

Foundation GCSE: 3D Shapes Problems

Name: _____

Class: _____

Instructions: Answer all questions. Questions are ordered from easiest (1) to hardest (15). Working out should be shown where appropriate.

1. A solid metal cylinder has a radius of 3 cm, a height of 10 cm, and a density of 8 g/cm^3 . Calculate its mass, using $\pi \approx 3.14$.
2. A rectangular water tank measures 2 m by 1.5 m by 1 m. Water is poured in at a rate of 500 litres per minute. How many minutes does it take to fill the tank completely? ($1 \text{ m}^3 = 1000 \text{ litres}$)
3. A solid wooden block is a cuboid measuring 10 cm by 5 cm by 4 cm and has a mass of 400 g. Calculate the density of the wood.
4. A metallic sphere has a radius of 3 cm. Given that the volume of a sphere is $V = \frac{4}{3}\pi r^3$, calculate its volume, using $\pi \approx 3.14$.
5. A solid iron bar is in the shape of a prism with a cross-sectional area of 15 cm^2 and a length of 2 m. If iron has a density of 7.8 g/cm^3 , calculate the mass of the bar in kilograms.
6. A scale model of a statue has a height of 10 cm and a volume of 150 cm^3 . If the linear scale factor of enlargement to the real statue is 4, calculate the volume of the real statue.
7. A cylindrical container has a radius of 5 cm and holds water up to a depth of 12 cm. A solid metal ball of radius 3 cm is submerged completely in the water. Calculate the new depth of the water, using $\pi \approx 3.14$, giving your answer to 1 decimal place.
8. A rectangular box has internal dimensions 40 cm by 30 cm by 20 cm. Small identical cubes of side 5 cm are packed inside the box without gaps. Calculate the maximum number of small cubes that fit.
9. A conical tent has a base radius of 3 m and a slant height of 5 m. Canvas material costs 12 per m^2 . Calculate the total cost of canvas required to cover the curved surface, using $\pi \approx 3.14$.
10. A solid metal cylinder has a diameter of 8 cm and a height of 15 cm. It is melted down and recast into identical small solid cubes of side 2 cm. Calculate the number of whole cubes produced, using $\pi \approx 3.14$.
11. A packaging company designs a cylindrical tin with a volume of 1000 cm^3 and a height of 10 cm. Calculate the radius of the tin, using $\pi \approx 3.14$, giving your answer to 1 decimal place.
12. A swimming pool is shaped as a prism with a cross-section that is a trapezium: width at top 12 m, bottom 8 m, depth 2 m, and length 20 m. Calculate its total volume of water.
13. Two similar solid cones have heights in the ratio 2 : 5. If the smaller cone has a surface area of 32 cm^2 , calculate the surface area of the larger cone.
14. A decorative sculpture consists of a solid hemisphere of radius 6 cm resting on top of a cylinder of radius 6 cm and height 10 cm. Calculate the total volume of the sculpture, using $\pi \approx 3.14$, giving your answer to 1 decimal place.
15. A storage silo consists of a cylinder of radius 4 m and height 12 m, topped by a cone of the same radius and vertical height 3 m. Calculate the total internal capacity, using $\pi \approx 3.14$, giving your answer to 1 decimal place.

Answers & Worked Solutions

1. 2260.8 g : Volume = $3.14 \times 3^2 \times 10 = 282.6$;
Mass = $282.6 \times 8 = 2260.8$.
2. 6 minutes : Volume = $2 \times 1.5 \times 1 = 3 \text{ m}^3 = 3000$ litres; Time = $3000 \div 500 = 6$.
3. 2 g/cm^3 : Volume = $10 \times 5 \times 4 = 200$; Density = $400 \div 200 = 2$.
4. 113.0 cm^3 : Volume = $\frac{4}{3} \times 3.14 \times 3^3 = 113.04 \approx 113.0$.
5. 23.4 kg : Length = 200 cm; Volume = $15 \times 200 = 3000 \text{ cm}^3$; Mass = $3000 \times 7.8 = 23400 \text{ g} = 23.4 \text{ kg}$.
6. 9600 cm^3 : Volume scale factor = $4^3 = 64$; Real volume = $150 \times 64 = 9600$.
7. 13.4 cm : Ball volume = $\frac{4}{3} \times 3.14 \times 3^3 = 113.04$;
Rise in height = $113.04 \div (3.14 \times 5^2) = 1.44$;
New depth = $12 + 1.44 = 13.44 \approx 13.4$.
8. 192 cubes : Along 40 cm: 8, along 30 cm: 6, along 20 cm: 4; Total = $8 \times 6 \times 4 = 192$.
9. 565.20 : Curved area = $3.14 \times 3 \times 5 = 47.1 \text{ m}^2$;
Cost = $47.1 \times 12 = 565.20$.
10. 94 cubes : Radius = 4; Cylinder volume = $3.14 \times 4^2 \times 15 = 753.6$; Cube volume = $2^3 = 8$;
Number of cubes = $753.6 \div 8 = 94.2 \rightarrow 94$.
11. 5.6 cm : $3.14 \times r^2 \times 10 = 1000 \Rightarrow 31.4r^2 = 1000 \Rightarrow r^2 = 31.847 \Rightarrow r \approx 5.6$.
12. 400 m^3 : Cross-section area = $\frac{1}{2}(12+8) \times 2 = 20 \text{ m}^2$; Volume = $20 \times 20 = 400$.
13. 200 cm^2 : Area scale factor = $(\frac{5}{2})^2 = 6.25$;
Larger area = $32 \times 6.25 = 200$.
14. 1582.6 cm^3 : Cylinder volume = $3.14 \times 6^2 \times 10 = 1130.4$; Hemisphere volume = $\frac{2}{3} \times 3.14 \times 6^3 = 452.16$; Total = $1130.4 + 452.16 = 1582.56 \approx 1582.6$.
15. 653.1 m^3 : Cylinder volume = $3.14 \times 4^2 \times 12 = 602.88$; Cone volume = $\frac{1}{3} \times 3.14 \times 4^2 \times 3 = 50.24$; Total = $602.88 + 50.24 = 653.12 \approx 653.1$.