OCR
Oxford Cambridge and RSA

Higher Check In - 10.04 Volume and surface area calculations

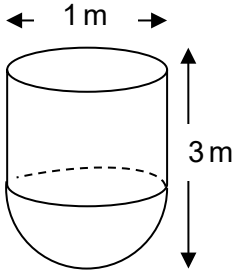
1. Calculate the exact dimensions of a cube which has a total surface area of 72 cm^2.

2. Calculate the **total** surface area of a cone with radius 5 cm and slant height 13 cm, giving your answer in terms of π.
   [Curved surface area of a cone $= \pi rl$, where r is the radius and l is the slant height of the cone]

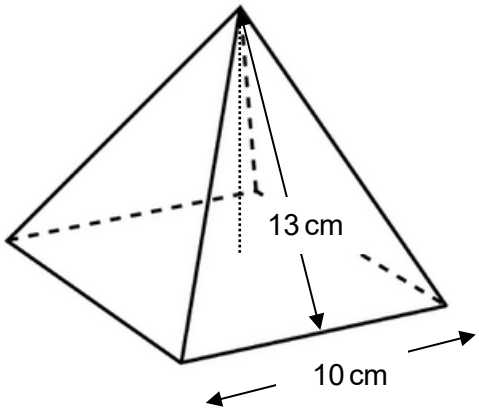
3. A cylinder of radius 18 cm has a volume of 2106π cm^3. Calculate the length of the cylinder.

4. A regular tetrahedron is a pyramid with 4 faces that are equilateral triangles. Calculate the surface area of a regular tetrahedron with a side of 6 cm.

5. Calculate the **total** surface area of the solid below, which has a total height of 3 m and a diameter of 1 m.
   [Surface area of a sphere $= 4\pi r^2$]



6. Below is a diagram of a square-based pyramid. Each face has a slant height of 13 cm and base of 10 cm. Show that the volume of the pyramid is 400 cm^3.
   [Volume of a pyramid $= \frac{1}{3} \times$ base area $\times$ height]



7. Keeley is trying to work out the surface area of a cube with volume 125 cm^3. She has correctly input $6\left(\sqrt[3]{125}\right)^2$ to the calculator. Explain what each operation is working out in relation to the cube.

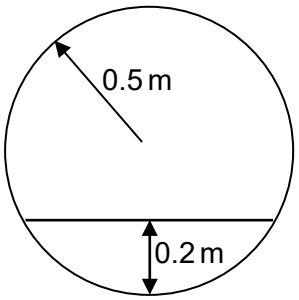
8. A solid metal sphere has radius 9.8 cm. The metal has a density of 10.075 g/cm^3. The estimated mass of this sphere is 40 kg. Show that this is a reasonable estimate for the mass of the sphere.

   [Volume of a sphere $= \frac{4}{3}\pi r^3$]

9. Three spherical balls of radius 5 cm just fit inside a cylindrical tube. Calculate the volume inside the tube not occupied by the balls.

   [Volume of a sphere $V = \frac{4}{3}\pi r^3$]

10. A cylindrical water tank is 1.5 m in length and has radius 0.5 m. It is resting flat on its side with a water depth of 0.2 m along its length, as shown in the diagram below. Work out the surface area of the tank that is underwater.



Not to scale

Extension

A square-based pyramid has a base with 6 cm sides.
The vertex of the pyramid is directly over the midpoint of the base.
The volume of the pyramid is 144 cm³.
Find the length of the slant edge of the pyramid, correct to 1 decimal place.

[Volume of a pyramid $= \frac{1}{3} \times$ base area $\times$ height]

Answers

1. Area of one side $= 72 \div 6 = 12\,\text{cm}^2$
   Side length $= \sqrt{12} = 2\sqrt{3}\,\text{cm}$
   Cube dimensions are $2\sqrt{3} \times 2\sqrt{3} \times 2\sqrt{3}\,\text{cm}$

2. Curved surface area of cone $= \pi rl = 5 \times 13 \times \pi = 65\pi\,\text{cm}^2$
   Surface area of bottom of cone $= \pi r^2 = 25\pi\,\text{cm}^2$
   Total surface area $= 65\pi + 25\pi = 90\pi\,\text{cm}^2$

3. Volume = area of base × length
   Length $= \dfrac{2106}{18^2} = 6.5\,\text{cm}$

4. Surface area = $4 \times (0.5 \times 6 \times 6 \times \sin 60) = 62.4\,\text{cm}^2$

5. $(2.5 + 0.5 + 0.25)\pi = 3.25\pi\ \text{m}^2$ or $10.2\,\text{m}^2$

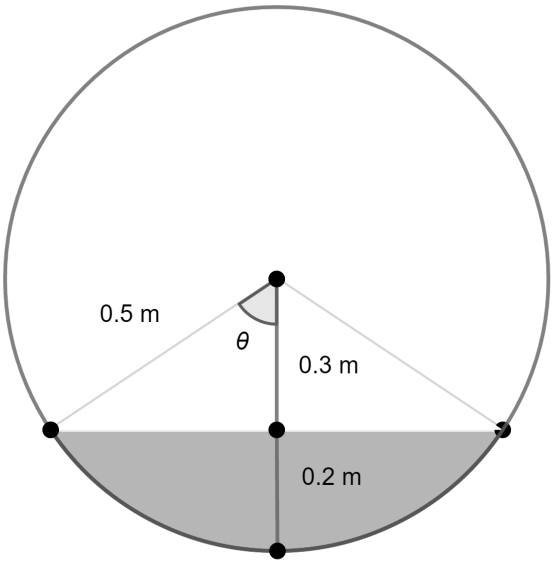
6. $h = \sqrt{13^2 - 5^2} = 12\,\text{cm}$
   $V = \dfrac{1}{3} \times 10^2 \times 12 = 400\,\text{cm}^3$

7. $\sqrt[3]{125}$ gives the length of one side of the cube as 5 cm. Squaring gives the area of one face as $25\,\text{cm}^2$. Multiplying by 6 gives the total area of all six faces as $150\,\text{cm}^2$.

8. Volume $= \dfrac{4}{3}\pi \times 10^3 \approx 4000\,\text{cm}^3$
   Mass $\approx 4000 \times 10 \approx 40\,000\,\text{g}$ or $40\,\text{kg}$

9. $(\pi \times 5^2 \times 30) - \left(3 \times \dfrac{4}{3} \times \pi \times 5^3\right) = 250\pi\,\text{cm}^3$ or $785\,\text{cm}^3$

10. Cross-sectional area of water in tank.



$\theta = \cos^{-1}\left(\frac{0.3}{0.5}\right) = 53.13^{\circ}$

Surface area = arc length × length of cylinder

Surface area $= \frac{106.26}{360} \times 2\pi \times 0.5 \times 1.5 = 1.39\ \text{m}^2$

Extension

Height, $H = \frac{3 \times 144}{6^2} = 12\ \text{cm}$

Length, $L = \sqrt{3^2 + 3^2 + 12^2} = 12.7\ \text{cm}$

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AO1	1	Calculate the dimensions of a cube from its surface area			
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AO2	6	Calculate the volume of a pyramid			
AO2	7	Interpret volume and surface area calculations of a cube			
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