

Volume and surface area

Foundation and Higher tiers

Total marks: 86

Marks

- M** Method mark, for a correct method. It can be implied by a correct answer.
- A** Accuracy mark, for a correct answer. It needs the method mark before it.
- B** A mark for a correct value or statement, with or without working.
- ft** Follow through: the mark is given for using an earlier wrong answer correctly.
- oe** Or equivalent.
- [a, b]** Any value from a to b inclusive.

Questions

Q	Skill	Spec	Tier	Grade	Calculator	Marks
1	Volume by counting cubes	G16	Foundation	1	No	1
2	Volume of a cuboid: find a length	G16	Foundation	2	No	2
3	Faces and surface area of a prism	G16 G12	Foundation	3	No	4
4	Packing cubes into a box	G16	Foundation	4	No	3
5	Volume of a cube from its surface area	G16	Foundation	4	No	3
6	Volume of a prism	G16	Foundation	4	No	3
7	Surface area of a cylinder in terms of π	G17 N8	Foundation	5	No	3
8	Volume of a pyramid, with a decision	G17	Common	5	No	3
9	Displacement: a sphere in a cylinder of water	G17	Common	7	No	3
10	Equal volumes: forming an equation	G17 A17	Common	7	No	3
11	Volume of a cuboid with decimals	G16	Foundation	2	Yes	2
12	Area of a face and volume of a cube	G16	Foundation	2	Yes	3
13	Volume in litres, a decision	G16 R1	Foundation	3	Yes	3
14	Volume of a prism, finding the length	G16	Foundation	3	Yes	2
15	Volume of a cylinder, a decision	G16	Foundation	4	Yes	3
16	Filling a cylinder at a rate	G16 R1	Foundation	5	Yes	4

Q	Skill	Spec	Tier	Grade	Calculator	Marks
17	Volume of a composite solid	G17 G16	Common	5	Yes	4
18	Melting and recasting a solid	G17	Common	6	Yes	4
19	Surface area of a cone	G17 G20	Common	6	Yes	4
20	Sphere: volume to surface area	G17	Common	7	Yes	4
21	Cone: volume to slant height	G17 G20	Common	7	Yes	4
22	Volume of a frustum	G17 G19	Common	8	Yes	5
23	Cone made from a sector	G17 G18 G20	Common	8	Yes	5
24	Volume of a pyramid using Pythagoras in 3D	G17 G20	Higher	8	Yes	5
25	Volume of a cone, similar shapes and a cube root	G17 G19	Common	8	Yes	6
	Total					86

Question 1 G16 · Foundation · Grade 1 · 1 mark

Q	Answer	Mark	Comments
1	6	B1	

Question 2 G16 · Foundation · Grade 2 · 2 marks

Q	Answer	Mark	Comments
2	$180 \div (9 \times 4)$ or $180 \div 36$	M1	oe
	5	A1	

Question 3 G16 G12 · Foundation · Grade 3 · 4 marks

Q	Answer	Mark	Comments
3(a)	5	B1	
3(b)	$\frac{1}{2} \times 6 \times 8$ or 24	M1	the area of a triangle, or one correct rectangle (72, 96 or 120)
	$2 \times 24 + 6 \times 12 + 8 \times 12 + 10 \times 12$	M1	oe, all five faces
	336	A1	

Question 4 G16 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
4	$32 \div 5 = 6.4$ so 6 cubes along the 32 cm edge	M1	oe, or $20 \div 5 = 4$ and $15 \div 5 = 3$
	$6 \times 4 \times 3$	M1	
	No and 72	A1	

Question 5 G16 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
5	$150 \div 6$ or 25	M1	
	$\sqrt{25}$ or 5	M1	the length of a side
	125	A1	

Question 6 G16 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
6	$\frac{1}{2} \times (5 + 9) \times 4$ or 28	M1	oe, the area of the trapezium
	their 28×10	M1	
	280	A1	

Question 7 G17 N8 · Foundation · Grade 5 · 3 marks

Q	Answer	Mark	Comments
7	$2 \times \pi \times 4 \times 9$ or 72π	M1	the curved surface
	$\pi \times 4^2$ or 16π	M1	one end
	$72\pi + 2 \times 16\pi = 104\pi$	A1	a full method with no errors

Question 8 G17 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
8	$\frac{1}{3} \times 8 \times 8 \times 6$ or 128	M1	
	$5^3 = 125$ and $5.1^3 = 132.651$	M1	both
	$125 < 128 < 132.651$ so the side is between 5 cm and 5.1 cm	A1	a conclusion with correct values

Question 9 G17 · Common · Grade 7 · 3 marks

Q	Answer	Mark	Comments
9	$\frac{4}{3} \times \pi \times 6^3$ or 288π	M1	oe
	their $288\pi \div (\pi \times 8^2)$	M1	oe, $\frac{288}{64}$
	4.5	A1	oe

Question 10 G17 A17 · Common · Grade 7 · 3 marks

Q	Answer	Mark	Comments
10	$\frac{4}{3} \times \pi \times (3x)^3$ or $36\pi x^3$	M1	oe
	$\frac{1}{3} \times \pi \times (4x)^2 \times h = 36\pi x^3$	M1	oe, ft their sphere
	$\frac{27x}{4}$	A1	oe, $6.75x$

Question 11 G16 · Foundation · Grade 2 · 2 marks

Q	Answer	Mark	Comments
11	$62.5 \times 30 \times 34.4$	M1	oe
	64 500	A1	

Question 12 G16 · Foundation · Grade 2 · 3 marks

Q	Answer	Mark	Comments
12(a)	21.16	B1	
12(b)	$4.6 \times 4.6 \times 4.6$ or 4.6^3	M1	oe, or their 21.16×4.6
	97.336	A1	

Question 13 G16 R1 · Foundation · Grade 3 · 3 marks

Q	Answer	Mark	Comments
13	$85 \times 24.5 \times 22$ or 45 815	M1	oe
	their $45\,815 \div 1000$ or 50×1000 or 50 000	M1	oe, a conversion between cm^3 and litres
	Yes and 45.815 litres	A1	oe, Yes and $45\,815 \text{ cm}^3$ compared with $50\,000 \text{ cm}^3$

Question 14 G16 · Foundation · Grade 3 · 2 marks

Q	Answer	Mark	Comments
14	$469.2 \div 18.4$	M1	oe
	25.5	A1	

Question 15 G16 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
15	$\pi \times 3.7^2$ or 43.01...	M1	oe, the area of the base
	$\pi \times 3.7^2 \times 11$	M1	oe
	No and 473.1	A1	accept [473, 473.1]

Question 16 G16 R1 · Foundation · Grade 5 · 4 marks

Q	Answer	Mark	Comments
16	$\pi \times 0.6^2 \times 1.5$	M1	oe, $1.696... \text{ m}^3$
	their volume $\times 1000$	M1	oe, 1696.5... litres
	their litres $\div 12$	M1	oe, 141.4... minutes
	2 hours 21 minutes	A1	

Question 17 G17 G16 · Common · Grade 5 · 4 marks

Q	Answer	Mark	Comments
17	$\pi \times 2.5^2 \times 7$	M1	oe, 137.4...
	$\frac{1}{2} \times \frac{4}{3} \times \pi \times 2.5^3$	M1	oe, 32.7...
	their cylinder + their hemisphere	M1	170.17...
	170	A1	accept [170.1, 170.2] if 3 significant figures not shown

Question 18 G17 · Common · Grade 6 · 4 marks

Q	Answer	Mark	Comments
18	6^3 or 216	M1	
	$\frac{4}{3} \times \pi \times 1.2^3$	M1	oe, 7.238...
	$216 \div$ their sphere	M1	29.84...
	29	A1	

Question 19 G17 G20 · Common · Grade 6 · 4 marks

Q	Answer	Mark	Comments
19	$5^2 + 12^2$ or 169 or $\neq 13$	M1	oe
	$\pi \times 5 \times$ their 13	M1	oe, 65π or 204.2...
	$\pi \times 5^2$ added to their curved surface	M1	oe, 25π
	282.7	A1	accept 90π or 282.7 or [282.74, 282.75]

Question 20 G17 · Common · Grade 7 · 4 marks

Q	Answer	Mark	Comments
20	$\frac{4}{3} \times \pi \times r^3 = 1000$	M1	oe
	$r = \sqrt[3]{\left(\frac{3000}{4\pi}\right)}$ or 6.204...	M1	oe, or $r^3 = 238.7...$
	$4 \times \pi \times$ their 6.20^2	M1	oe
	484	A1	accept [483, 484]

Question 21 G17 G20 · Common · Grade 7 · 4 marks

Q	Answer	Mark	Comments
21	$\frac{1}{3} \times \pi \times 6.5^2 \times h = 500$	M1	oe
	$h = 11.30\dots$	A1	
	$\sqrt{(6.5^2 + \text{their } 11.30^2)}$	M1	oe
	13.0	A1	accept 13.0 or [13.03, 13.04]

Question 22 G17 G19 · Common · Grade 8 · 5 marks

Q	Answer	Mark	Comments
22	radius of the small cone = 3	B1	$9 \times \frac{8}{24}$ oe
	$\frac{1}{3} \times \pi \times 9^2 \times 24$	M1	oe, 648π or 2035.8...
	$\frac{1}{3} \times \pi \times \text{their } 3^2 \times 8$	M1	oe, 24π or 75.4...
	their large cone – their small cone	M1	624π
	1960	A1	accept [1960, 1961]

Question 23 G17 G18 G20 · Common · Grade 8 · 5 marks

Q	Answer	Mark	Comments
23	$\frac{200}{360} \times 2 \times \pi \times 14$ or 48.87...	M1	oe, the arc length
	their 48.87 ÷ (2 × π) or 7.778...	M1	oe, the radius of the cone, or $\frac{200}{360} \times 14$
	$\sqrt{(14^2 - \text{their } 7.78^2)}$ or 11.64...	M1	oe, the height of the cone
	$\frac{1}{3} \times \pi \times \text{their } 7.78^2 \times \text{their } 11.64$	M1	oe
	737	A1	accept [737, 738]

Question 24 G17 G20 · Higher · Grade 8 · 5 marks

Q	Answer	Mark	Comments
24	$10^2 + 10^2$ or $\sqrt{200}$ or 14.14...	M1	oe, the diagonal AC
	half of their diagonal, 7.07...	M1	oe, or $\sqrt{50}$
	$\sqrt{(13^2 - \text{their } 7.07^2)}$ or $\sqrt{119}$ or 10.91...	M1	oe, the perpendicular height
	$\frac{1}{3} \times 10 \times 10 \times \text{their } 10.91$	M1	oe
	364	A1	accept [363, 364]

Question 25 G17 G19 · Common · Grade 8 · 6 marks

Q	Answer	Mark	Comments
25	$\pi \times 4^2 \times 15$ or 240π or 754.0...	M1	the volume of water
	radius of the water surface = $\frac{12}{30}d$ or $0.4d$	M1	oe, similar triangles, where d is the depth
	$\frac{1}{3} \times \pi \times (0.4d)^2 \times d = 240\pi$	M1	oe, an equation in d
	$d^3 = 4500$	M1	oe, a correct rearrangement
	$\sqrt[3]{4500}$	M1	oe, dep on the previous M1
	16.5	A1	accept 16.5 or [16.50, 16.51]