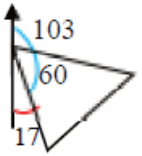
Question	Answer	Marks	AO Element	Notes	Guidance
1	317	**2**		**M1** for 137 + 180 oe	
2	[0]71	**1**			
3	239	**2**		**M1** for $180 + 59$ or $360 - (180 - 59)$ oe or indicates correct angle on diagram	
4	142°	**1**			
5	252	**3**		**M2** for $180 \div (7 - 2)$ oe OR **M1** for $180 - x + y = 360$ oe **M1** for correct use of ratio	
6	142	**2**		**M1** for $322 - 180$ oe or a clear diagram with both 322 or 38 marked and the reverse bearing to be found	

Question	Answer	Marks	AO Element	Notes	Guidance
7(a)	Measurement of *PQ* correctly scaled to km	**2**		**M1** for correct measurement of *PQ* in cm seen or for *their* measurement [in cm] multiplied by 4	
7(b)	065	**1**			
7(c)	*X* correctly placed 7 cm from *P* on a bearing of 140°	**2**		**M1** for *X* on bearing of 140° from *P* or for *X* 7 cm from *P* If 0 scored, **SC1** for *X* on bearing of 140° from *Q* and 7 cm from *Q*	
8(a)	247	**1**			
8(b)	Point *C* correctly plotted	**3**		**B2** for line from *B* 8.3 cm to 8.7 cm long or **M1** for 102 ÷ 12 and **B1** for bearing 155° to 159°	

Question	Answer	Marks	AO Element	Notes	Guidance
9	343	**2**		**B1** for 103 in correct position **and** 60 or 17 in correct position  	
10	285	**2**		**M1** for 180 + 105 or 75 or 105 seen in correct position at *B*	
11	**M2** for $[x =] \frac{17.5}{\tan 48}$ or $[x =] \tan 42 \times 17.5$ **A1** for 15.75.. or 15.76	**3**		**M1** for $\tan 48 = \frac{17.5}{x}$ or $\tan (90 - 48) = \frac{x}{17.5}$	

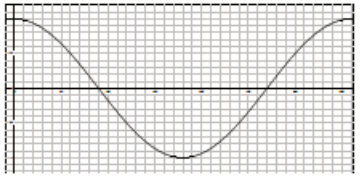
Question	Answer	Marks	AO Element	Notes	Guidance
12	21 600	**5**		**B3** for 168 OR **M2** for $204^2 - 180^2$ or better or **M1** for $[\ldots]^2 + 180^2 = 204^2$ oe **A1** for 96 dep on **M2** **and M1** for $\frac{1}{2}(72 + their168) \times 180$ oe If zero scored, then **SC1** for 72 × 180 alone or as part of total area calculation	
13	9.23 or 9.234 to 9.235	**2**		**M1** for $\sin[38 =] \frac{BC}{15}$ or better	
14(a)	Congruent	**1**			
14(b)	37.5 or 37.48 to 37.49	**2**		**M1** for $\cos[ABC =] \frac{7.3}{9.2}$	

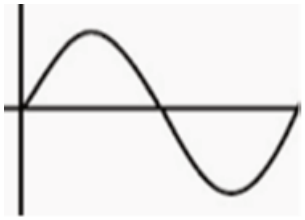
Question	Answer	Marks	AO Element	Notes	Guidance
15(a)	$\frac{(12-2)\times 180}{12}$ [= 150] oe or $180-\frac{360}{12}$ [= 150]	**1**		Accept $\frac{(2\times 12-4)\times 90}{12}$ [= 150]	
15(b)(i)	**M2** for $\frac{3}{\cos 75}$ oe or $\frac{6\sin 75}{\sin 30}$ **A1** for 11.59...	**3**		**M1** for $\frac{3}{AO}=\cos 75$ oe or $\frac{r}{\sin 75}=\frac{6}{\sin 30}$	
15(b)(ii)A	72.8 or 72.9 or 72.82 to 72.89…	**2**		**M1** for $2\times\pi\times 11.6$	
15(b)(ii)B	12.1 or 12.06 to 12.08	**2**		**M1** for [6 +] *their* **(b)(ii)(A)** ÷ 12 oe	
15(c)	806 or 807 or 805.9 to 807.4	**3**		**B2** for 402.9… to 403.7 OR **M2** for $\frac{1}{2}\times 6\times 11.6\times\sin 75\times 12$ oe 2 or **M1** for $\frac{1}{2}\times 6\times 11.6\times\sin 75$ [$\times k$] oe	

Question	Answer	Marks	AO Element	Notes	Guidance
16(a)	87.[0] or 86.98 to 86.99	**3**		**M2** for $\sqrt{82^2 + 55^2 - 2 \times 82 \times 55 \times \cos 76}$ oe OR **M1** for $82^2 + 55^2 - 2 \times 82 \times 55 \times \cos 76$ oe **A1** for 7570 or 7566 to 7567	
16(b)	66.1 or 66.2 or 66.13 to 66.17	**3**		**M2** for $\frac{82 \times \sin 76}{their(\mathbf{a})}$ oe or **M1** for $\frac{82}{\sin C} = \frac{their(\mathbf{a})}{\sin 76}$ oe	
16(c)	13.3 or 13.30 to 13.31	**3**		**M2** for $AG = 55 \cos 76$ oe or **M1** for recognition that CG is perpendicular to AB	

Question	Answer	Marks	AO Element	Notes	Guidance
16(d)	54.1 or 54.13… **and** 125.9 or 125.86 to 125.87	**5**		**B4** for 54.1 or 54.13… or 125.9 or 125.86 to 125.87 or **M3** for $[\sin Q =] \frac{0.5 \times 82 \times 55 \times \sin 76}{0.5 \times 90 \times 60}$ oe or **M2** for $0.5 \times 82 \times 55 \times \sin 76 = 0.5 \times 60 \times 90 \times \sin Q$ oe or **M1** for $0.5 \times 82 \times 55 \times \sin 76$ oe or for $0.5 \times 60 \times 90 \sin Q = \textit{their}$ area of ABC If **B4** not scored then **SC1** for two angles seen that sum to 180 (from use of sine ratio) but not 0 and 180.	
17(a)	Complete method shown and evaluated	**2**		**M1** for correct Pythagoras e.g. $120^2 + 126^2 \left[= 174^2\right]$	

Question	Answer	Marks	AO Element	Notes	Guidance
17(b)	18 090 cao	**5**		**B4** for 18 081 to 18 094.1 OR **M2** for $126 \times \tan 53$ or **M1** for $\tan 53 = \frac{x}{126}$ and **M1** for $\frac{1}{2} \times 120 \times 126$ or $\frac{1}{2} \times 126 \times$ *their PS* or $\frac{1}{2} \times 126 \times (120 +$ *their PS*$)$ oe If 0 scored, **SC1** for evidence of rounding *their* answer to 4sf	

Question	Answer	Marks	AO Element	Notes	Guidance
18(a)	41.2 or 41.21 to 41.23	**4**		**M1** for $SQ = 2 \times 32 \times \sin\left(\frac{1}{2} \times 56\right)$ oe or $\sqrt{32^2 + 32^2 - 2 \times 32 \times 32 \times \cos 56}$ oe or $\frac{32 \sin 56}{\sin((180 - 56) \div 2)}$ oe **M2** for $SR^2 = 47^2 + (theirSQ)^2 - 2 \times 47 \times theirSQ \times \cos 60$ or **M1** for implicit form	
18(b)	28.3 or 28.25 to 28.29…	**3**		**M2** for $32 \times \sin 62$ oe or **M1** for recognition that line from P is perpendicular to SQ	
19(a)	Correct sketch  Correct sketch to go through (0, 1), (360, 1) and (180, −1)	**2**		To go through (0, 1) and close to (360, 1) and reasonably close to (180, −1) **B1** for correct cosine curve shape through (0, 1)	

Question	Answer	Marks	AO Element	Notes	Guidance
19(b)	120, 240	**2**		**B1** for each or for two values with sum of 360	
20(a)	 Correct sketch to go through (0, 0), (180, 0) and (360, 0)	**2**		**B1** for correct sine curve shape through the origin	
20(b)	199.5 or 199.47… and 340.5 or 340.52 to 340.53…	**3**		**B2** for one correct or **M1** for $\sin x = -\frac{1}{3}$ oe If 0 scored, **SC1** for two reflex angles with sum of 540 or two non-reflex angles with sum of 180	

Question	Answer	Marks	AO Element	Notes	Guidance
21	221.8 or 221.81... and 318.2 or 318.18 to 318.19	**3**		**B2** for one correct or **M1** for $\sin x = -\frac{2}{3}$ oe If 0 scored, **SC1** for two reflex angles with a sum of 540 or two non-reflex angles with a sum of 180	
22(a)	1.27 or 1.272 to 1.273	**2**		**M1** for $\left[\frac{1}{2}\times\right]\pi\times 0.45^2\times 4$ or $\frac{1}{2}\times\pi\times 0.45^2$ [×4]	

Question	Answer	Marks	AO Element	Notes	Guidance
22(b)	742 or 743	**6**		**M5** for a method leading to the volume of water e.g. $4 \times \left\{ 2 \times \frac{inv\cos\left(\frac{0.15}{0.45}\right)}{360} \times \pi \times 0.45^2 - \frac{1}{2} \times 0.45^2 \times \sin\left(2inv\cos\left(\frac{0.15}{0.45}\right)\right) \right\}$ oe OR **M2** for $2 \times \frac{inv\cos\left(\frac{0.15}{0.45}\right)}{360} \times \pi \times 0.45^2$ oe or $[2\times] \frac{90 - inv\cos\left(\frac{0.15}{0.45}\right)}{360} \times \pi \times 0.45^2$ oe or **M1** for use of $\frac{\theta}{360} \times \pi \times 0.45^2$ oe **M2** for $\frac{1}{2} \times 0.45^2 \times \sin\left(2inv\cos\left(\frac{0.15}{0.45}\right)\right)$	

Question	Answer	Marks	AO Element	Notes	Guidance
				oe or $\frac{1}{2} \times 0.15 \times 0.45 \times \sin\left(inv\cos\left(\frac{0.15}{0.45}\right)\right)$ [×2] oe or **M1** for use of $\frac{1}{2} \times 0.45^2 \times \sin\theta$ oe or [2×] $\frac{1}{2} \times 0.15 \times 0.45 \times$ esinβ o If 0 scored, **SC1** for $inv\cos\left(\frac{0.15}{0.45}\right)$ or $inv\sin\left(\frac{0.15}{0.45}\right)$ or $\sqrt{0.45^2 - 0.15^2}$ soi	
23(a)	7.06 or 7.058… or 7.059	**3**		**M2** for $\sqrt{6.4^2 + 10.9^2 - 2 \times 6.4 \times 10.9 \times \cos 38}$ oe OR **M1** for $6.4^2 + 10.9^2 - 2 \times 6.4 \times 10.9 \times \cos 38$ oe **A1** = 49.8...	

Question	Answer	Marks	AO Element	Notes	Guidance
23(b)(i)	97	**1**			
23(b)(ii)	15.3[0…]	**3**		**M2** for $[AB =]\ \dfrac{10.9 \times \sin\ their\ 97}{\sin 45}$ or **M1** for $\dfrac{\sin\ their\ 97}{AB} = \dfrac{\sin 45}{10.9}$ oe	
23(c)	72.8 to 72.81…	**3**		**M2** for $\frac{1}{2} \times 6.4 \times 10.9 \times \sin 38 + \frac{1}{2}\ their 15.3 \times 10.9 \times \sin 38$ oe or **M1** for $\frac{1}{2} \times 6.4 \times 10.9 \times \sin 38$ oe or $\frac{1}{2}\ their 15.3 \times 10.9 \times \sin 38$ oe or **M1** for height = $10.9 \times \sin 38$ oe	

Question	Answer	Marks	AO Element	Notes	Guidance
24(a)	27[.0] or 26.97… nfww	**3**		**M2** for $[\cos =] \frac{8.6^2 + 9.7^2 - 4.4^2}{2 \times 8.6 \times 9.7}$ or **M1** for implicit form	
24(b)	9.19 or 9.192 to 9.193	**4**		**B1** for [angle BCD =] 73 seen **M2** for $\frac{9.7 \times \sin 65}{\sin (180 - 65 - 42)}$ oe or **M1** for $\frac{\sin (180 - 65 - 42)}{9.7} = \frac{\sin 65}{DC}$ oe	
24(c)	6.15 or 6.149 to 6.151…	**3**		**M2** for $\frac{d}{their 9.19} = \sin 42$ oe or **M1** for right angle between line from C to BD and BD soi	
25	28	**3**		**M2** for $24^2 + 12^2 + 8^2$ or **M1** for $24^2 + 12^2$ or $24^2 + 8^2$ or $12^2 + 8^2$	

Question	Answer	Marks	AO Element	Notes	Guidance
26(a)	20.8 or 20.76 to 20.79	**4**		**B3** for [BC =] 10.4 or 10.38 to 10.39… or $6\sqrt{3}$ oe or **M2** for $(2x)^2 + x^2 + 6^2 = 24^2$ oe or **M1** for $24^2 - 6^2$ oe or $x^2 + 6^2$ oe or $(2x)^2 + 6^2$ oe or $x^2 + (2x)^2$ oe or **SC2** for final answer of $12\sqrt{5}$ or 26.8 or 26.83… OR **M3** for $x^2 + \left(\frac{x}{2}\right)^2 + 6^2 = 24^2$ oe or **M2** for $x^2 + \left(\frac{x}{2}\right)^2$ or **M1** for $x^2 + 6^2$ oe or $\left(\frac{x}{2}\right)^2 + 6^2$ oe or $24^2 - 6^2$ oe	

Question	Answer	Marks	AO Element	Notes	Guidance
26(b)	14.5 or 14.47 to 14.48	**3**		**M2** for $\sin[\ldots] = \frac{6}{24}$ oe or **M1** for recognising the correct angle *GAC*	
27	31.9 or 31.85...	**4**		**M3** for $\tan = \frac{12}{\sqrt{18^2 + 7^2}}$ oe or **M2** for $\sqrt{18^2 + 7^2}$ or **M1** for $18^2 + 7^2$ or **B1** for identifying correct angle *CAG*	
					[Total: 130]