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MATHEMATICS

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MARK SCHEME

Maximum Mark: 130

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Abbreviations

cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
oe	or equivalent
SC	Special Case
nfw	not from wrong working
soi	seen or implied

Question	Answer	Mark	Part marks
1 (a) (i)	60 and 45	2	M1 for $105 \div (4 + 3)$
	(ii) 117.6[0] final answer	2	M1 for 105×1.12 oe
	(iii) 125	3	M2 for $105 \div (1 - \frac{16}{100})$ oe or M1 for 105 seen associated with 84%
	(b) 30.68 final answer	6	B5 for 30.7[0] or 30.68... or B4 for 905 to 906 and 875 or 405 to 406... and 375 OR M1 for $500 \times \left(1 + \frac{2}{100}\right)^{30}$ [- 500] oe M1 for $[500 +] \frac{500 \times 2.5 \times 30}{100}$ B1 for 905 to 906 or 875 or 405 to 406 or 375
	(c) 480 or 479.8 to 479.9...	3	M2 for $1469 \div \left(1 + \frac{3.8}{100}\right)^{30}$ oe or M1 for $P \times \left(1 + \frac{3.8}{100}\right)^{30} = 1469$ oe
	(d) 6.5[0] or 6.500...	3	M2 for $\sqrt[11]{\frac{120150}{60100}} [\times 100 - 100]$ oe or M1 for $60100 \times ()^n = 120150$ oe where $n = 5$ or 11 or 55

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Question	Answer	Mark	Part marks
2 (a) (i)	15 to 15.2	1	
	(ii) 10.8 to 11	1	
	(iii) 9 to 9.2	1FT	FT 20 – <i>their</i> (a)(ii)
	(iv) 10	1	
	(v) 24	2	B1 for 176 written
	(b) (i) 16.75 nfw	4	isw attempted time conversion after correct answer M1 for 5, 12.5, 17.5, 25, 45 soi M1 for Σfx M1 dep for $\text{their } \Sigma fx \div 200$
	(ii) Fully correct histogram	4	B1 for each correct block If zero scored, SC1 for frequency densities of 9.6, 12, 2.6 and 0.6 seen
3 (a) (i)	51.7 or 51.69 to 51.70...	4	M3 for $(2 \times \frac{2}{3} \times \pi \times 13^3 + \pi \times 13^2 \times 25) \times 2.3 [\div 1000]$ oe or SC3 for figs 517 or figs 5169 to 5170... or M2 for $(2 \times \frac{2}{3} \times \pi \times 13^3 + \pi \times 13^2 \times 25)$ oe OR M1 for $2 \times \frac{2}{3} \times \pi \times 13^3$ seen or $\pi \times 13^2 \times 25$ seen M1indep for <i>their</i> volume $\times 2.3 \div 1000$
	(ii) 1.96 or 1.957 to 1.958 ...	4	M3 for $(2 \times 2 \times \pi \times 13^2 + \pi \times 2 \times 13 \times 25) [\div 100^2] \times 4.7$ oe or SC3 for figs 196 or figs 1957 to 1958... M2 for $(2 \times 2 \times \pi \times 13^2 + \pi \times 2 \times 13 \times 25)$ oe OR M1 for $2 \times 2 \times \pi \times 13^2$ seen or $\pi \times 2 \times 13 \times 25$ seen M1indep for <i>their</i> area divided by 100^2 soi

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Question	Answer	Mark	Part marks
(b)	6.2[0] or 6.203 to 6.204	3	M2 for $x^3 = \frac{500}{\frac{2}{3}\pi}$ oe or better or M1 for $\frac{1}{3} \times \pi \times x^2 \times 2x = 500$ oe
(c)	286 or 285.7...	3	M2 for $\frac{180}{A} = \left(\frac{180}{360}\right)^{\frac{2}{3}}$ oe or M1 for $\left(\sqrt[3]{\frac{360}{180}}\right)^{[2]}$ oe or $\left(\sqrt[3]{\frac{180}{360}}\right)^{[2]}$ oe seen or $\frac{A^3}{180^3} = \frac{360^2}{180^2}$
4 (a)	0.92, ..., ..., 0.5, -1, ..., ..., -1, 0.5, ..., ..., 0.92	3	B2 for 4 or 5 correct or B1 for 2 or 3 correct
(b)	Fully correct graph	5	B4 for correct graph but branches joined OR B3FT for 11 or 12 correct points or B2FT for 9 or 10 correct points or B1FT for 7 or 8 correct points Blindep for a branch on each side of the y-axis, without touching it
(c) (i)	Correct ruled line through (-2, 1) and (2, -3)	2	B1 for straight line with gradient -1 or cutting y-axis at -1 or correct line but freehand or short correct ruled line
(ii)	0.7 to 0.95	1	
(iii)	$[p =] 2$ and $[q =] -2$	3	B2 for $x^3 + 2x^2 - 2 = 0$ oe or B1 for $x^2 - 2 = -x^3 - x^2$ oe or better or $1 + 1 - \frac{2}{x^2} + x [= 0]$ or better
(d) (i)	(1.3 to 1.6, 0)	1	
(ii)	Ruled line from (0, -2) to intersection of <i>their</i> graph with positive x-axis	1FT	
(iii)	Tangent [to curve] A or (1.3 to 1.6, 0)	1 1	

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Question	Answer	Mark	Part marks
5 (a) (i)	Image at $(-2, -4), (4, -4), (4, 0)$	2	SC1 for translation $\begin{pmatrix} -4 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ -8 \end{pmatrix}$
(ii)	8.94 or 8.944...	2	M1 for $\sqrt{(-4)^2 + (-8)^2}$ or $\sqrt{4^2 + 8^2}$
(b) (i)	Enlargement [factor] 0.5 oe [centre] (0, 0) oe	1 1 1	
(ii)	$\begin{pmatrix} 0.5 & 0 \\ 0 & 0.5 \end{pmatrix}$ oe	2FT	FT their scale factor from (b)(i) dep on enlargement and centre (0, 0) B1FT for one row or column
(iii)	0.25 or $\frac{1}{4}$	1FT	Strict FT <i>their</i> matrix but not for identity matrix
6 (a)	126 or 126.4 to 126.5	3	M2 for $\sqrt{220^2 - 180^2}$ oe or M1 for $BC^2 + 180^2 = 220^2$ oe
(b)	99.9 or 99.86 to 99.87	4	M2 for $180^2 + 170^2 - 2 \times 180 \times 170 \cos 33$ or M1 for $\cos 33 = \frac{180^2 + 170^2 - CD^2}{2 \times 180 \times 170}$ A1 for 9970 or 9973 to 9974
(c)	92.6 or 92.58 to 92.59	2	M1 for $\frac{\text{dist}}{170} = \sin 33$ oe
(d)	115.1 or 115.0 to 115.1	3	M1 for $\cos = \frac{180}{220}$ oe M1dep for $47 + 33 + \text{their angle } BAC$
(e)	19700 or 19708 to 19720	3	M1 for $0.5 \times 180 \times 170 \times \sin 33$ oe or $0.5 \times 180 \times \text{their (c)}$ oe M1 for $0.5 \times 180 \times \text{their (a)}$ oe or $0.5 \times 180 \times 220 \times \sin(\text{their } BAC)$ oe

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Question	Answer	Mark	Part marks
7 (a)	0.7, 0.1 oe correctly placed 0.2, 0.8 oe correctly placed	1 1	
(b) (i)	0.44 nfwv oe	3	M2 for $1 - \text{their } 0.7 \times \text{their } 0.8$ or for $0.3 + \text{their } 0.7 \times \text{their } 0.2$ oe or M1 for $\text{their } 0.7 \times \text{their } 0.8$ or for two of 0.3×0.9 , $0.3 \times \text{their } 0.1$, $\text{their } 0.7 \times \text{their } 0.2$
(ii)	110	1FT	FT $250 \times \text{their (b)(i)}$
(c)	If late at first two stations then certain to be late at station C oe	1	Indication of certain event (allow 1 or 100% probability or sure) at third station if late at first two stations
8 (a)	$\frac{323}{x} + \frac{323}{x+2} = 36$ oe three term equation $323(x+2) + 323x = 36x(x+2)$ oe or $\frac{323x + 646 + 323x}{x(x+2)} = 36$ oe $36x^2 - 574x - 646 = 0$ $18x^2 - 287x - 323 = 0$	B2 M1 A1	B1 for $\frac{323}{x}$ seen oe or $\frac{323}{x+2}$ seen oe i.e. for clearing the fractions (or all still over common denominator) or reducing the two algebraic fractions to one fraction and expanding the brackets in the numerator
(b) (i)	17, 19	1	answer reached without any omissions or errors with at least one intermediate line with brackets expanded after M1
(ii)	(..... + 19)(..... - 17)	2	SC1 for (..... + a)(..... + b) where a, b are integers and $ab = -323$ or $a + 18b = -287$
(iii)	$17, -\frac{19}{18}$ oe	1FT	FT <i>their (b)(ii)</i>
(c)	11 cao	1	

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Question	Answer	Mark	Part marks
9 (a)	236	3	B2 for 243 and 7 or M2 for $3^{2(2)+1} - (2(3^{[1]} + 1))$ oe B1 for h(5) or f(3) soi or M1 for $3^{2x+1} - (2(3^x) + 1)$ or better
(b)	$6x + 1$ final answer	2	M1 for $3(2x + 1) - 2$
(c)	$x < 3$ oe final answer	2	M1 for $1 + 2 > 3x - 2x$ or $2x - 3x > -2 - 1$ oe
(d)	-2	1	
(e)	$\frac{x+2}{3}$ oe final answer	2	M1 for $x = 3y - 2$ or $y + 2 = 3x$ or $\frac{y}{3} = x - \frac{2}{3}$
(f)	$\frac{6x^2 - x + 3}{2x + 1}$ final answer	3	M1 for $5 + (2x + 1)(3x - 2)$ or better isw B1 for common denominator $2x + 1$ isw
(g)	9	1	
10 (a)	115 or 114.5 to 114.6	3	M2 for $\frac{r^2}{\frac{\pi r^2}{360}}$ or better or M1 for $\frac{w}{360} \times \pi \times r^2 = r^2$
(b)	126	3	M2 for $\frac{x}{360} \times 2\pi r [+ 2r] = [2r +] \frac{7\pi r}{10}$ or better or M1 for $\frac{x}{360} \times 2\pi r$
(c)	120	4	B3 for $\frac{y}{2} = 60$ or x (base angle) = 30 OR M3 for $\cos x$ or $\sin\left(\frac{y}{2}\right) = \frac{\sqrt{3}}{2}$ oe or $\cos y = -\frac{1}{2}$ oe or M2 for $\cos x$ or $\sin\left(\frac{y}{2}\right) = \frac{q\sqrt{3}}{2q}$ or $[\cos y] = \frac{q^2 + q^2 - (q\sqrt{3})^2}{2 \times q \times q}$ oe or M1 for $\left[(q\sqrt{3})^2 = \right] q^2 + q^2 - 2 \times q \times q \cos y$ oe After M0 , SC1 for $[h^2 =] q^2 - \left(\frac{1}{2} q\sqrt{3}\right)^2$ or for q replaced by 1, 2, 4, etc.