

**Extended Mathematics**  
**Topic : Mensuration**  
**Year : May 2013 - May 2024**

**Paper -4**

**Answers**

Question 1

(a)	3080	2	<b>M1</b> for $\frac{1}{2} \times 7 \times 22 \times 40$
(b)	46.2 or 46.18 to 46.2 www	4	<b>M3</b> for $\sqrt{7^2 + 22^2 + 40^2}$ <b>or M2</b> for $7^2 + 22^2 + 40^2$ soi by 2133 <b>or M1</b> for correct Pythagoras on one face
(c)	8.7 or 8.7 to 8.72 www	3	<b>M2</b> for $\sin^{-1} \frac{7}{\text{their}(b)}$ oe
(d)	217	3	<b>M1</b> for $\frac{4}{3} \times \pi \times 1.5^3$ soi by 14.1 to 14.14 <b>and M1 dep</b> for <i>their</i> (a) $\div$ <i>their</i> 14.14 soi by 218. Dependent on <b>M1</b> earned
(e) (i)	25.13875 final answer	2	<b>B1</b> for 4.55 <b>and</b> 11.05 seen or 25.13875 seen and then spoiled
(ii)	25.14	1FT	<b>Strict FT</b> <i>their</i> (e)(i) correct to 4s.f. if rounding is possible

Question 2

(i)	6360 or 6361 to 6363	2	<b>M1</b> for $\pi \times 45^2$
(ii)	165 or 164.9 to 165	2	<b>M1</b> for $\frac{210}{360} \times 2\pi \times 45$

Question 3

(a)	371 or 371.1...	4	<b>M3</b> for $(6 \times 4 \times 12) + (2 \times 6 \times 0.5 \times 4 \times 4 \times \sin 60)$ oe <b>or M2</b> for area of 1 or 2 hexagons <b>or M1</b> for area of one relevant triangle or trapezium or rectangle within hexagon
(i)	1740 or 1743.6 to 1744.2	4	<b>M3</b> for $\frac{12000}{4} \div (\pi \times 0.74^2)$ oe <b>or SC2</b> for figs 174[3..] or 174[4..]
(ii)	87 cao www 5	5	<b>B4</b> for 87.39 to 87.43 <b>or M3</b> for $[r=] \sqrt{\frac{\text{figs } 12}{\pi \times \text{figs } 5}}$ oe

Question 4

(a)	329.7 to 330	3	<b>M2</b> for $\frac{1}{2}\pi(12^2 + 8.75^2 - 3.25^2)$ oe or <b>M1</b> for $\frac{1}{2}\pi 12^2$ or $\frac{1}{2}\pi 8.75^2$ or $\frac{1}{2}\pi 3.25^2$  <b>SC2</b> for answer 1318 to 1320
(b)	2970 or 2967 to 2969.[...]	4	<b>M3</b> for $\frac{1}{2}\pi(24 + 17.5 + 6.5) \times 35$ + <i>their</i> (a) or <b>M2</b> for $\frac{1}{2}\pi(24 + 17.5 + 6.5) \times 35$ or <b>M1</b> for $\frac{1}{2}\pi \times 24$ or $\frac{1}{2}\pi \times 17.5$ or $\frac{1}{2}\pi \times 6.5$  <b>SC3</b> for 3955 to 3960 dep on <b>SC2</b> in (a)
(c)	11.5 or 11.6 or 11.53 to 11.55	<b>3FT</b>	<b>M1</b> for <i>their</i> (a) $\times 35$ <b>A1</b> for 11500 or 11530 to 11550
(d) (i)	$\frac{r}{h} = \frac{20}{40}$ or $\frac{r}{20} = \frac{h}{40}$	1	Accept $20 : 40 = r : h$ leading to $40r = 20h$ [ $r = h/2$ ] $\frac{20}{40} = \frac{1}{2}$ and $\frac{r}{h} = \frac{1}{2}$
(ii)	35.3 or 35.31 to 35.34	3	<b>M2</b> for $\sqrt[3]{\frac{\text{their } 11545 \times 12}{\pi}}$ oe or $2 \times \text{their } r$ or <b>M1</b> for <i>their</i> $11545 = \frac{1}{3} \times \pi \times \left(\frac{h}{2}\right)^2 \times h$ oe or <i>their</i> $11545 = \frac{1}{3} \times \pi \times r^2 \times 2r$ oe

Question 5

(a)	$9 - 2x, 7 - 2x$ oe	2	<b>B1</b> for each, accept in any order
(b)	$x(9 - 2x)(7 - 2x)$ $4x^3 - 32x^2 + 63x$	<b>M1FT</b> <b>A1</b>	Correct expansion and simplification with no errors

Question 6

(a) (i)	$90 \div (42/360 \times \pi \times 8^2)$ o.e.  3.836 to 3.837	<b>M3</b>  <b>A1</b>	<b>M2</b> for $42/360 \times \pi \times 8^2 \times h = 90$ or <b>M1</b> for $42/360 \times \pi \times 8^2$
(ii)	131 or 130.75 to 130.9 nfw	5	<b>M2</b> for $42/360 \times \pi \times 2 \times 8 \times 3.84$ oe [22.48 to 22.53] or <b>M1</b> for $42/360 \times \pi \times 2 \times 8$ oe soi [5.86 to 5.87] and <b>M1</b> for $2 \times (8 \times 3.84)$ [61.37 to 61.44] and <b>M1</b> for $2 \times (42/360 \times \pi \times 8^2)$ [46.88 to 47]

(b) 2.42 or 2.416 to 2.419

3

**M2** for  $3.84 \times \sqrt[3]{\frac{22.5}{90}}$  oe or  $h = \sqrt[3]{\frac{3.84^3 \times 22.5}{90}}$   
or **M1** for  $\sqrt[3]{\frac{22.5}{90}}$  oe or  $\sqrt[3]{\frac{90}{22.5}}$  oe seen  
or  $\frac{3.84^3}{h^3} = \frac{90}{22.5}$  oe

Question 6

(a) (i) 204 or 204.2 to 204.23

2

**M1** for  $\pi \times 5 \times 13$  implied by answer in range 204.1 to 204.3

(ii) 12 cao

3

**M2** for  $\sqrt{13^2 - 5^2}$  or states 5, 12, 13 triangle  
or **M1** for  $13^2 = 5^2 + h^2$  or better

(iii) 314 or 314.1 to 314.2

2

**M1** for  $\frac{1}{3} \times \pi \times 5^2 \times \text{their (a) (ii)}$  implied by answer in range 314 to 314.3

(iv)  $3.14 \times 10^{-4}$  or 3.141 to  $3.142 \times 10^{-4}$

2FT

**FT** *their (a) (iii)*  $\div 100^3$  correctly evaluated **and** given in standard form to 3 sig figs or better  
or **M1 FT** for *their (a) (iii)*  $\div 100^3$   
or **SC1** for conversion of *their*  $m^3$  into standard form only if negative power

(b) 138 or 138.3 to 138.5

4

**M3** for  $\frac{10\pi}{26\pi} \times 360$  oe or  
 $\frac{\pi \times 5 \times 13 \text{ or their (a) (i)}}{\pi \times 13^2} \times 360$  oe  
or **M2** for a correct fraction without  $\times 360$   
or **M1** for  $\pi \times 2 \times 13$  oe [81.6 to 81.8] seen  
or  $\pi \times 13^2$  oe [530.6 to 531.2] seen

Question 7

(a) (i)	204 or 204.2 to 204.23	2	<b>M1</b> for $\pi \times 5 \times 13$ implied by answer in range 204.1 to 204.3
(ii)	12 cao	3	<b>M2</b> for $\sqrt{13^2 - 5^2}$ or states 5, 12, 13 triangle or <b>M1</b> for $13^2 = 5^2 + h^2$ or better
(iii)	314 or 314.1 to 314.2	2	<b>M1</b> for $\frac{1}{3} \times \pi \times 5^2 \times$ <i>their (a) (ii)</i> implied by answer in range 314 to 314.3
(iv)	$3.14 \times 10^{-4}$ or 3.141 to $3.142 \times 10^{-4}$	2FT	<b>FT</b> <i>their (a) (iii)</i> $\div 100^3$ correctly evaluated <b>and</b> given in standard form to 3 sig figs or better or <b>M1 FT</b> for <i>their (a) (iii)</i> $\div 100^3$ or <b>SC1</b> for conversion of <i>their</i> $m^3$ into standard form only if negative power
(b)	138 or 138.3 to 138.5	4	<b>M3</b> for $\frac{10\pi}{26\pi} \times 360$ oe or $\frac{\pi \times 5 \times 13 \text{ or } \textit{their (a) (i)}}{\pi \times 13^2} \times 360$ oe

Question 8

(a)	$[r = ] 2.30[9\dots]$	3	<b>B2</b> for $[r = ] 2.31$ or <b>M2</b> for $4 \tan 30$
(b)	333 or 332.5 to 332.6	4	<b>M3</b> for $0.5 \times 8 \times 8 \times \sin 60 \times 12$ oe or <b>M2</b> for $0.5 \times 8 \times 8 \times \sin 60$ oe or <b>M1</b> for <i>their</i> triangle area $\times 12$ shown

Question 9

(a) (i)	2412 to 2413....	<b>B2</b>	Must be at least 4 figures shown <b>M1</b> for $\pi \times 8^2 \times 12$ oe
(ii)	2.41[0]	<b>B1</b>	

(b)	1 min 24 s	4	<b>B3</b> for 83.76 to 83.8[0] or 84 or 1.396 to 1.397 or 1.4 or 1 min 23.76 to 1 min 23.8 seen <b>or M2</b> for $\frac{1}{3}\pi \times 4^2 \times 10 \div 2$ [ 80/3 $\pi$ ] <b>or M1</b> for $\frac{1}{3}\pi \times 4^2 \times 10$ [160/3 $\pi$ or 167.5 to 167.6]
(c)	14	3	<b>M1</b> for $\frac{2410}{\frac{1}{3}\pi \times 4^2 \times 10}$ or $\frac{2410}{\frac{1}{3}\pi \times 4^2 \times 10}$ <i>their cone vol from part (b)</i> <b>A1</b> for 14.3 to 14.4....

### Question 10

(i)	59 112 to 59 113 or 59 100 or 59 110 or 59 119 to 59 120 or 59 100 nfw	3	<b>M2</b> for $\pi \times 21 \times (30^2 - 2^2)$ oe <b>Or</b> <b>M1</b> for $\pi \times 21 \times 30^2$ or $\pi \times 21 \times 2^2$
(ii)	(a) 0.0125 (b) 7580 or 7582 or 7581 or 7583 nfw	1 4	<b>M1</b> for $21 \times 29.7 \times$ <i>their</i> 0.0125 [=7.796 or 7.8[0]] <b>and</b> <b>M1</b> for <i>their (d)(i)</i> $\div (21 \times 29.7 \times$ <i>their</i> 0.0125) <b>A1</b> for 7580 to 7583.2 (non integer)  If 0 then <b>SC1</b> for <i>their (d)(i)</i> $\div (21 \times 29.7 \times 0.125)$

### Question 11

(a)	$\frac{1}{2} \times 8 \times 8 \times \sin 56$ oe 26.52 to 26.53	<b>M1</b> <b>A1</b>	or $[\frac{1}{2} \times 2] 8 \sin 28 \times 8 \cos 28$ or $[\frac{1}{2} \times 2] \times 7.06... \times 3.75...$
(b) (i)	72.[0] or 71.87 to 72.0	3	<b>M2</b> for $26.5 / (\pi \times 6.5^2) \times 360$ oe or <b>M1</b> for $\frac{x}{360} \times \pi \times 6.5^2 = 26.5$ or better
(ii)	21.1 or 21.2 or 21.14 to 21.17	3	<b>M2</b> for $\frac{\text{their (b)(i)}}{360} \times \pi \times 2 \times 6.5 + 2 \times 6.5$ oe or <b>M1</b> for $\frac{\text{their (b)(i)}}{360} \times \pi \times 2 \times 6.5$ oe or $\frac{\text{their (a)}}{0.5 \times 6.5}$

(c) (i)	$\frac{30}{360} \times \pi \times r^2 - \frac{1}{2} \times r^2 \times \sin 30$ $\text{oe}$ $\frac{1}{12} \times \pi \times r^2 - \frac{1}{4} \times r^2$ $\frac{1}{4} r^2 \left( \frac{1}{3} \pi - 1 \right)$	<b>M2</b> <b>A1</b> <b>A1</b>	<b>M1</b> for $\frac{30}{360} \times \pi \times r^2$ or $\frac{1}{2} \times r^2 \times \sin 30$  Dep on <b>M2 A1</b> and no errors seen
(ii)	20.6 or 20.7 or 20.55 to 20.71	3	<b>M2</b> for $[r^2 =] \frac{5}{\frac{1}{4} \left( \frac{1}{3} \pi - 1 \right)}$ or <b>M1</b> for one correct rearrangement step to $r$ from $\frac{1}{4} r^2 \left( \frac{1}{3} \pi - 1 \right) = 5$

Question 12

(a) (i)	5.37[1...]	2	<b>M1</b> for $[AD^2 =] 2.6^2 + 4.7^2$ oe or better
(ii)	54.1 or 54.11 to 54.12	3	<b>M2</b> for $\tan [BCD =] \frac{4.7}{(17-11-2.6)}$ oe or <b>B1</b> for 3.4 seen
(iii)	65.8	2	<b>M1</b> for $\frac{11+17}{2} \times 4.7$ oe
(b)	263.2 or 263	3FT	<b>FT</b> <i>their (a)(iii)</i> $\times 4$ correctly evaluated <b>M2</b> for <i>their (a)(iii)</i> $\times \left( \frac{9.4}{4.7} \right)^2$ oe or <b>M1</b> for [scale factor =] $\left( \frac{9.4}{4.7} \right)^2$ or $\left( \frac{4.7}{9.4} \right)^2$ soi

Question 13

(a) (i)	$120 \times 55 \times 75 [= 495000]$ $\div 1000 [= 495]$ or $495[1] \times 1000 = 495000[\text{ml}]$	<b>M1</b> <b>M1</b>	
(b) (i)	11	2	<b>M1</b> for $495000 \div 750 [= 660]$ oe [660] After 0 scored, <b>SC1</b> for answer figs 11

(ii)	37.5 or 37.50 to 37.51	3	<p><b>M2</b> for <math>\sqrt{\frac{\text{figs}495}{112\pi}}</math> oe</p> <p>or <b>M1</b> for <math>[112r^2 = ] \frac{\text{figs}495}{\pi}</math> or</p> <p><math>[\pi r^2 = ] \frac{\text{figs}495}{112}</math> or better</p>
(c)	15	4	<p><b>B3</b> for answer 60</p> <p>or <b>M3</b> for <math>75 - \sqrt{145^2 - (55^2 + 120^2)}</math> oe</p> <p><b>M2</b> for <math>\sqrt{145^2 - (55^2 + 120^2)}</math> oe</p> <p>or <b>M1</b> for <math>\sqrt{55^2 + 120^2}</math></p>
(d)	24.4[4..] to 24.45	3	<p><b>M2</b> for <math>\cos^{-1}(\sqrt{55^2 + 120^2}/145)</math> oe, e.g.</p> <p>or <math>\sin^{-1}(75 - \text{their (c)})/145</math></p> <p>or <math>\tan^{-1}((75 - \text{their (c)})/\sqrt{55^2 + 120^2})</math></p> <p>or <b>M1</b> for <math>\cos = \sqrt{55^2 + 120^2}/145</math> oe</p> <p>or <math>\sin = (75 - \text{their (c)})/145</math></p> <p>or <math>\tan = (75 - \text{their (c)})/\sqrt{55^2 + 120^2}</math></p>

#### Question 14

(a) (i)	47.7 or 47.74 to 47.75	3	<p><b>M1</b> for <math>[\text{arc} = ] 68 - 2 \times 24</math></p> <p>or <math>24 + 24 + \frac{x}{360} \times 2\pi \times 24 = 68</math></p> <p><b>M1</b> for <math>[x = ] \text{their arc} \times 360 \div (2 \times \pi \times 24)</math></p>
(ii)	252 or 252.3 to 252.4...	6	<p><b>M1</b> for <math>r = \frac{20}{2\pi}</math> or</p> <p><math>\left(\frac{\text{their}47.7}{360} \times 2 \times \pi \times 24\right) \div (2\pi)</math></p> <p><b>A1</b> for <math>r = 3.18</math> or 3.182 to 3.183... or <math>\frac{10}{\pi}</math></p> <p><b>M1</b> for <math>h^2 = 24^2 - \text{their } r^2</math></p> <p><b>A1</b> for <math>h = 23.8</math> or 23.78... to 23.79</p> <p><b>M1dep</b> on M1 earned for</p> <p><math>V = \frac{1}{3}\pi \times \text{their } h \times \text{their } r^2</math></p>

(b)	139 or 139.3 to 139.4... nfw	5	<b>M4</b> for $8^2 + \frac{1}{4}\pi \times 8^2 + \frac{1}{2}\pi \times \left(\frac{8}{2}\right)^2$ <b>or M1</b> for $\frac{1}{4}\pi \times 8^2$ <b>and M1</b> for $\frac{1}{2}\pi \times \left(\frac{8}{2}\right)^2$ <b>and M1</b> for $8^2$ added to at least one term with $\pi$
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Question 15

$\frac{1}{2}(x+4+3x+2)(x+1)=15$	<b>M1</b>	Allow $\frac{1}{2}(4x+6)(x+1)=15$
$4x^2+4x+6x+6=30$ or $2x^2+2x+3x+3=15$	<b>M1</b>	Dep on 1 <sup>st</sup> <b>M1</b>
$2x^2+5x-12=0$	<b>A1</b>	With no errors or omissions

Question 16

(a)	28.3 or 28.29...	2	<b>M1</b> for $180\,000 \div (\pi \times 45^2)$
(b) (i)	360 000	3	<b>M2</b> for $\frac{1}{2}(70+50) \times 40 \times 150$ oe <b>or M1</b> for $\frac{1}{2}(70+50) \times 40$ oe <i>or their area of ABCD</i> $\times 150$ dependent on <i>their area</i> being two dimensional
(ii)	360	<b>1FT</b>	<b>FT</b> <i>their (b)(i)</i> $\div 1000$
(c)	3 h 20 min	3	<b>M2</b> for $180\,000 \div 15 \div 60$ (implied by 200) <b>or M1</b> for $180\,000 \div 15$ (implied by 12000) <b>or correct conversion of their seconds into h and min</b>
(d) (i)	$\frac{h}{40} = \frac{\frac{1}{2}(x-50)}{10}$ oe  $h = 2(x-50)$	<b>M1</b>	i.e. a correct statement from similar figures which must contain $h$ , $x$ and numbers
(ii)	$\frac{1}{2}(x+50)2(x-50)$	<b>A1</b>	Answer established with at least one more step and no errors or omissions
		<b>M1</b>	

(iv)	21.7 or 21.65 to 21.66	1FT	FT for 2(their (d)(iii) – 50) evaluated only if $x > 50$
(iii)	60.8 or 60.82 to 60.83	2	M1 for $(x^2 - 2500) \times 150 = 180000$ or better

Question 17

(a) (i)	$9\pi$ final answer	2	M1 for $\frac{135}{360} \times 2 \times \pi \times 12$ oe
(ii) (a)	4.5[0] or 4.497 to 4.504...	2FT	FT their $9 \div 2$ M1 for $2\pi r = \text{their } 9\pi$ or $12\pi r = \frac{135}{360}\pi 12^2$ oe
(b)	11.1 or 11.12[...]	3FT	FT their $\sqrt{12^2 - \text{their } 4.5^2}$ to 3 sf or better (their $4.5 < 12$ ) M2 for $\sqrt{12^2 - \text{their } 4.5^2}$ (their $4.5 < 12$ ) or M1 for $12^2 = h^2 + \text{their } 4.5^2$ oe (their $4.5 < 12$ )
(b) (i)	75 nfw	3	M2 for $l = \frac{35}{7} \times 15$ or $x = \frac{35}{7} \times 8$ oe or for 40 seen nfw or correct trig or Pythagoras' method leading to value rounding to 40.0 M1 for $\frac{l}{15} = \frac{35}{7}$ oe or $\frac{x}{8} = \frac{35}{7}$ oe or $\frac{l-35}{8} = \frac{35}{7}$ oe or $\frac{l-35}{l} = \frac{8}{15}$ oe
(ii)	2730 or 2730.0 to 2730.4 nfw	3	M2 dep for $\pi \times 15 \times \text{their } 75 - \pi \times 8 \times (\text{their } 75 - 35) [+ \pi \times 8^2]$ dep their $75 > 35$ or $805\pi$ [2527.7 to 2530] nfw or $869\pi$ [2728.6 to 2731.2] nfw or M1 for $\pi \times 15 \times \text{their } 75$ or $1125\pi$ [3532.5 to 3535.8] nfw seen or $\pi \times 8 \times (\text{their } 75 - 35)$ or $320\pi$ [1004.8 to 1005.8] nfw seen or $\pi \times 8^2$ or $64\pi$ [200.9 to 201.2] nfw seen

(c) (i)	$16r^3$	2	<b>M1</b> for $[M=] k \times r^3$ or $1458=k \times 4.5^3$ oe or $\frac{M}{1458} = \frac{r^3}{4.5^3}$ oe After <b>M0</b> , <b>SC1</b> for 16 seen
(ii)	8 : 27 oe	1	Must be numeric, e.g. 128:432

Question 18

(i)	37.7 or 37.69 to 37.704 nfw	2	<b>M1</b> for $6\pi + 4\pi \pm 2\pi$ oe
(ii)	12100, 12060, 12070, 12062.4 to 12065.6 nfw	5	<b>SC4</b> for answer with figs 121 or 1206 to 1207

Question 19

(a)	43 200	3	<b>M2</b> for $0.5 \times (35 + 25) \times 12 \times 120$ oe or <b>M1</b> for $0.5 \times (35 + 25) \times 12$ oe
(b) (i)	$0.5 \times (25 + 30) \times 6 \times 120 [= 19\ 800]$	<b>M2</b>	Dep on a valid method for obtaining the width of 30 cm <b>B1</b> for $0.5 \times (25 + 35)$ oe
(ii)	45.8 or 45.83...	<b>1FT</b>	<b>FT</b> for $\frac{19\ 800}{\text{their (a)}} \times 100$
(c)	1 hr 39 min	4	<b>B3</b> for 1.65 [h] or 99 mins or $\frac{33}{20}$ or <b>M2</b> for $\frac{19\ 800}{12 \times 1000}$ oe or <b>M1</b> for $\frac{19\ 800}{12}$ or $\frac{19\ 800}{1000}$ or $12 \times 1000$  If zero scored then <b>SC1</b> for figs 165 <b>and</b> <b>B1</b> for converting their time (in hours) into hours and minutes
(d)	12.8 or 12.80 to 12.81	3	<b>M2</b> for $\sqrt[3]{\frac{19\ 800}{3\pi}}$ or <b>M1</b> for $\pi r^2 \ 3r = 19\ 800$
(e)	21[.0]	2	<b>M1</b> for $\frac{19\ 800}{1000} + 1.2$

Question 20

(a)	5.2[0] or 5.196...	3	<b>M2</b> for $[h^2=] 6^2 - 3^2$ or better or <b>M1</b> for $h^2 + 3^2 = 6^2$ or <b>B1</b> for $PR$ (or $PQ$ or $QR$ ) = 6
(b) (i)	7.2[0] or 7.196...	1FT	<b>FT</b> <i>their</i> (a) + 2
(ii)	62.4 or 62.35...	5	<b>M4</b> for $12 \times 6 \times \frac{1}{2} \tan 60$ oe or <b>M3</b> for $6 \times \frac{1}{2} \tan 60$ oe or <b>M2</b> for realising that $\frac{1}{2}$ base = $1 \times \tan 60$ oe or <b>B1</b> for angle 30 or 60 in correct position on diagram or in a calculation If 0 scored, <b>SC1</b> for volume = an area $\times$ 12 seen

Question 21

(a)	3	1	
(b) (i)	9900	3	<b>M2</b> for $2(60 \times 35) + 2(60 \times 30) + 2(30 \times 35)$ oe or <b>M1</b> for one correct rectangle
(ii)	0.99 oe	1FT	<b>FT</b> <i>their</i> (b)(i) $\div$ 10 000
(c) (i)	75.7 or 75.66 to 75.67	4	<b>M3</b> for $\sqrt{60^2 + 30^2 + 35^2}$ oe could be in stages or <b>M2</b> for $60^2 + 30^2 + 35^2$ oe or <b>M1</b> for $60^2 + 30^2$ or $60^2 + 35^2$ or $35^2 + 30^2$ oe
(ii)	23.4 or 23.3 or 23.34 to 23.36...	3	<b>M2</b> for $\sin^{-1}(30 \div \sqrt{60^2 + 35^2 + 30^2})$ oe or for $\sin^{-1}(30 \div \textit{their} (c)(i))$ or <b>M1</b> for $\sin = 30 \div \sqrt{60^2 + 35^2 + 30^2}$ oe or for $\sin = 30 \div \textit{their} (c)(i)$
(d) (i)	$30 \times 35 \times 60$ [= 63 000]	1	With no errors seen
(ii)	22.4 or 22.38 to 22.391	3	<b>M2</b> for $\sqrt{\frac{63\,000}{40\pi}}$ oe or <b>M1</b> for $40\pi r^2 = 63\,000$ oe

Question 22

(a)	14 137 to 14 137.2 or 14 139	2	<b>M1</b> for $\frac{4}{3} \times \pi \times 15^3$
(b) (i)	104 000 or 103 600 to 103 700	3	<b>M2</b> for $\pi \times 25^2 \times 60 - 14140$ or <b>M1</b> for $\pi \times 25^2 \times 60$
(ii)	52.8 or 52.75 to 52.81...	2	<b>M1</b> for <i>their</i> (b)(i) $\div (\pi \times 25^2)$ or $14140 \div (\pi \times 25^2)$
(c) (i)	15.8 or 15.81.....	3	<b>M2</b> for $[r^2 = ] \frac{14140}{\frac{1}{3} \times \pi \times 54}$ or <b>M1</b> for $\frac{1}{3} \times \pi \times r^2 \times 54 = 14140$ oe
(ii)	3580 or 3576 to 3581 nfw	4	<b>M1</b> for $(\text{their (c)(i)})^2 + 54^2$ <b>M1</b> for $\pi \times (\text{their (c)(i)}) \times \sqrt{\{(\text{their (c)(i)})^2 + 54^2\}}$ <b>M1</b> for $\pi \times (\text{their (c)(i)})^2$

Question 23

(a)	Attempt to use $18 - r$ in Pythagoras' $144 = r^2 - 324 + 18r + 18r - r^2$ oe $468 = 36r$ oe	<b>M1</b> <b>B2</b> <b>A1</b>	or <b>B1</b> for $324 - 18r - 18r + r^2$ Correct simplification with no errors
(b)	$[2 \times] \sin^{-1}\left(\frac{12}{13}\right)$ oe  134.76...	<b>M1</b> <b>A1</b>	or $\cos = \left(\frac{13^2 + 13^2 - 24^2}{2 \times 13 \times 13}\right)$ or better or $[180 - ] 2 \times \sin^{-1}\left(\frac{5}{13}\right)$ Not $67.4 \times 2$
(c) (i)	332 or 332.1 to 332.2...	3	<b>M2</b> for $\frac{(360 - 134.8)}{360} \times \pi \times 13^2$ or <b>M1</b> for $\frac{134.8}{360} \times \pi \times 13^2$
(ii)	392 or 392.0 to 392.2...	3	<b>M2</b> for $\frac{1}{2} \times 24 \times 5 + \text{their (c)(i)}$ or $\frac{1}{2} \times 13^2 \times \sin 134.8 + \text{their (c)(i)}$ or <b>M1</b> for $\frac{1}{2} \times 24 \times 5$ or $\frac{1}{2} \times 13^2 \times \sin 134.8$

<b>(c) (i)</b>	332 or 332.1 to 332.2...	<b>3</b>	<b>M2</b> for $\frac{(360-134.8)}{360} \times \pi \times 13^2$ or <b>M1</b> for $\frac{134.8}{360} \times \pi \times 13^2$
<b>(ii)</b>	392 or 392.0 to 392.2...	<b>3</b>	<b>M2</b> for $\frac{1}{2} \times 24 \times 5 + \text{their (c)(i)}$ or $\frac{1}{2} \times 13^2 \times \sin 134.8 + \text{their (c)(i)}$ or <b>M1</b> for $\frac{1}{2} \times 24 \times 5$ or $\frac{1}{2} \times 13^2 \times \sin 134.8$
<b>(iii)</b>	15 700 or 15 670 to 15 690	<b>1FT</b>	<b>FT</b> for answer to $40 \times \text{their (c)(ii)}$
<b>(d)</b>	29.5 or 29.6 or 29.51 to 29.57...	<b>2FT</b>	<b>M1</b> for $\pi \times 13^2 \times h = \text{their (c)(iii)}$ or better

Question 24

<b>(i)</b>	1.32	<b>2</b>	<b>M1</b> for $0.8 \times 1.5 \times 1.1$
<b>(ii)</b>	0.725 or 0.7246 to 0.7247...	<b>2</b>	<b>M1</b> for $\pi r^2 \times 0.8 = \text{their (a)(i)}$ or $\pi r^2 = 1.5 \times 1.1$ oe
<b>(iii)</b>	0.513 to 0.518 nfw	<b>5</b>	<b>M1</b> for $2(1.5 \times 1.1 + 1.5 \times 0.8 + 1.1 \times 0.8)$  <b>M1</b> for $[2 \times] \pi \times (\text{their (a)(ii)})^2$  <b>M2</b> for $\pi \times 2 \times (\text{their (a)(ii)}) \times 0.8$ or <b>M1</b> for $\pi \times 2 \times (\text{their (a)(ii)})$

Question 25

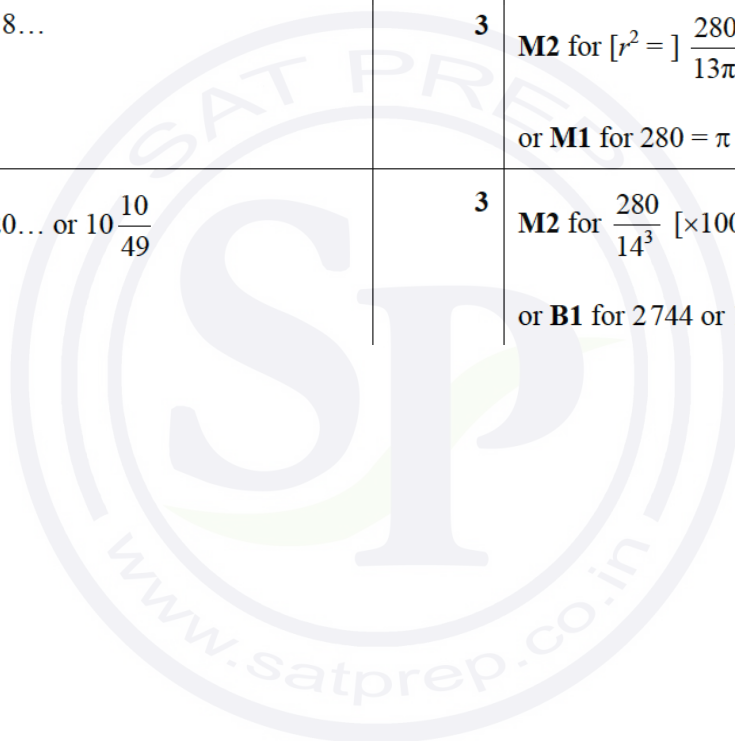
(a) (i)	51.7 or 51.69 to 51.70...	4	<p><b>M3</b> for  <math>(2 \times \frac{2}{3} \times \pi \times 13^3 + \pi \times 13^2 \times 25) \times 2.3 [\div 1000]</math> oe                      or <b>SC3</b> for figs 517 or figs 5169 to 5170...                      or <b>M2</b> for <math>(2 \times \frac{2}{3} \times \pi \times 13^3 + \pi \times 13^2 \times 25)</math> oe  <b>OR</b>  <b>M1</b> for <math>2 \times \frac{2}{3} \times \pi \times 13^3</math> seen                      or <math>\pi \times 13^2 \times 25</math> seen  <b>M1indep</b> for <i>their</i> volume <math>\times 2.3 \div 1000</math></p>
(ii)	1.96 or 1.957 to 1.958 ...	4	<p><b>M3</b> for  <math>(2 \times 2 \times \pi \times 13^2 + \pi \times 2 \times 13 \times 25) [\div 100^2] \times 4.7</math> oe                      or <b>SC3</b> for figs 196 or figs 1957 to 1958...  <b>M2</b> for <math>(2 \times 2 \times \pi \times 13^2 + \pi \times 2 \times 13 \times 25)</math> oe  <b>OR</b>  <b>M1</b> for <math>2 \times 2 \times \pi \times 13^2</math> seen or <math>\pi \times 2 \times 13 \times 25</math> seen  <b>M1indep</b> for <i>their</i> area divided by <math>100^2</math> soi</p>
(b)	6.2[0] or 6.203 to 6.204	3	<p><b>M2</b> for <math>x^3 = \frac{500}{\frac{2}{3}\pi}</math> oe or better                      or <b>M1</b> for <math>\frac{1}{3} \times \pi \times x^2 \times 2x = 500</math> oe</p>
(c)	286 or 285.7...	3	<p><b>M2</b> for <math>\frac{180}{A} = \left(\frac{180}{360}\right)^{\frac{2}{3}}</math> oe                      or <b>M1</b> for <math>\left(\sqrt[3]{\frac{360}{180}}\right)^{[2]}</math> oe or <math>\left(\sqrt[3]{\frac{180}{360}}\right)^{[2]}</math> oe seen                      or <math>\frac{A^3}{180^3} = \frac{360^2}{180^2}</math></p>

Question 26

(a)(i)	94.2 or 94.3 or 94.24 to 94.26	2	<b>M1</b> for $\pi \times 3 \times 10$
(a)(ii)	9.54 or 9.539...	3	<b>M2</b> for $\sqrt{10^2 - 3^2}$ or <b>M1</b> for $h^2 + 3^2 = 10^2$ oe
(a)(iii)	89.9 or 89.90 to 89.92...	2	<b>M1</b> for $\frac{1}{3} \times \pi \times 3^2 \times \text{their (a)(ii)}$
(b)	108 or 107.9 to 108.1 nfw	4	<b>M3</b> for $\frac{\pi \times 3 \times 10}{\pi \times 10^2} \times 360$ oe or $\frac{\text{their (a)(i)}}{\pi \times 10^2} \times 360$ oe or $\frac{2 \times \pi \times 3}{2 \times \pi \times 10} \times 360$ oe or <b>M2</b> for $\frac{x}{360} \times \pi \times 10^2 = \text{their (a)(i)}$ oe or $\frac{x}{360} \times 2 \times \pi \times 10 = 2 \times 3 \times \pi$ oe or <b>M1</b> for $\frac{x}{360} \times \pi \times 10^2$ seen or $\frac{x}{360} \times 2 \times \pi \times 10$ seen
(c)	46.6 to 46.8	4	<b>M3</b> for $\frac{\text{their (b)}}{360} \times \pi \times 10^2 - \frac{1}{2} \times 10 \times 10 \times \sin(\text{their (b)})$ oe or <b>M1</b> for $\frac{\text{their (b)}}{360} \times \pi \times 10^2$ or $\text{their (a)(i)}$ soi and <b>M1</b> for $\frac{1}{2} \times 10 \times 10 \times \sin(\text{their (b)})$ soi

Question 27

(a)(i)	17.5 or 17.46....nfww	6	<p><b>B3</b> for triangle height 3.46[4...] or <math>\sqrt{12}</math> oe  or <b>M2</b> for <math>\sqrt{4^2 - 2^2}</math>  or <b>M1</b> for <math>h^2 + 2^2 = 4^2</math></p> <p><b>and M2</b> for <math>2 \times 7 + \frac{1}{2} \times 2 \times \text{their } h</math> oe</p> <p>or <b>M1</b> for <math>\frac{1}{2} \times 2 \times \text{their } h</math></p>
(a)(ii)	140 or 139.6 to 139.7...	1FT	FT <i>their (a)</i> $\times 8$
(b)(i)	2.62 or 2.618...	3	<p><b>M2</b> for <math>[r^2 = ] \frac{280}{13\pi}</math> oe  or <b>M1</b> for <math>280 = \pi \times r^2 \times 13</math></p>
(b)(ii)	10.2 or 10.20... or $10\frac{10}{49}$	3	<p><b>M2</b> for <math>\frac{280}{14^3}</math> [<math>\times 100</math>] oe  or <b>B1</b> for 2744 or <math>14^3</math> seen</p>



Question 28

(a)(i)	50890 or 50893 to 50900.4	2	<b>M1</b> for $\pi \times 18^2 \times 50$
(a)(ii)	20.5 or 20.52 to 20.534	3	<p><b>B2</b> for answer 29.5 or 29.46 to 29.48 OR <b>M2</b> for <math>(50900 - 30000) \div (\pi \times 18^2)</math> oe</p> <p>or <b>M1</b> for <math>(\text{figs } 50.9 - \text{figs } 30) \div (\pi \times \text{figs } 18^2)</math> or <b>M1</b> for <math>(50900 - 30000) = (\pi \times 18^2)h</math> oe</p> <p>OR <b>alternative method</b> <b>M2</b> for <math>50 - \frac{30000}{\pi \times 18^2}</math> oe</p> <p><b>M1</b> for <math>\text{figs } 30 = \pi \times \text{figs } 18^2 \times (50 - h)</math> oe or for <math>\frac{\text{figs } 30}{\pi \times \text{figs } 18^2}</math> oe</p> <p>OR <b>alternative method</b> <b>M2</b> for <math>\frac{(50.9 - 30)}{50.9} \times 50</math> oe or <b>M1</b> for <math>\frac{(50.9 - 30)}{50.9}</math> or <math>\frac{30}{50.9} \times 50</math> oe or <b>M1</b> for <math>\frac{(\text{figs } 50.9 - \text{figs } 30)}{\text{figs } 50.9} \times 50</math> oe</p>
(a)(iii)	334 nfw	4	<p><b>M2</b> for <math>\text{figs } 30 \div \frac{2}{3} \pi \times 3.5^3</math> oe or <b>M1</b> for <math>\frac{1}{2} \times \frac{4}{3} \pi \times 3.5^3</math> oe</p> <p>and <b>B1</b> for 30 000</p>
(b)(i)	3.28[6..] or 3.29	3	<p><b>M2</b> for <math>[r^2 = ] \frac{95 \times 3}{8.4\pi}</math> oe or <b>M1</b> for <math>\frac{1}{3} \pi \times r^2 \times 8.4 [= 95]</math></p>
(b)(ii)	93.1 to 93.6	4	<b>M3</b> for $\pi \times 3.3 \times \sqrt{3.3^2 + 8.4^2}$

Question 29

i(a)(i)	25.5 or 25.46...	2	<b>M1</b> for $\pi \times 5^2 \times h = 2000$ oe
(a)(ii)	9.85 or 9.847...	3	<b>M2</b> for $[r^3=] 2000 \div \left(\frac{2}{3}\pi\right)$ oe or <b>M1</b> for $\frac{2}{3}\pi r^3 = 2000$ oe
(a)(iii)	952 or 952.4...	3	<b>M2</b> for $[6 \times] \sqrt[3]{2000}^2$ or <b>M1</b> for $\sqrt[3]{2000}$ or 6 times <i>their</i> area of one face
i(b)(i)	22.5 or 22.49...	2	<b>M1</b> for $\frac{1}{2} \times 7 \times 10 \times \sin 40$
(b)(ii)	$\sqrt{(10^2 + 7^2 - 2 \times 10 \times 7 \cos 40)} + 7$ + 10	<b>M3</b>	<b>M2</b> for $10^2 + 7^2 - 2 \times 10 \times 7 \cos 40$ or <b>M1</b> for correct implicit cosine rule
	23.46...	<b>A2</b>	<b>A1</b> for 6.46... or 41.7 to 41.8
(c)	64.9 or 64.92 to 64.94	3	<b>M2</b> for $28.2 - 2 \times 9 = \frac{c}{360} \times 2 \times \pi \times 9$ oe or <b>M1</b> for $\frac{c}{360} \times 2 \times \pi \times 9$ soi

Question 30

(a)(i)	1070 or 1072. ...	3	<b>M1</b> for $\pi \times 8^2 \times 2 \times 8$ <b>M1</b> for $\frac{4}{3} \times \pi \times 8^3$ or <b>M2</b> for $\frac{2}{3}\pi r^3$ or <b>M1</b> for $\pi r^2 2r - \frac{4}{3}\pi r^3$
(a)(ii)	2.58 or 2.580 to 2.581	3	<b>B2</b> for $r^3 = \frac{36 \times 3}{2\pi}$ or better or <b>M1</b> for $\pi \times r^2 \times 2 \times r - \frac{4}{3} \times \pi \times r^3 = 36$ oe

(b)(i)	4.24 or 4.241 to 4.242	4	<b>M3</b> for $(\pi \times 5^2 + \pi \times 5 \times \sqrt{5^2 + 12^2})$ or <b>M2</b> for $\pi \times 5 \times \sqrt{5^2 + 12^2}$ or <b>M1</b> for $5^2 + 12^2$ or $\pi \times 5^2$
(b)(ii)	64 cao final answer	3	<b>M2</b> for $\frac{[k\pi] \times 5^2 \times 12}{[k\pi] \times 1.25^2 \times 3}$ or <b>M1</b> for $\frac{1}{3} \times \pi \times 5^2 \times 12$ or $\frac{1}{3} \times \pi \times 1.25^2 \times 3$

Question 31

(a)	204 or 203.5 to 203.6... nfw	4	<b>M2</b> for $\pi \times 1.5^2 \times 8 \times 60 \times 60$ or <b>M1</b> for $\pi \times 1.5^2$  <b>M1</b> for dividing <i>their</i> volume by 1000  If 0 scored <b>SC1</b> for an answer figs 204 or figs 2035 to 2036 without working
(b)(i)	$\pi \times 6 \times 12 + \pi \times 6^2 = 108\pi$	<b>M2</b>	<b>M1</b> for $\pi \times 6 \times 12$
(b)(ii)	$[x = ] 5.2[0]$ or 5.196...  $[y = ] 6$	4	<b>B2</b> or <b>M1</b> for $4\pi x^2 = 108\pi$ seen  <b>B2</b> or <b>M1</b> for $\frac{1}{2}(4\pi y^2) + \pi y^2$ or better seen

Question 32

(a)	4.79 or 4.788 to 4.789	3	<b>M2</b> for $\sqrt[3]{\frac{230 \times 3}{2 \times \pi}}$ oe or <b>M1</b> for $230 = \frac{2}{3} \times \pi \times r^3$ oe If 0 scored <b>SC1</b> for answer 3.8[0...]
(b)(i)	8.7[0] or 8.702 to 8.704	3	<b>M2</b> for $(300 - 230) \div (1.6^2 \pi)$ or <b>M1</b> for $\pi \times 1.6^2 \times h$
(b)(ii)	6.4	3	<b>M2</b> for $1.6 \times \sqrt[3]{\frac{19200}{300}}$ oe or <b>M1</b> for sf $\sqrt[3]{\frac{19200}{300}}$ or $\sqrt[3]{\frac{300}{19200}}$ oe or for $\left(\frac{1.6}{r}\right)^3 = \frac{300}{19200}$

Question 33

(a)(i)	$75000 \times 60 \times 20$ oe	<b>M1</b>	Allow $\times 1200$ for $\times 60 \times 20$
(a)(ii)	16.4 or 16.36 ...	<b>3</b>	<b>M2</b> for $\frac{9 \times 10^7 \times 100}{1000 \times 55 \times 10^4}$ oe or <b>B2</b> for answer 0.164 or 0.1636 ... or <b>B1</b> for answer figs 164 or 1636 ... or <b>M1</b> for figs $9 \div$ figs 55
(a)(iii)	28.3 or 28.27 to 28.28	<b>3</b>	<b>M2</b> for $\frac{76}{360} \times 2\pi \times 8.5 + 2 \times 8.5$ oe or <b>M1</b> for $\frac{76}{360} \times 2\pi \times 8.5$ oe
(b)(i)	3770 or 3769 to 3770. ...	<b>2</b>	<b>M1</b> for $\frac{1}{3} \times \pi \times 10^2 \times 36$
(b)(ii)	3.68 or 3.683 to 3.684 ...	<b>4</b>	<b>M3</b> for $[r^3 =] \frac{1}{2} \times$ their <b>(b)(i)</b> $\times \frac{3}{4\pi \times 9}$ oe or <b>M2</b> for $\frac{4\pi r^3}{3} + \frac{4\pi(2r)^3}{3} = \frac{1}{2} \times$ their <b>(b)(i)</b> or for $\frac{4\pi r^3}{3} = \frac{1}{1+8} \times \frac{1}{2} \times$ their <b>(b)(i)</b> or <b>M1</b> for $\frac{4\pi r^3}{3} + \frac{4\pi(2r)^3}{3}$ or $\frac{1}{2} \times \frac{\pi \times 10^2 \times 36}{3}$ or $\frac{1}{2}$ their <b>(b)(i)</b> seen or ratio of vols = $1 : 2^3$ oe seen

Question 34

(a)(i)	$[h =] 253.8 \div 18 \div \left(\frac{6}{2}\right)$ or $[h =] \frac{253.8 \times 2}{6 \times 18}$ or $[h =] \frac{253.8}{18 \times \frac{6}{2}}$	<b>3</b> For <b>M3</b> no errors at any stage <b>M2</b> for $253.8 = \frac{1}{2} \times 6 \times h \times 18$ oe (no previous errors) or <b>M1</b> for triangle area = $\frac{1}{2} \times 6 \times h$ soi
(a)(ii)	38.1 or 38.06 to 38.08	<b>2</b> <b>M1</b> for $\tan = \frac{4.7}{6}$ oe
(b)	358 or 357.9 to 358	<b>6</b> <b>M1</b> for $6^2 + 4.7^2$ <b>M1</b> for $\sqrt{6^2 + 4.7^2} \times 18$ [ $\times 2$ ] <b>M1</b> for $6 \times 18$ [ $\times 2$ ] <b>M1</b> for $4.7 \times 18$ <b>M1</b> for $2 \times \frac{1}{2} \times 6 \times 4.7$ oe

Question 35

(a)(i)	$\frac{1}{2} \times \frac{4}{3} \times \pi \times 5.6^3$	<b>M1</b>
	367.8... to 367.9	<b>A1</b>
(a)(ii)	3.06 or 3.060 to 3.061...	<b>4</b> <b>M1</b> for $0.8 \times 368$ [= 294.4] <b>M2</b> for $[r^2 =] \frac{\text{their } 294.4}{10\pi}$ oe or <b>M1</b> for $\pi r^2 \times 10 = \text{their } 294.4$ oe
(b)(i)	44[.0] or 43.98 to 43.99 nfw	<b>5</b> <b>B2</b> for [slant height = ] $\frac{25}{4}$ oe or <b>M1</b> for $[l^2 = ] 6^2 + 1.75^2$ oe <b>M2</b> for $\pi \times 1.75 \times \text{their } l + \pi \times 1.75^2$ or <b>M1</b> for $\pi \times 1.75 \times \text{their } l$ or $\pi \times 1.75^2$

(b)(ii)(a)	SF = $\frac{1}{4}$ oe soi	<b>B1</b>
	$\frac{1}{3}\pi \times 1.75^2 \times 6 - \frac{1}{3}\pi \times \text{their } 0.4375^2 \times 1.5$ <b>OR</b> $\frac{1}{3}\pi \times 1.75^2 \times 6 \times \left(1 - \left(\frac{1}{4}\right)^3\right)$ oe	<b>M2</b> <b>M1</b> for $\frac{1}{3}\pi \times 1.75^2 \times 6$ or $\frac{1}{3}\pi \times \text{their } 0.4375^2 \times 1.5$ <b>OR</b> <b>M1</b> for $1 - \left(\frac{1}{4}\right)^3$ oe
	18.94 or 18.939 to 18.944...	<b>A1</b>
(b)(ii)(b)	95 final answer	<b>3</b> <b>B2</b> for 94.5 or 94.69 to 94.722 <b>OR</b> <b>M2</b> for $18.9 \times 10^3 \div 200$ oe  or <b>M1</b> for $18.9 \times 10^3$ or $200 \div 10^3$ or figs 189.. $\div$ 200 or 18.9.. $\div$ figs 2

Question 36

(a)(i)	18[.0] or 17.99 to 18.00...	<b>3</b>	<b>M2</b> for $\sqrt[3]{\frac{24430 \times 3}{4\pi}}$ oe or <b>M1</b> for $\frac{4}{3}\pi r^3 = 24430$
(a)(ii)	447 or 446.8 to 446.9...	<b>3</b>	<b>M2</b> for $\pi \times 50^2 \times 60 - 24430$ oe or <b>M1</b> for $\pi \times 50^2 \times 60$ oe
(b)	4 [hours] 30 [ mins] nfw	<b>4</b>	<b>B3</b> for 16200 or 4.5 or 270 or <b>M2</b> for $\frac{\text{figs } 18 \times \text{figs } 15 \times \text{figs } 12}{\text{figs } 2}$ oe or <b>M1</b> for figs 18 $\times$ figs 15 $\times$ figs 12 oe
(c)	12.5 or 12.50...	<b>3</b>	<b>M2</b> for $17 \times \sqrt{\frac{159.5}{295}}$ oe  or <b>M1</b> for $\sqrt{\frac{159.5}{295}}$ or $\sqrt{\frac{295}{159.5}}$ seen  or for $\frac{159.5}{295} = \frac{x^2}{17^2}$ oe

Question 37

(a)	10	1	
(b)	6.2[0] or 6.203 to 6.204	3	<b>M2</b> for $[x^3 = ] 1000 \div \frac{4}{3}\pi$ oe or better or <b>M1</b> for $\frac{4}{3}\pi x^3 = 1000$
(c)	7.82 or 7.815 to 7.816	4	<b>B3</b> for $[x^3 = ] 1000 \div \frac{1}{3}\pi \div 2$ oe or better or <b>M1</b> for $(x\sqrt{5})^2 - x^2$ soi by $4x^2$ or $2x$ <b>M1dep</b> for $\frac{1}{3}\pi \times x^2 \times their h [= 1000]$
(d)	$6\frac{2}{3}$ or 6.67 or 6.666 to 6.667	4	<b>B3</b> for $[x^3 = ] 1000 \div \frac{27}{8}$ oe or $\frac{3x}{2} = 10$ or better or <b>M2</b> for $\frac{1}{2} \times x \times \frac{x}{2} \times \frac{27x}{2} = 1000$ oe or <b>M1</b> for $\frac{1}{2} \times x \times \frac{x}{2}$ If 0 scored, <b>SC2</b> for answer 5.29 or 5.291..

Question 38

(a)	4.73 or 4.730 to 4.731...	3	<b>M2</b> for $3 \times 1.2 + \pi \times 0.6^2$ oe or <b>M1</b> for $\pi \times 0.6^2$ or $\frac{1}{2} \times \pi \times 0.6^2$ or $3 \times 1.2$
(b)	946 or 946.0 to 946.2...	3	<b>M2</b> for <i>their (a)</i> $\times 0.2 \times 1000$ oe or <b>M1</b> for <i>their (a)</i> $\times 0.2$ or 20 implied by figs 946[0] to 9462
(c)	1.28 or 1.29 or 1.284 to 1.290	3	<b>M2</b> for $\frac{(1007 - their(b)) \div 1000}{their(a)} \times 100$ oe or for $\frac{1007 - their(b)}{their(b)} \times 20$ oe or <b>M1</b> for figs $\frac{1007 - their(b)}{their(a)}$ or

Question 39

(i)	81	3	<p><b>M2</b> for <math>\frac{A}{36} = \left(\sqrt[3]{\frac{2187}{648}}\right)</math> oe or better  or for <math>A \times \frac{648}{36} \times \sqrt[3]{\frac{2187}{648}} = 2187</math> oe  or better  or <b>M1</b> for <math>\frac{A^3}{36^3} = \frac{2187^2}{648^2}</math> oe  or <math>\sqrt[3]{\frac{2187}{648}}</math> or <math>\sqrt[3]{\frac{648}{2187}}</math></p>
(ii)	8.05 or 8.051 to 8.052...	3	<p><b>M2</b> for <math>[r^3 =] \frac{2187 \times 3}{4 \times \pi}</math> oe  or <b>M1</b> for <math>\frac{4\pi r^3}{3} = 2187</math>  <b>SC2</b> for <math>\frac{648 \times 3}{4 \times \pi}</math> or <b>SC1</b> for <math>\frac{4\pi r^3}{3} = 648</math></p>

Question 40

(a)	452 or 452.2 to 452.4...	2	<p><b>M1</b> for <math>\left[\frac{1}{2} \times\right] \frac{4}{3} \times \pi \times 6^3</math></p>
	cm <sup>3</sup>	1	
(b)(i)(a)	400 or 399.6 to 399.9	6	<p><b>B3</b> for <math>[CD =] \sqrt{72.96}</math>  or <math>[\text{angle } CBD =] 58.7</math> or 58.66 to 58.67  or <b>M2</b> for <math>\sqrt{10^2 - 5.2^2}</math> oe or  <math>[CBD =] \cos^{-1}\left(\frac{5.2}{10}\right)</math> oe  or <b>M1</b> for <math>(CD)^2 + 5.2^2 = 10^2</math> oe or  <math>\cos [CBD] = \frac{5.2}{10}</math> oe  or <math>\sin [CDB] = \frac{5.2}{10}</math> oe  <b>M1dep</b> for <math>\frac{5.2 \times \text{their } CD}{2}</math> oe  or <math>\frac{1}{2} \times 5.2 \times 10 \times \sin(\text{their } CBD)</math> oe  <b>M1</b> for <i>their area</i> <math>\times 18</math> oe</p>

(b)(i)(b)	14.6 or 14.62 to 14.63...	4	<b>M3</b> for $\sin BEC = \frac{5.2}{\sqrt{10^2 + 18^2}}$ oe or <b>M2</b> for $[BE = ] \sqrt{10^2 + 18^2}$ oe seen or $[EC = ] \sqrt{18^2 + 10^2 - 5.2^2}$ oe seen  or <b>M1</b> for $[BE^2 = ] 10^2 + 18^2$ oe seen or $[EC^2 = ] 18^2 + 10^2 - 5.2^2$ seen
(b)(ii)	125 or 124.9 to 125.0...	3	<b>B2</b> for 55[.0...] seen or <b>M2</b> for $180 - \tan^{-1}\left(\frac{10}{7}\right)$ oe  or $\cos EGB = \frac{11^2 + (10^2 + 7^2) - (10^2 + 18^2)^2}{2 \times 11 \times \sqrt{10^2 + 7^2}}$ oe  or <b>M1</b> for $\tan[ ] = \left(\frac{10}{7}\right)$ oe  or for $(10^2 + 18^2) = 11^2 + (10^2 + 7^2) - 2 \times 11 \times$ $\sqrt{10^2 + 7^2} \cos EGB$ oe

Question 41

(a)(i)	955 or 955.0 to 955.2	2	<b>M1</b> for $2 \times \pi \times 8 \times 19$ oe
(a)(ii)	812 or 811.7 to 811.9...	2	<b>FT</b> <i>their</i> (i) $\times 0.85$ <b>M1</b> for <i>their</i> (i) $\times 0.85$ or <i>their</i> (i) $\times 85$
(b)(i)	$\frac{4}{3} \times \pi \times 6^3$ $\frac{1}{3} \times \pi \times 8^2$ or cancelling clearly seen to reach 13.5	<b>M2</b>	<b>M1</b> for $\frac{4}{3} \times \pi \times 6^3 = \frac{1}{3} \times \pi \times 8^2 \times h$
(b)(ii)	15.7 or 15.69...	2	<b>M1</b> for $8^2 + 13.5^2$ or better
(b)(iii)	394 or 395 or 394.3 to 394.6...	1	<b>FT</b> $\pi \times 8 \times$ <i>their</i> (b)(ii)

(c)	567	3	<b>M2</b> for $\frac{168}{V} = \left(\frac{80}{180}\right)^{\frac{3}{2}}$ oe or better or <b>M1</b> for $\left(\frac{180}{80}\right)^{\frac{1}{2}}$ or $\left(\frac{80}{180}\right)^{\frac{1}{2}}$ oe seen or better
(d)	51.3 or 51.34...	3	<b>M2</b> for $\tan = \frac{5}{4}$ oe or <b>M1</b> for recognition of angle $PBX$

Question 42

(i)	8.7[0] or 8.695...	4	<b>B3</b> for $\sqrt{980}$ oe or 31.3 or 31.30... or <b>M3</b> for $40 - \sqrt{20^2 + 18^2 + 16^2}$ oe or <b>M2</b> for $20^2 + 18^2 + 16^2$ oe or <b>M1</b> for any correct attempt at 2-dimensional Pythagoras' e.g. $18^2 + 16^2$
(ii)	30.7 or 30.73 to 30.74...	3	<b>M2</b> for $[\sin =] \frac{16}{\sqrt{20^2 + 18^2 + 16^2}}$ oe or <b>B1</b> for identifying angle $GAC$

Question 43

(a)	32.9 or 32.91 to 32.92...	2	<b>M1</b> for $\pi \times 1.65 \times 4.7 + \pi \times 1.65^2$
(b)	69.4 or 69.44 to 69.45	2	<b>M1</b> for $\cos = 1.65 \div 4.7$ oe
(c)(i)	12.5 or 12.54 to 12.55	4	<b>M3</b> for $\frac{1}{3} \times \pi \times 1.65^2 \times \sqrt{4.7^2 - 1.65^2}$ oe or <b>M2</b> for $\sqrt{4.7^2 - 1.65^2}$ oe or for $4.7 \times \sin(\text{their } \mathbf{(b)})$ oe or <b>M1</b> for $1.65^2 + h^2 = 4.7^2$ oe or for $\frac{h}{4.7} = \sin(\text{their } \mathbf{(b)})$ oe
(c)(ii)	41 nfw	4	<b>B3</b> for 41.7... to 41.9 or <b>M2</b> for $\frac{4}{3} \times \pi \times 5^3 + \text{their } 12.5$ or <b>M1</b> for $\frac{4}{3} \times \pi \times 5^3$

Question 44

(a)	187	2	<b>M1</b> for $220 \times \left(1 - \frac{15}{100}\right)$ oe or <b>B1</b> for 33 seen
(b)	19.8	3	<b>M2</b> for $29.7 \times \sqrt[3]{\frac{0.4}{1.35}}$ oe or <b>M1</b> for $\sqrt[3]{\frac{0.4}{1.35}}$ or $\sqrt[3]{\frac{1.35}{0.4}}$ oe seen or for $\frac{29.7^3}{x^3} = \frac{1.35}{0.4}$ oe
(c)	12.4 or 12.44...	3	<b>M1</b> for $90 \times 75 \times h = 7 \times \text{figs } 12$ <b>B1</b> for $1000 \text{ cm}^3 = 1 \text{ litre}$ soi

Question 45

(a)	315 or 314.5 to 315.0	6	<b>M1</b> for $\tan 70 = \frac{\text{height}}{\frac{1}{2}(8-5)}$ oe or better seen <b>M1dep</b> for $\frac{1}{2}(8+5) \times \text{their height}$ or better seen <b>dep</b> on trig attempt for height <b>M2</b> for $12 \times \frac{\frac{1}{2}(8-5)}{\cos 70}$ oe or better seen or <b>M1</b> for $\frac{\frac{1}{2}(8-5)}{\cos 70}$ oe or better seen <b>M1</b> for $8 \times 12$ oe isw and $5 \times 12$ oe isw
(b)(i)	$8 - \frac{1}{2}(8-5)$ or $5 + \frac{1}{2}(8-5)$	<b>M1</b>	
(b)(ii)	13.6 or 13.64 to 13.65	2	<b>M1</b> for $12^2 + (6.5)^2$ oe
(b)(iii)	16.8 or 16.9 or 16.79 to 16.91... nfw	2	<b>M1</b> for identifying angle $GAX$ from a diagram or from working or better

Question 46

(a)(i)	$\frac{53}{360} \times \pi \times 9.5^2$	<b>M1</b>	
	41.74 to 41.75	<b>A1</b>	
(a)(ii)	5.9[0] or 5.899 to 5.903..	<b>4</b>	<p><b>M3</b> for <math>[OA^2 =] \frac{1}{3} \times 41.7 \div \frac{1}{2} \sin 53</math> oe</p> <p><b>M2</b> for <math>\frac{1}{2} \times OA^2 \times \sin 53 = \frac{1}{3} \times 41.7</math> oe</p> <p><b>M1</b> for <math>\frac{1}{2} \times OA \times OB \times \sin 53 = \frac{1}{3} \times 41.7</math> seen or better</p>
(b)	396 or 397 or 396.4 to 396.6	<b>6</b>	<p><b>M2</b> for <math>[r =] \left( \frac{60}{360} \times 2 \times \pi \times 24 \right) \div 2\pi</math> oe or better</p> <p>or <b>M1</b> for <math>2\pi r = \frac{60}{360} \times 2 \times \pi \times 24</math> oe</p> <p><b>M2</b> for <math>\sqrt{24^2 - a^2}</math></p> <p>or <b>M1</b> for <math>h^2 + a^2 = 24^2</math></p> <p><b>M1</b> for <math>\frac{1}{3} \pi \times their\ r^2 \times their\ h</math></p>

Question 47

(a)(i)	1200	<b>1</b>	
(a)(ii)(a)	800	<b>3</b>	<p><b>M2</b> for <math>[2 \times] (20 \times 12 + 20 \times 5 + 12 \times 5)</math></p> <p>or <b>M1</b> for <math>20 \times 12</math> or <math>20 \times 5</math> or <math>12 \times 5</math></p>
(a)(ii)(b)	0.19	<b>1</b>	<b>FT</b> $152 \div their\ 800$
(b)	$\frac{3x}{2}$ or $1.5x$	<b>3</b>	<p><b>B2</b> for <math>r^3 = \frac{27x^3[\pi]}{8[\pi]}</math> or better</p> <p>or <b>M1</b> for <math>\frac{4}{3} \pi r^3 = \pi x^2 \times \frac{9x}{2}</math></p>

(c) 13.6 or 13.59 to 13.61

7 If chord is  $AB$  and  $O$  is centre of the cross section

**M2** for  $2 \times \cos^{-1}\left(\frac{20-5}{20}\right)$  oe

or **M1** for  $\cos = \frac{20-5}{20}$  oe

**M1** for  $\frac{\text{their } AOB}{360} \times \pi \times 20^2$

or  $\frac{1}{2}(20)^2\left(\frac{82.8\pi}{180}\right)$

**M1** for  $\frac{1}{2} \times 20^2 \times \sin(\text{their } AOB)$  oe

**M1** for *their* area  $\times 150$

**M1** for *their* volume  $\div 1000$

Question 48

(a) [L =] 11.8  
[W =] 5.9  
[H =] 7.1

5 **M1** for  $L = 2W$  oe soi  
**M1** for  $W + 2H = 20.1$  oe  
**M1** for  $2L + 2H = 37.8$  oe  
**B1** for at least one correct answer

(b)(i) 0.559 to 0.56[0...]

**B4** **M2** for  $\frac{1}{3} \times 18 \times 15 \times \sqrt{24^2 - 18^2}$  isw  
conversion  
or **M1** for  $h^2 + 18^2 = 24^2$  oe or better  
**M1** for figs 800  $\div$  figs *their* volume isw

(b)(ii)  $\text{g/cm}^3$  or  $\text{g cm}^{-3}$  final answer  
34.1 or 34.11 to 34.12

**B1** **4** **M3** for  $\tan [ ] = \frac{\sqrt{24^2 - 18^2}}{\sqrt{18^2 + 15^2}}$  oe  
or **M2** for  $\sqrt{18^2 + 15^2}$  isw  
or  $\sqrt{24^2 + 15^2}$  isw  
or **M1** for  $18^2 + 15^2$  isw or  $24^2 + 15^2$  isw  
or **M1** for indicating required angle is  $EBD$

Question 49

(a)	1350 or 1354....	6	<p><b>M2</b> for <math>20^2 - 13^2</math>  or <b>M1</b> for <math>BC^2 + 13^2 = 20^2</math>  <b>A1</b> for <math>\sqrt{231}</math> or 15.2 or 15.19 to 15.20  <b>M1</b> for <math>20 \times 24</math> and <math>13 \times 24</math> and <i>their</i>  <math>15.2 \times 24</math>  <b>M1</b> for <math>[\frac{1}{2} \times]</math> <i>their</i> <math>15.2 \times 13</math></p>
(b)	2370 or 2369 to 2371... cao	1	
(c)	24.6 or 24.58 to 24.59	4	<p><b>M3</b> for <math>\sin [\dots] = \frac{13}{\sqrt{20^2 + 24^2}}</math> oe  or <b>M2</b> for <math>\sqrt{20^2 + 24^2}</math> or <math>\sqrt{24^2 + 20^2 - 13^2}</math>  or <b>M1</b> for <math>AF^2 = 20^2 + 24^2</math> or <math>24^2 + 20^2 - 13^2</math>  or <b>M1</b> for correct angle identified</p>

Question 50

(a)	2.64 or 2.638...	4	<p><b>M3</b> for <math>[R^2 =] \frac{\pi \times 2.4^2 + \pi \times 2.4 \times 6.3}{\pi + 2\pi}</math> oe  or <b>M2</b> for  <math>\pi \times 2.4^2 + \pi \times 2.4 \times 6.3 = \pi R^2 + \frac{1}{2} \times 4\pi R^2</math>  or <b>M1</b> for <math>[\pi \times 2.4^2] + \pi \times 2.4 \times 6.3</math> oe  or <math>[\pi R^2] + \frac{1}{2} \times 4\pi R^2</math> oe</p>
(b)	953 or 952.6 to 952.8	4	<p><b>M3</b> for <math>\frac{1}{3} \times \pi \times 7.6^2 \times 16 \times \left(1 - \left(\frac{16-12}{16}\right)^3\right)</math>  or <math>\frac{1}{3} \times \pi \times 7.6^2 \times 16 - \frac{1}{3} \times \pi \times 1.9^2 \times (16-12)</math>  or <b>M1</b> for <math>\frac{1}{3} \times \pi \times 7.6^2 \times 16</math>  or for <math>\frac{1}{3} \times \pi \times (\text{their } 1.9)^2 \times (16-12)</math></p>

Question 51

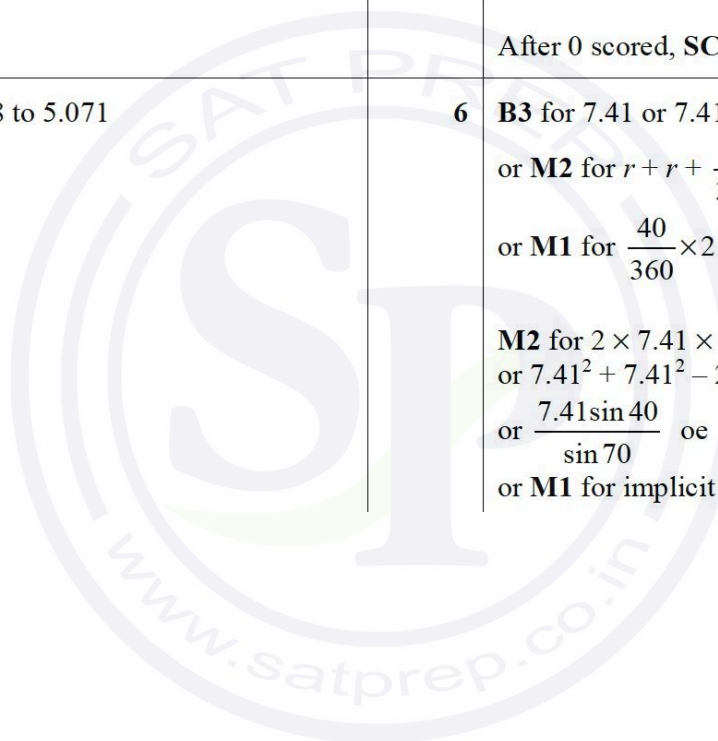
(a)(i)	4.095	2	<b>B1</b> for figs 4095 or <b>M1</b> for $\frac{525 \times 7.8}{1000}$
(a)(ii)	15	3	<b>B2</b> for 35 OR <b>M2</b> for $\frac{1}{2}(10+4) \times 5 \times L = 525$ oe <b>M1</b> for $\frac{1}{2}(10+4) \times 5$ oe
(a)(iii)	455 or 454.9...	6	<b>M3</b> for <i>their</i> $[BD =] \sqrt{3^2 + 5^2} \times (\textit{their } 15)$ [ $\times 2$ ] or <b>B2</b> for $\sqrt{34}$ or 5.83 or 5.830 to 5.831 or <b>M1</b> for $5^2 + \left(\frac{1}{2}(10-4)\right)^2$ and <b>M1</b> for <i>their</i> $35 \times 2$ <b>M1</b> for $(\textit{their } 15) \times 10$ and $(\textit{their } 15) \times 4$
(a)(iv)	4200	3	<b>M2</b> for $525 \times \left(\frac{10}{5}\right)^3$ oe or <b>M1</b> for $\left(\frac{10}{5}\right)^3$ or $\left(\frac{5}{10}\right)^3$ oe
(b)	182.875 ... 307.125 final answer	3	<b>B2</b> for either seen or <b>M1</b> for $10 \pm 0.5$ or $6 \pm 0.5$ or $4 \pm 0.5$ oe

Question 52

(a)(i)	$\frac{16\pi}{3}$ or $5\frac{1}{3}\pi$ final answer	2	<b>M1</b> for $\frac{1}{2} \times \frac{4}{3} \pi \times 2^3$ oe
(a)(ii)	2.4[0]	4	<b>B3</b> for answer in range 2.396... to 2.40... OR <b>M3</b> for <i>their</i> $\frac{16\pi}{3} + \pi \times 2^2 \times 5.2 +$ $\frac{1}{3} \pi \times 2^2 \times h = \frac{88\pi}{3}$ oe or <b>M2</b> for $\frac{88\pi}{3} - \text{their } \frac{16\pi}{3} - \pi \times 2^2 \times 5.2$ oe or <b>M1</b> for $\pi \times 2^2 \times 5.2$ oe or $\frac{1}{3} \pi \times 2^2 \times h$ oe soi
(a)(iii)	1 hour 38 min or 1 hour 37.8 min to 1 hour 37.9... min	3	<b>B2</b> for 1.63[2...] or 98 [mins] or 97.8 to 97.9... ] or <b>M1</b> for $\frac{88\pi}{3} \times 620$ $\frac{3}{35000}$ [ $\times 60$ ] oe
(b)	8.5[0] or 8.496 to 8.497	4	<b>M3</b> for $[r = ] \sqrt{\frac{65}{\frac{140}{360}\pi - \frac{1}{2}\sin 140}}$ oe or <b>M2</b> for $\frac{140}{360}\pi \times r^2 - \frac{1}{2}r^2 \times \sin 140 [=65]$ oe or <b>M1</b> for either area expression seen

Question 53

(a)	3.5 oe	3	<b>M1</b> for $2(x + x + 3) = 20$ oe <b>M1</b> for correct $ax = b$ for <i>their</i> linear equation
(b)	116.8 or 116.83 to 116.85 nfw	5	<b>M2</b> for $\sin p = \frac{5 \sin 20}{2.5}$ or <b>M1</b> for $\frac{2.5}{\sin 20} = \frac{5}{\sin p}$  <b>A1</b> for 43.2 or 43.15 to 43.17  <b>M1dep</b> for $180 - (20 + \textit{their} 43.2)$  After 0 scored, <b>SC1</b> for length of side = 5
(c)	5.07 or 5.068 to 5.071	6	<b>B3</b> for 7.41 or 7.412 to 7.413 or <b>M2</b> for $r + r + \frac{40}{360} \times 2 \times \pi \times r = 20$ oe or <b>M1</b> for $\frac{40}{360} \times 2 \times \pi \times r$ oe seen  <b>M2</b> for $2 \times 7.41 \times \sin 20$ oe or $7.41^2 + 7.41^2 - 2(7.41^2) \cos 40$ oe or $\frac{7.41 \sin 40}{\sin 70}$ oe or <b>M1</b> for implicit version



Question 54

(a)	54[.0] or 53.99 to 54.03...	<p><b>6</b> <b>M2</b> for <math>[h = ] 95.4 \times 3 \div (\pi \times 2.4^2)</math> oe  or <b>M1</b> for <math>95.4 = \frac{1}{3} \times \pi \times 2.4^2 \times h</math></p> <p><b>M2</b> for [slant ht , <math>l = ] \sqrt{(their\ h)^2 + 2.4^2}</math>  or <b>M1</b> for <math>(their\ h)^2 + 2.4^2</math></p> <p><b>M1</b> for <math>\frac{x}{360} \times 2 \times \pi \times their\ l = 2 \times \pi \times 2.4</math> oe  or <math>\frac{x}{360} \times \pi \times (their\ l)^2 = \pi \times 2.4 \times their\ l</math></p>
(b)	14500 or 14470 to 14480	<p><b>4</b> <b>M3</b> for <math>200 \times 60 \times 24 \times \pi \times 4^2 [\div 1000]</math>  or <math>2 \times 60 \times 24 \times \pi \times 0.04^2 [\times 1000]</math></p> <p>or <b>M2</b> for <math>200 \times \pi \times 4^2</math>  or for <math>2 \times \pi \times 0.04^2</math></p> <p>or <b>M1</b> for <math>\pi \times 4^2</math> oe or <math>\pi \times 0.04^2</math> seen oe isw</p> <p>or <math>1000\text{ cm}^3 = 1\text{ litre soi}</math> or <math>1\text{ m}^3 = 1000\text{ litres soi}</math></p> <p>or for <math>24 \times 60</math> seen oe</p>

Question 55

(a)	31.5	<p><b>3</b> <b>M2</b> for <math>17.5 \times \sqrt{\frac{1134}{350}}</math> oe  or <b>M1</b> for <math>\sqrt{\frac{1134}{350}}</math> oe isw or <math>\sqrt{\frac{350}{1134}}</math> oe isw  or for <math>\frac{1134}{350} = \left(\frac{x}{17.5}\right)^2</math> oe</p>
(b)	163.9375 or $163\frac{15}{16}$ final answer	<p><b>2</b> <b>B1</b> for <math>15 + 0.25</math> or <math>10.5 + 0.25</math> or better seen</p>
(c)	40.5[0]	<p><b>2</b> <b>M1</b> for <math>x \times \left(1 - \frac{18}{100}\right) = \frac{166.05}{[5]}</math> oe</p>
(d)	\$2.23 final answer	<p><b>3</b> <b>B2</b> for 2.227... or 2.23 seen  OR  <b>M2</b> for <math>57 - \frac{48.2}{0.88}</math> oe  or <b>M1</b> for <math>\frac{48.2}{0.88}</math> oe</p> <p>If 0 scored <b>SC1</b> for <math>57 \times 0.88</math> oe seen</p>

Question 56

(a)(i)	4.455 to 4.456... [= 4.46]	2	M1 for $[r =] \frac{28}{2\pi}$ oe
(a)(ii)	1250 or 1247 to 1249.9...	2	M1 for $20 \times \pi \times 4.46^2$ oe
(a)(iii)	66[.0] or 65.95 to 66.02	3	M2 for $[\tan] = \frac{20}{2 \times 4.46}$ oe or B1 for identifying angle ANB on cylinder <b>not on rectangle</b>
(b)	11.8 or 11.82 to 11.83	5	M2 for $[r =] \sqrt[3]{\frac{310 \times 3}{2\pi}}$ oe or $[h =] \sqrt[3]{\frac{310 \times 3 \times 4}{\pi}}$ oe or M1 for $310 = \frac{1}{3} \pi \times r^2 \times 2r$ or $310 = \frac{1}{3} \pi \left(\frac{h}{2}\right)^2 h$ M2 for $\sqrt{(their\ r)^2 + (2 \times their\ r)^2}$ oe or M1 for $[l^2 =] (their\ r)^2 + (2 \times their\ r)^2$ oe

Question 57

(a)(i)(a)	$\frac{(8-2) \times 180}{8 \times 2}$ oe	M2	M1 for $\frac{(8-2) \times 180}{8}$ or $\frac{360}{8}$ or $\frac{(2 \times 8 - 4) \times 90}{8}$
(a)(i)(b)	174 or 173.8....	4	M3 for $\frac{1}{2} \times 6 \times OM$ oe or $\frac{1}{2} \times (OA)^2 \times \sin 45$ oe or $\frac{1}{2} \times 6 \times OA \times \sin 67.5$ oe where OA and OM are as in the M2 or M2 for $OM = 3 \times \tan 67.5$ oe or for $OA = \left(\frac{3}{\cos 67.5}\right)$ or $\frac{6 \times \sin 67.5}{\sin 45}$ oe or M1 for $\frac{OM}{3} = \tan 67.5$ oe or for $\frac{3}{OA} = \cos 67.5$ oe or for $\frac{\sin 45}{6} = \frac{\sin 67.5}{OA}$ oe
5(a)(ii)	193 or 193.0 to 193.1	3	M2 for $\pi \times \left(\frac{3}{\cos 67.5}\right)^2$ oe or M1 for $\frac{3}{r} = \cos 67.5$ or $\frac{\sin 45}{6} = \frac{\sin 67.5}{r}$

(b)(i)	1.27 or 1.272 to 1.273	2	<b>M1</b> for $\left[\frac{1}{2} \times\right] \pi \times 0.45^2 \times 4$ or $\frac{1}{2} \times \pi \times 0.45^2 [\times 4]$
(b)(ii)	742 or 743	6	<b>M5</b> for a method leading to the volume of water e.g. $4 \times \left\{ 2 \times \frac{\operatorname{invcos}\left(\frac{0.15}{0.45}\right)}{360} \times \pi \times 0.45^2 \right.$ $\left. - \frac{1}{2} \times 0.45^2 \times \sin\left(2 \operatorname{invcos}\left(\frac{0.15}{0.45}\right)\right) \right\}$ oe <b>OR</b> <b>M2</b> $\left[ 2 \times \frac{\operatorname{invcos}\left(\frac{0.15}{0.45}\right)}{360} \times \pi \times 0.45^2 \right]$ oe or $\left[ 2 \times \frac{90 - \operatorname{invcos}\left(\frac{0.15}{0.45}\right)}{360} \times \pi \times 0.45^2 \right]$ oe or <b>M1</b> for use of $\frac{\theta}{360} \times \pi \times 0.45^2$ oe <b>M2</b> for $\frac{1}{2} \times 0.45^2 \times \sin\left(2 \operatorname{invcos}\left(\frac{0.15}{0.45}\right)\right)$ oe or $\frac{1}{2} \times 0.15 \times 0.45 \times \sin\left(\operatorname{invcos}\left(\frac{0.15}{0.45}\right)\right) [\times 2]$ oe

### Question 58

(a)	$\left(\frac{(36+50) \times 40}{2}\right) \times 120$ oe or $\left(\frac{(0.36+0.5) \times 0.4}{2}\right) \times 1.2$ oe	M2	<b>M1</b> for $\frac{(36+50) \times 40}{2}$ oe or $\frac{(0.36+0.5) \times 0.4}{2}$ oe
	206400 $\div$ 1000 = 206.4 or 0.2064 $\times$ 1000 = 206.4 nfvw	A1	Must see an explicit conversion
(b)	5 [minutes] 44 seconds	3	<b>B2</b> for 344 [seconds] oe 5.73... [mins] or <b>M1</b> for figs 206.4 $\div$ figs 6 oe
(c)(i)	28[.0] or 27.96 to 27.97	3	<b>M2</b> for $[r^2 =] \frac{\text{figs } 2064}{(\text{figs } 84)\pi}$ or <b>M1</b> for $\pi r^2 \times \text{figs } 84 = \text{figs } 2064$
(c)(ii)	140 cao	2	<b>M1</b> for $0.6h = 84$ oe ALT method <b>M1</b> for $\pi \times (\text{their (c)(i)})^2 \times h = \text{figs } 206400 \div 0.6$ oe
(d)	128 or 127.7 to 127.8	4	<b>B3</b> for $40^2 + 120^2 + 18^2$ oe OR <b>B1</b> for horizontal length 18 soi <b>M1</b> for any correct attempt at 2-dimensional Pythagoras' $18^2 + 120^2$ , $120^2 + 40^2$ , $18^2 + 40^2$

Question 59

(a)(i)	1580 or 1583 to 1584	2	M1 for $\pi \times 6^2 \times 14$
(a)(ii)	452 or 452.3 to 452.4...	2	M1 for $\left[\frac{1}{2}\right] \times \frac{4}{3} \times \pi \times 6^3$
(b)(i)	$7.85 \div 1000 [= 0.00785]$	M1	
(b)(ii)	16[.0] or 15.95 to 15.99	2	FT $\{their (a)(i) + their (a)(ii)\} \times 0.00785$ evaluated to 3 sig fig or better M1 for $(their (a)(i) + their (a)(ii)) \times 0.00785$
(c)(i)	16.2 or 16.21 to 16.23	3	M2 for $\frac{2000 - 50 \times \frac{4}{3} \times \pi \times 2^3}{2000} [\times 100]$ or for $\frac{50 \times \frac{4}{3} \times \pi \times 2^3}{2000} \times 100$ or M1 for $\frac{50 \times \frac{4}{3} \times \pi \times 2^3}{2000}$
(c)(ii)	6.87 or 6.870 to 6.872	1	FT $\sqrt[3]{2000 - their \left(50 \times \frac{4}{3} \times \pi \times 2^3\right)}$ evaluated to 3sf or better
(d)	$\frac{2}{3}$ oe	4	M1 for $[\pi](3R)^2 + [\pi]3R \times 9R$ oe M1 for $2[\pi]x^2 + 2[\pi]x \times 7x$ oe M1 for <i>their</i> area of cone = <i>their</i> area of cylinder seen

Question 60

<p>(a) <math display="block">[h = ] \frac{\frac{1}{2} \times \frac{4}{3} \times \pi \times 3^3}{\pi \times 12^2} \text{ oe}</math>                     leading to 0.125</p> <p>or</p> $3 - \frac{\pi \times 12^2 \times 3 - \frac{1}{2} \times \frac{4}{3} \times \pi \times 3^3}{\pi \times 12^2} \text{ oe}$ leading to 0.125	<p><b>M3</b></p> <p><b>M2</b> for <math>\pi \times 12^2 \times h = \frac{1}{2} \times \frac{4}{3} \times \pi \times 3^3</math> oe                      or for <math>\pi \times 12^2 \times 3 = \pi \times 12^2 \times x + \frac{2}{3} \times \pi \times 3^3</math> oe                      or for <math>\frac{\frac{1}{2} \times \frac{4}{3} \times \pi \times 3^3}{\pi \times 12^2 \times 3} = \frac{h}{3}</math> oe                      or <b>M1</b> for <math>\pi \times 12^2 \times h</math> or <math>\frac{1}{2} \times \frac{4}{3} \times \pi \times 3^3</math> oe                      or <math>\pi \times 12^2 \times 3</math></p> <p><b>3</b> <b>M2</b> for <math>\pi \times 12^2 \times (3 - 0.125) = \pi \times R^2 \times 18</math> oe                      or  <math>\pi \times 12^2 \times 3 - \frac{2}{3} \times \pi \times 3^3 = \pi \times R^2 \times 18</math>                      or <b>B1</b> for 3 - 0.125 or for 414 <math>\pi</math> oe</p>
<p>(b) 4.8[0] or 4.795 to 4.796</p>	<p><b>3</b></p> <p><b>M2</b> for <math>\frac{\frac{4}{3} \times \pi \times 3^3 - 30 \times 1.5^3}{\frac{4}{3} \times \pi \times 3^3}</math> or <math>\frac{30 \times 1.5^3}{\frac{4}{3} \times \pi \times 3^3} \times 100</math> oe                      or <b>M1</b> for <math>\frac{4}{3} \times \pi \times 3^3 - 30 \times 1.5^3</math> or <math>\frac{30 \times 1.5^3}{\frac{4}{3} \times \pi \times 3^3}</math> oe</p>
<p>(c) 10.5 or 10.47 to 10.49</p>	<p><b>3</b></p>

Question 61

1.13 or 1.128 to 1.129

**5**

**M4** for  $4.5 \times \sqrt[3]{\frac{0.385 \times 8000}{195200}}$  oe  
 or  $\sqrt[3]{\frac{4.5^3 \times 0.385 \times 8000}{195200}}$  oe

or **M3** for  $\sqrt[3]{\frac{0.385}{\text{their}24.4}}$  or  $\sqrt[3]{\frac{\text{their}3080}{195200}}$

or  $\frac{0.385}{\text{their}24.4} = \frac{l^3}{4.5^3}$  oe

or **M2** for  $\frac{\text{their}24.4}{0.385}$  or  $\frac{0.385}{\text{their}24.4}$  oe

or **B2** for 24.4 or 3080 seen

or **M1** for  $195\,200 \div 8000$   
 or for  $0.385 \times 8000$

Question 62

(a)(i)	251 or 251.3 to 251.4	2	M1 for $\frac{1}{3} \times \pi \times 4^2 \times 15$ oe
(a)(ii)	79.5 or 79.51...	5	M3 for $\pi \times 4 \times \sqrt{4^2 + 15^2}$ oe or M2 for $\sqrt{15^2 + 4^2}$ oe or M1 for $[l^2 = ] 4^2 + 15^2$ oe or $\pi \times 4 \times \text{their } l$  M1 for $\frac{\text{their curved surface area}}{\text{their curved surface area} + \pi \times 4^2} [\times 100]$ oe
(b)(i)	13 min 20 sec	3	B2 for 800 or $\frac{40}{3}$ oe seen or M1 for figs 3 ÷ figs 375 or figs 3 ÷ 22 500
(b)(ii)	0.472 or 0.4715 to 0.4716...	3	M2 for $\pi \times 0.45^2 \times h = 0.3$ or $\pi \times 45^2 \times h = 300000$ oe or M1 for $\pi \times \text{figs } 45^2 \times h = \text{figs } 3$ oe

Question 63

(a)(i)	96	2	M1 for $\frac{1}{2} \times 24 \times 8$
(a)(ii)	18.4 or 18.43...	2	M1 for $\tan[x] = \frac{8}{24}$ oe
(b)	622 or 622.0 to 622.1....	2	M1 for $[\frac{1}{2} \times] \pi \times 6^2 \times 11$ or $\frac{1}{2} \times \pi \times 6^2 [\times 11]$

(c)(i)	246 or 246.2 to 246.3...	5	<b>M4</b> for $15 \times 20 - 4 \times 4 - \frac{270}{360} \times \pi \times 4^2$ oe OR <b>M2</b> for $\frac{270}{360} \times \pi \times 4^2$ oe or <b>M1</b> for $k \times \pi \times 4^2$ , where $k \leq 1$  <b>M1</b> for $15 \times 20$ or $4 \times 4$ oe
(c)(ii)	80.8 or 80.9 or 80.84 to 80.85...	3	<b>M1</b> for $15 + 20 + 11 + 16$ oe <b>M1</b> for $\frac{3}{4} \times 2 \times \pi \times 4$ oe



Question 64

(a)(i)	$\sin[BOC] = \frac{2}{6}$ or better oe	<b>M1</b>	
	19.47...	<b>A1</b>	
(a)(ii)	64.6 or 64.55 to 64.58	<b>3</b>	<b>M2</b> for $\frac{360-135-19.5}{360} \times \pi \times 6^2$ oe or <b>M1</b> for $\frac{k}{360} \times \pi \times 6^2$ oe



(a)(iii)	16.1 or 16.10 to 16.13	<p><b>5</b></p> <p><b>M2</b> for <math>2 \times \sqrt{6^2 - 2^2}</math> oe or <math>2 \times 6 \cos 19.5</math> oe  or <b>M1</b> for <math>OC^2 + 2^2 = 6^2</math> oe or <math>6 \cos 19.5</math> or better</p> <p>AND</p> <p><b>M2</b> for  <math>\sqrt{6^2 + \text{their } OD^2 - 2 \times 6 \times \text{their } OD \times \cos 135}</math>  OR  <b>M1</b> for <math>6^2 + \text{their } OD^2 - 2 \times 6 \times \text{their } OD \times \cos 135</math>  <b>A1</b> for 259 to 260</p>
(a)(iv)	94.2 or 94.3 or 94.15 to 94.27... nfw	<p><b>4</b></p> <p><b>M1</b> for <math>\frac{1}{2} \times 6 \times \text{their } OD \times \sin 135</math> oe</p> <p><b>M1</b> for <math>\frac{1}{2} \times 6 \times 2 \times \sin(90 - 19.5)</math> oe  or for <math>\frac{1}{2} \times \text{their } OC \times 2</math></p> <p><b>M1dep</b> for <i>their (a)(ii)</i> + <i>their</i> two triangle areas</p>
(b)	1000 cao	<p><b>3</b></p> <p><b>M2</b> for <math>160 \times \left(\frac{20}{8}\right)^2</math> or <math>160 \div \left(\frac{8}{20}\right)^2</math> oe  or <b>M1</b> for <math>\left(\frac{20}{8}\right)^2</math> or <math>\left(\frac{8}{20}\right)^2</math> oe</p> <p>OR</p> <p><b>M2</b> for <math>\frac{\text{sector angle}}{360} \times \pi 20^2</math>  or <b>M1</b> for <math>\frac{160}{\pi 8^2} \times 360</math> oe or better</p> <p>OR</p> <p><b>M2</b> for <math>\frac{\text{percentage}}{100} \times \pi 20^2</math> oe or better  or <b>M1</b> for <math>\frac{160}{\pi 8^2} [\times 100]</math> oe or better</p>

Question 65

(a)	72 or 72.0 cao nfw	3	<p><b>M2</b> for <math>\frac{x}{360} \times 2 \times \pi \times 7.5 = 2 \times \pi \times 1.5</math> oe</p> <p>or <b>M1</b> for <math>\frac{x}{360} \times 2 \times \pi \times 7.5</math> or for</p> <p><math>2 \times \pi \times 1.5</math> oe</p> <p>OR</p> <p><b>M2</b> for <math>\frac{x}{360} \times \pi \times 7.5^2 = \pi \times 1.5 \times 7.5</math> oe</p> <p>or <b>M1</b> for <math>\frac{x}{360} \times \pi \times 7.5^2</math> or for</p> <p><math>\pi \times 1.5 \times 7.5</math> oe</p>
(b)(i)	$2 \times \sqrt{17^2 - 8^2}$ or $\sqrt{34^2 - 16^2}$ oe	<b>M2</b>	<b>M1</b> for $17^2 = 8^2 + d^2$ or $34^2 = 16^2 + k^2$
(b)(ii)	29.3 or 29.30 to 29.31	4	<p><b>M3</b> for <math>([\pi] \times 8^2 \times 30) \div \frac{4}{3} \times [\pi] \times 17^3 [\times 100]</math> oe</p> <p>OR</p> <p><b>M1</b> for <math>\pi \times 8^2 \times 30</math> oe</p> <p><b>M1</b> for <math>\frac{4}{3} \times \pi \times 17^3</math> oe</p>
(c)	12.7 or 12.73 to 12.74	3	<p><b>B2</b> for 2.26 or 2.261 to 2.262... soi</p> <p>or <b>M2</b> for <math>\left(20^2 \times 15 - \frac{4}{3} \times \pi \times 6^3\right) \div 20^2</math> oe</p> <p>or for <math>15 - \left(\frac{4}{3} \times \pi \times 6^3 \div 20^2\right)</math> oe</p> <p>or <b>M1</b> for <math>20^2 \times 15 - \frac{4}{3} \times \pi \times 6^3</math> oe</p> <p>or <math>20^2 \times D = \frac{4}{3} \times \pi \times 6^3</math> oe</p> <p>If 0 scored, <b>SC1</b> for answer 11[.0] or 10.97 to 10.98</p>

Question 66

(a)(i)	$\frac{2}{3}\pi(3.6)^3 + \frac{2}{3}\pi(5.4)^3 + \pi(3.6)^2 \times 6.5$	<b>M3</b>	<p><b>M1</b> for either <math>\frac{2}{3}\pi(3.6)^3</math> or <math>\frac{2}{3}\pi(5.4)^3</math></p> <p><b>M1</b> for <math>\pi(3.6)^2 \times 6.5</math></p>
	692.1 to 692.2...	<b>A1</b>	
(a)(ii)	33.6 or 33.60 to 33.62	<b>4</b>	<p><b>M3</b> for <math>\left(\frac{0.6}{3.6}\right)^3 \times 692 \times 10.49</math> oe</p> <p>or <b>M2</b> for <math>\left(\frac{0.6}{3.6}\right)^3 \times 692</math> oe</p> <p>or <b>M1</b> for <math>\left(\frac{0.6}{3.6}\right)^3</math> or <math>\left(\frac{3.6}{0.6}\right)^3</math> oe</p> <p>If 0 scored, <b>SC1</b> for <i>their</i> volume <math>\times 10.49</math></p>
(b)(i)	$12\pi$ final answer	<b>2</b>	<p><b>M1</b> for <math>\frac{216}{360} \times 2\pi \times 10</math> oe</p> <p>After <b>0</b> scored</p> <p><b>SC1</b> for final answer <math>8\pi</math> or <math>12\pi + 20</math></p>
(b)(ii)	302 or 301.5 to 301.6...	<b>4</b>	<p><b>M1</b> for <math>2\pi r = \textit{their (b)(i)}</math> oe or for <math>\frac{216}{360} \times \pi \times 10^2 = \pi \times r \times 10</math> oe</p> <p>and</p> <p><b>M1</b> for <math>[h =] \sqrt{10^2 - \textit{their}6^2}</math> oe</p> <p>and</p> <p><b>M1</b> for <math>[V =] \frac{1}{3}\pi(\textit{their}6)^2 \times (\textit{their}8)</math></p>

Question 67

(a)	88.9 or 88.92 to 88.93...	4	<p><b>M3</b> for <math>2 \times 12 + \frac{360-50}{360} \times 2 \times \pi \times 12</math> oe</p> <p>or <b>M2</b> for <math>\frac{(360-50)}{360} \times 2 \times \pi \times 12</math> oe isw</p> <p>or <b>M1</b> for <math>\frac{50}{360} \times 2 \times \pi \times 12</math> oe isw</p>
(b)	9.01 or 9.009 to 9.010...	3	<p><b>M2</b> for <math>\frac{(360-50)}{360} \times \pi \times 12^2 \times h = 3510</math></p> <p>or <b>M1</b> for <math>\frac{k}{360} \times \pi \times 12^2 \times h</math> oe seen</p> <p>with <math>k = 50</math> or <math>360 - 50</math></p>

Question 68

(a)(i)	432	2	<b>M1</b> for $12 \times 12 \times 9 \div 3$ oe
(a)(ii)	404 or 403.5 to 403.7	5	<p><b>M4</b> for <math>12^2 + 4 \times \frac{1}{2} \times 12 \times \sqrt{6^2 + 9^2}</math> oe</p> <p>or <b>M3</b> for <math>\frac{1}{2} \times 12 \times \sqrt{6^2 + 9^2}</math> oe</p> <p>or <b>M2</b> for explicit method to find height of triangular face</p> <p>e.g. <math>\sqrt{6^2 + 9^2}</math> oe</p> <p>or <b>M1</b> for implicit method to find height of triangular face</p> <p>or for <math>6^2 + 9^2</math> oe seen</p> <p>or <b>B1</b> for slant height of triangle <math>FC</math></p> <p><math>\sqrt{153}</math> or <math>3\sqrt{17}</math> or 12.4 or 12.36 to 12.37 soi</p>
(b)	4.4[0] or 4.398 to 4.399... nfw	4	<p><b>M3</b> for <math>\sqrt{\frac{304}{(2+3) \times \pi}}</math> oe</p> <p>or <b>M2</b> for <math>\frac{4\pi r^2}{2} + \pi r \times 3r = 304</math> oe</p> <p>or <b>M1</b> for <math>\frac{4\pi r^2}{2}</math> oe seen or <math>\pi r \times 3r</math> oe seen</p>

Question 69

(a)(i)	37.3 or 37.26 to 37.27	5	<p><b>M2</b> for <math>\pi \times 0.35 \times \sqrt{0.35^2 + 1.5^2}</math> oe</p> <p>or <b>M1</b> for <math>0.35^2 + 1.5^2</math> or better</p> <p><b>M1</b> for <math>\pi \times 0.35^2</math></p> <p><b>M1</b> for <math>2 \times \pi \times 0.35 \times 16</math></p>
(a)(ii)	6.35 or 6.349 to 6.351	3	<p><b>M1</b> for <math>\pi \times 0.35^2 \times 16</math></p> <p><b>M1</b> for <math>\frac{1}{3} \times \pi \times 0.35^2 \times 1.5</math></p>
(a)(iii)	22.2 or 22.3 or 22.24 to 22.26	3	<p><b>M2</b> for <math>17.5 \times 3.5 \times 1.4 - 10 \times</math> <i>their(a)(ii)</i></p> <p>or <b>M1</b> for <math>17.5 \times 3.5 \times 1.4</math></p>
(b)	154 or 154.3 to 154.4	3	<p><b>M2</b> for <math>450 \times \left(\sqrt{\frac{98}{200}}\right)^3</math> oe</p> <p>or <b>M1</b> for <math>\left(\sqrt{\frac{98}{200}}\right)^3</math> or <math>\left(\sqrt{\frac{200}{98}}\right)^3</math> oe</p> <p>or for <math>\left(\frac{450}{V}\right)^2 = \left(\frac{200}{98}\right)^3</math> oe</p>

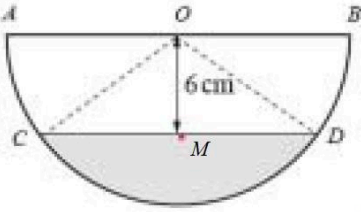
Question 70

(a)	[a =] 9 [b =] 14	3	<b>B2</b> for $a = 9$ OR <b>M2</b> for $\frac{60}{360} \times 2 \times \pi \times 17 + \frac{60}{360} \times 2 \times \pi \times 10 + 7 + 7$ oe or <b>M1</b> for $\frac{60}{360} \times 2 \times \pi \times 17$ oe or $\frac{60}{360} \times 2 \times \pi \times 10$ oe
			If 0 scored <b>SC1</b> for $b = 14$
(b)(i)	60° at centre or interior angle = 120°	<b>B1</b>	
	[6×] $\frac{1}{2} \times d^2 \times \sin 60$ oe	<b>M1</b>	
	[ $d^2 =$ ] $\frac{127.3}{6 \times \frac{1}{2} \times \sin 60}$	<b>M1</b>	
	6.99[9...] to 7.00[...]	<b>A1</b>	Dep on M1M1
(b)(ii)(a)	1273	<b>1</b>	
(b)(ii)(b)	675 or 674.5 to 674.6	<b>2</b>	<b>M1</b> for $2 \times 127.3$ oe or $6 \times 7 \times 10$ oe

Question 71

[TSA cylinder =]	$2\pi x^2 + 2\pi x \times 3x$	<b>M1</b>	
[TSA hemisphere=]	$\pi(5y)^2 + \frac{4\pi(5y)^2}{2}$	<b>M1</b>	
Leading to	$2\pi x^2 + 6\pi x^2 = 50\pi y^2 + 25\pi y^2$ oe	<b>M1</b>	dep <b>M1M1</b>
	$x^2 = \frac{75y^2}{8}$	<b>A1</b>	dep on <b>M1M1M1</b>

Question 72

(a)(i)	22 620 cao	3	<p><b>B2</b> for <math>7200\pi</math> or 22 608 to 22 629  or <b>M1</b> for <math>\frac{1}{2} \times \pi \times 12^2</math> [<math>\times</math> figs 1] oe</p>
(a)(ii)	<p>8840 or 8850 or 8836 to 8850.</p> 	5	<p><b>M1</b> for <math>\cos COM = \frac{6}{12}</math> oe  or <math>\sin AOC = \frac{6}{12}</math> oe  <b>M1</b> for <math>\left(\frac{\text{their } COD}{360} \times \pi \times 12^2\right)</math> oe    <b>M1</b> for <math>\left(\frac{1}{2} \times 12^2 \times \sin(\text{their } COD)\right)</math> oe    <b>M1dep</b> for <math>(\text{their area of sector } COD - \text{their area of triangle } COD) \times 100</math> <b>dep</b> on at least M1M1 oe</p>
(b)	647 or 646.8	3	<p><b>M2</b> for <math>2.2 = \frac{m}{42 \times 35 \times 0.2}</math> oe  or <b>M1</b> for [vol of stone =] <math>42 \times 35 \times 0.2</math> oe    If 0 scored <b>SC1</b> for answer figs 647 or figs 6468</p>
(c)	46.1 or 46.12 to 46.14	4	<p><b>M3</b> for <math>\tan = \frac{15}{\sqrt{8^2 + 12^2}}</math> oe  or <b>M2</b> for <math>8^2 + 12^2</math> oe or <math>8^2 + 12^2 + 15^2</math> oe  or <b>M1</b> for identifying the angle <math>GAC</math></p>

Question 73

(a)(i)	10 100	3	<b>M2</b> for $30 \times 70 + 2 \times 30 \times 40 + 2 \times 40 \times 70$ or <b>M1</b> for $30 \times 40$ or $30 \times 70$ or $40 \times 70$
(a)(ii)	16	3	<b>M2</b> for 2 fit width, 2 fit height and 4 fit length soi or <b>M1</b> for 70, 30 or $40 \div 15$ or 20
(b)(i)	$\frac{1}{3} \pi r^2 \times 3r = \text{their } (750 \div 8.9) \text{ oe}$	<b>M2</b>	<b>M1</b> for using 750 and 8.9 correctly in $v = m / d$ oe or $750 \div 8.9$
	$r^3 = \frac{\text{their}(750 \div 8.9)}{\pi} \text{ oe}$	<b>M1dep</b>	
	$r = 2.993 \dots$	<b>A1</b>	
(b)(ii)	117 or 116.9 to 117.2	5	<b>M4</b> for $\pi \times 2.99^2 + \pi \times 2.99 \times \sqrt{2.99^2 + (3 \times 2.99)^2}$ oe or <b>M3</b> for $\pi \times 2.99 \times \sqrt{2.99^2 + (3 \times 2.99)^2}$ or <b>M2</b> for $\sqrt{2.99^2 + (3 \times 2.99)^2}$ or <b>M1</b> for $2.99^2 + (3 \times 2.99)^2$ or for $\pi \times 2.99^2$

