1	**Alternative method 1: working in terms of π**		
	π (×) 4^2 (×) 10 or 160π or [502, 503]	M1	oe accept 3 or better for π accept 480 or 496
	$\frac{2}{3}$ (×) π (×) 6^3 or 144π or [452, 453]	M1	oe accept 3 or better for π accept 0.66 or 0.67 or better for $\frac{2}{3}$ accept 432 or 446(.4)
	160π and 144π or [502, 503] and [452, 453]	A1	oe values accept 480 and 432 or 496 and 446(.4)
	160π and 144π and cylinder or [502, 503] and [452, 453] and cylinder or cylinder is 16π greater	A1ft	ft correct decision for their 160π and their 144π with M1M1 scored accept 480 and 432 and cylinder or 496 and 446(.4) and cylinder
	Alternative method 2: working without π		
	4^2 (×) 10 or 160	M1	oe
	$\frac{2}{3}$ (×) 6^3 or 144	M1	oe accept 0.66 or 0.67 or better for $\frac{2}{3}$
	160 and 144	A1	oe values
	160 and 144 and cylinder	A1ft	ft correct decision for their 160 and their 144 with M1M1 scored
	Additional Guidance for this question is on the next page		

	Additional Guidance	
1	Better than 3 for π could be 3.1, 3.14, 3.142 or $\frac{22}{7}$	
	160π with incorrect method for hemisphere	M1M0A0A0
	144π with incorrect method for cylinder	M0M1A0A0
	160π and 144π with incorrect decision or no decision	M1M1A1A0
	160 and 144 with incorrect or no decision	M1M1A1A0
	Accept values given as fractions for the first A mark, but for the second A mark, they must have a common denominator. eg 160π and $\frac{432\pi}{3}$ and cylinder eg $\frac{480}{3}$ and $\frac{432}{3}$ and cylinder	 M1M1A1A0 M1M1A1A1
	Working with π for one value but not the other can only score M1 eg 160π and 144 (with or without a decision)	 M1 only
	Do not allow M1 for a correct formula as part of an incorrect formula eg $\frac{1}{3} \times \pi \times 4^2 \times 10$	 M0

2	**Alternative method 1**		
	6 × 2 × 2 or 2 × 2 × 2 × 3 or 24 or 6 × 2 × 2 + 2 × 2 × 2 × 3 or 48	M1	oe volume of one layer oe volume of two layers
	336 ÷ their 24 or 14 or 336 ÷ their 48 or 7	M1dep	oe eg 336 ÷ 2 ÷ their 24
	21	A1	
	Alternative method 2		
	6 × 2 × 2 × 2 + 2 × 2 × 2 × 6 or 96	M1	oe volume of four layers
	336 ÷ their 96 or 3.5	M1dep	oe
	21	A1	
	Alternative method 3		
	336 ÷ 2 or 168	M1	oe total volume of all cubes
	their 168 ÷ (2 × 2 × 2) or their 168 ÷ 8	M1dep	oe
	21	A1	
	Alternative method 4		
	6 × 2 × 2 or 2 × 2 × 2 × 3 or 24 or 6 × 2 × 2 × 2 + 2 × 2 × 2 × 6 or 96	M1	oe volume of one layer oe volume of four layers
	(336 – their 96) ÷ their 24 + 4 or 240 ÷ their 24 + 4 or 10 + 4 or 14	M1dep	oe using volume of additional layers
	21	A1	
	Additional Guidance		
	24, 48 and 96 must not come from area or perimeter calculations		

Q	Answer	Mark	Comments
3	240	B1	

Q	Answer	Mark	Comments
4	**Alternative method 1** Working out time to fill the ball		
	$4 \div 3 \times 15^3 \times \pi$ or [4488, 4500]π or [14 092, 14 139]	M1	oe allow 1.33 or better
	their [14 092, 14 139] – 5000 or [9092, 9139] or their [14 092, 14 139] ÷ 160 or [88, 88.37]	M1dep	oe
	(their [14 092, 14 139] – 5000) ÷ 160 or [56, 57.12]	M1dep	oe eg their [9092, 9139] ÷ 160 or their [88, 88.37] – 5000 ÷ 160
	[56, 57.12] and Yes	A1	
	Alternative method 2 Comparing volume needed with volume that could be filled		
	$4 \div 3 \times 15^3 \times \pi$ or [4488, 4500]π or [14 092, 14 139]	M1	oe allow 1.33 or better
	their [14 092, 14 139] – 5000 or [9092, 9139]	M1dep	
	[58, 60] × 160 or [9280, 9600]	M1	oe
	[9092, 9139] and [9280, 9600] and Yes	A1	

4 cont	**Alternative method 3** Volume of ball compared with volume that could be filled + 5000		
	$4 \div 3 \times 15^3 \times \pi$ or [4488, 4500]π or [14 092, 14 139]	M1	oe allow 1.33 or better
	[58, 60] × 160 or [9280, 9600]	M1	oe
	their [9280, 9600] + 5000 or [14 280, 14 600]	M1dep	dep on 2nd M1
	[14 092, 14 139] and [14 280, 14 600] and Yes	A1	
	Additional Guidance		
	Accept $\frac{4}{3}\pi 15^3$ without multiplication signs		
	Condone use of 1.3 for up to M3 if 1.3 shown		
	Up to M3 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts		
	Using an incorrect power eg 15^2, $15\pi^3$, $(15\pi)^3$ or omitting π unless recovered		1st M0
	NB 56.(59…) or 56.6 or 57 coming from 5000 ÷ 88.35…		M1M1M0
	Yes can be implied eg Alt 1 $57 < 60$		M3A1

Q	Answer	Mark	Comments
5	**Alternative method 1** Compares 70% of volume of hemisphere with volume of water		
	$\frac{4}{3} \times \pi \times 12^3$ or 2304π or [7216, 7239.2] or $\frac{2}{3} \times \pi \times 12^3$ or 1152π or [3581, 3638]	M1	oe eg $\frac{4}{3}\pi \times 1728$ allow without any multiplication signs eg $\frac{4}{3}\pi 12^3$
	0.7 × their 1152π or 806.4π or [2506, 2547]	M1dep	oe 0.7 × their [3581, 3638] or $\frac{4032}{5}\pi$ must be using volume of hemisphere
	325 × 8 or 2600	M1	oe
	[2506, 2547] and 2600 and Yes	A1	oe
	Alternative method 2 Works out volume of water as proportion of volume of hemisphere		
	$\frac{4}{3} \times \pi \times 12^3$ or 2304π or [7216, 7239.2] or $\frac{2}{3} \times \pi \times 12^3$ or 1152π or [3581, 3638]	M1	oe eg $\frac{4}{3}\pi \times 1728$ allow without any multiplication signs eg $\frac{4}{3}\pi 12^3$
	325 × 8 or 2600	M1	oe
	their 2600 ÷ their 1152π or [0.71, 0.73]	M1dep	oe eg their 2600 ÷ their [3581, 3638] or 72% dep on M2 must be using volume of hemisphere
	[71, 73](%) and Yes	A1	oe eg 0.72 and 0.7 and Yes

5 cont	**Alternative method 3** Works out time to fill 70% of volume of hemisphere		
	$\frac{4}{3} \times \pi \times 12^3$ or 2304π or [7216, 7239.2] or $\frac{2}{3} \times \pi \times 12^3$ or 1152π or [3581, 3638]	M1	oe eg $\frac{4}{3}\pi \times 1728$ allow without any multiplication signs eg $\frac{4}{3}\pi 12^3$
	$0.7 \times$ their 1152π or 806.4π or [2506, 2547] or their $1152\pi \div 325$ or [11, 11.2]	M1dep	oe $0.7 \times$ their [3581, 3638] or $\frac{4032}{5}\pi$ or their [3581, 3638] ÷ 325 must be using volume of hemisphere
	$0.7 \times$ their $1152\pi \div 325$ or $0.7 \times$ their [3581, 3638] ÷ 325 or [7.7, 7.84]	M1dep	oe their [2506, 2547] ÷ 325 or $0.7 \times$ their [11, 11.2]
	[7.7, 7.84] and Yes	A1	oe

	Additional Guidance	
5 cont	Up to M3 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts	
	Allow 1.33(…) for $\frac{4}{3}$	
	Allow 0.66(…) or 0.67 for $\frac{2}{3}$	
	π may be seen as [3.14, 3.142] eg Alt 1 $\frac{2}{3} \times 3.14 \times 12^3$	M1
	If a number (or calculation) in terms of π is seen but π is subsequently omitted, treat as a miscopy for M marks eg Alt 1 1152π $0.7 \times 1152 = 806.4$ $325 \times 8 = 2600$ Yes	 M1 M1dep M1A0
	Yes cannot be implied by inequalities	
	Alts 1 and 2 $325\,cm^3 \times 8$ seen is M1 even if evaluated incorrectly $325^3 \times 8$ seen is M0 unless recovered to 2600	
	Do not allow misreads of the given formula unless recovered eg1 using 12^2 instead of 12^3 eg2 using $\frac{3}{4}$ instead of $\frac{4}{3}$	
	For $0.7 \times$ their 1152π, do not accept $70\% \times$ their 1152π unless recovered	

Q	Answer	Mark	Comments
6	No ticked and correct reason or correct evaluation of the surface areas for any numerical or algebraic values or correct ratio of the surface areas	B2	eg 2 faces are hidden B1 No ticked
	Additional Guidance		
	Ignore irrelevant reasons or evaluations alongside a correct reason or evaluation, unless contradictory		
	"No" may be implied by a correct reason		
	Accept reasoning that uses A as a cube		
	No ticked and A has 6, B has 10 (condone sides for faces) A has 3, B has 5 A has 6 sides, on B each cube only has 5 Ratio is 3:5 (accept equivalent ratios) The bottom and the top are missing (or covered) When they are put together you lose two faces You wouldn't count two sides (condone sides for faces) Some of the faces are covered You cannot see one side because they are stacked together One face covered Part of the area of A is covered where it joins B Both touching sides		 B2 B2 B2 B2 B2 B2 B2 B2 B2 B2 B2 B2
	Yes ticked or Cannot tell ticked		B0

Q	Answer	Mark	Comments
7(a)	11 5 4 or 10 7 3 or 10 6 4 or 9 8 3 or 9 7 4 or 9 6 5 or 8 7 5	B2	any order B1 answer of three positive numbers in any order with sum 20 eg 17 2 1 or $9\frac{1}{2}$ $8\frac{1}{2}$ 2 or 10 5 5 or $6\frac{2}{3}$ $6\frac{2}{3}$ $6\frac{2}{3}$ or correct equation in w, x and y eg $4w + 4x + 4y = 80$ or $w + x + y = 20$

Additional Guidance	
Ignore attempts to work out the volume or surface area eg 10 5 5 volume calculated as 500	B1
Negative numbers and/or zero used	B0
$wxy > 200$ or $wxy = 200$	B0
Allow $6.\dot{6}$ for $6\frac{2}{3}$	

Q	Answer	Mark	Comments
7(b)	$54a^2$	B1	

Q	Answer	Mark	Comments
8a	Correct statement	B1	eg she used the height instead of the slant height or she used the vertical height or she used 12 (instead of 13)
	Additional Guidance		
	Check diagram		
	For 'vertical' accept anything that implies she has used the wrong height		
	Condone 'length' to mean 'height' or 'slant height'		
	12 or 13 circled on the diagram must be accompanied by a supporting statement		
	Indicates '12' in the calculation		B1
	She should have done $\pi \times 5 \times 13$		B1
	It should be 65π		B1
	She used the wrong height / the (value of) l is wrong		B1
	She hasn't used the slant height (she used the (vertical) height)		B1
	She hasn't used the 13		B1
	She hasn't used the 13 and should be $5 \times 12 \times 13 \times \pi$		B0
	The multiplication used the wrong number(s)		B0
	She hasn't used a value for π		B0
	An incorrect statement with a correct statement eg she used 13 instead of 12 and didn't square the radius		B0

Q	Answer	Mark	Comments
8b	$\pi \times 5 \times 5$ or 25π or $3 \times 5 \times 5$	M1	oe accept [3.14, 3.142] or $\frac{22}{7}$ for π
	75	A1	
	Additional Guidance		
	$\pi 25$		M1

Q	Answer	Mark	Comments
8c	'More than' indicated or implied by statement and valid reason	B1	eg valid reasons 3.14 is greater (than 3) Beth's number is bigger (than Adam's) (the correct answer is) 78.5 (with their answer to (b) less than 78.5)
	Additional Guidance		
	If calculations are used, the outcomes must be correct		
	Accept 78 or 79 for 78.5 unless from incorrect working		
	'Less than' indicated	B0	
	Do not penalise use of the same incorrect formula in (b) and (c) eg $3 \times 10 = 30$ in (b) and $3.14 \times 10 = 31.4$ in (c) with 'More than' ticked	B1	
	Ignore a non-contradictory reason with a correct reason eg 3.14 is bigger than 3 and nearer the true value of pi	B1	
	Acceptable reasons		
	Adam has rounded (pi) down / Adam only used 3	B1	
	There is an extra 0.14 to multiply by	B1	
	Her number has decimal places	B1	
	Her number is to more significant figures	B1	
	Non-acceptable reasons		
	3.14 will give a bigger answer / 3.14 is more accurate	B0	