 148 cm²; B: $48\pi \approx 150.8$ cm².

(c) The package must hold at least 120 cm³. Which design meets this requirement using less material? Explain. [2 marks]

Compare total areas after checking that both volumes reach 120 cm³.

Answer: A. Both meet the volume requirement, but 148 cm² is less than about 150.8 cm².

16. A rectangle is recorded as 10.0 cm long and 5.0 cm wide. Both readings are rounded to the nearest 0.1 cm. [5 marks]

(a) Calculate the area using the recorded readings. [1 mark]

$10.0 \times 5.0 = 50.0$ cm².

Answer: 50.0 cm²

(b) State the interval for each unrounded length. [2 marks]

Each rounding half-step is 0.05 cm.

Answer: $9.95 \le l < 10.05$ cm and $4.95 \le w < 5.05$ cm.

(c) Use the intervals to give lower and upper bounds for the actual area. [2 marks]

Lower product $9.95(4.95) = 49.2525$; upper product $10.05(5.05) = 50.7525$. All lengths are positive, so endpoint products give the area bounds.

Answer: $49.2525 \le A < 50.7525$ cm².