Question	Answer	Marks	Guidance
1	$(y) = \frac{x^{\frac{1}{2}}}{\frac{1}{2}} - 3x\ (+c)$	**B1B1**	
	Sub (4, –6) $-6 = 4 - 12 + c \quad \rightarrow \quad \boldsymbol{c} = 2$	**M1A1**	Expect $(y) = 2x^{\frac{1}{2}} - 3x + 2$
		4	

Question	Answer	Marks	Guidance
2(i)	${}^7C_2(+/-2x)^2$ or ${}^7C_3(-2x)^3$	**M1**	SOI, Allow for either term correct. Allow + or – inside first bracket.
	$84\,(x^2)$, $-280\left(x^3\right)$	**A1A1**	
		3	
2(ii)	$2 \times (\mathit{their} - 280) + 5 \times (\mathit{their}\ 84)$ only	**M1**	
	–140	**A1**	
		2	

Question	Answer	Marks	Guidance
3(i)	$40 + 60 \times 1.2 = 112$	**M1A1**	Allow 1.12 m. Allow **M1** for 40 + 59 × 1.2 OE
		2	

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Question	Answer	Marks	Guidance
3(ii)	Find rate of growth e.g. 41.2/40 or 1.2/40	*M1	SOI, Also implied by 3% , 0.03 or 1.03 seen
	$40\times(1+\mathit{their}\,0.03)^{60\ or\ 59}$	DM1	
	236	A1	Allow 2.36 m
		3	

Question	Answer	Marks	Guidance
4(i)	$\frac{1}{\sqrt{3}}=\frac{2}{x}$ or $y-2=\frac{-1}{\sqrt{3}}x$	M1	OE, Allow $y-2=\frac{+1}{\sqrt{3}}x$. Attempt to express $\tan\frac{\pi}{6}\ or\ \tan\frac{\pi}{3}$ <u>exactly</u> is required or the use of $1/\sqrt{3}\ or\ \sqrt{3}$
	$(x=)2\sqrt{3}$	A1	OE
		2	
4(ii)	Mid-point (a, b) = (½ *their* **(i)**, 1)	B1FT	Expect (√3, 1)
	Gradient of AB leading to gradient of bisector, m	M1	Expect $-1/\sqrt{3}$ leading to $m=\sqrt{3}$
	Equation is $y-\mathit{their}\,b=m(x-\mathit{their}\,a)$ OE	DM1	Expect $y-1=\sqrt{3}(x-\sqrt{3})$
	$y=\sqrt{3}x-2$ OE	A1	
		4	

Question	Answer	Marks	Guidance
5(a)	$2\tan x + 5 = 2\tan^2 x + 5\tan x + 3 \rightarrow 2\tan^2 x + 3\tan x - 2(=0)$	**M1A1**	Multiply by denom., collect like terms to produce 3-term quad. in tan$x$
	0.464 (accept 0.148π), 2.03 (accept 0.648π)	**A1A1**	**SCA1** for both in degrees 26.6º, 116.6º only
		4	
5(b)	$\alpha = 30°$ $k = 4$	**B1B1**	Accept $\alpha = \pi / 6$
		2	

Question	Answer	Marks	Guidance
6(i)	$\frac{PQ}{2} = 10 \times \sin 1.1$	**M1**	Correct use of sin/cos rule
	(PQ =) 17.8 (17.82…implies **M1**, **A1**) AG	**A1**	OR $PQ = \frac{10\sin 2.2}{\sin\left(\frac{\pi}{2} - 1.1\right)}$ or $\frac{10\sin 2.2}{\sin 0.4708}$ or $\sqrt{200 - 200\cos 2.2} = 17.8$
		2	
6(ii)	Angle OPQ = (π/2 – 1.1) [accept 27°]	**B1**	OE Expect 0.4708 or 0.471. Can be scored in part **(i)**
	Arc QR =17.8 × *their* (π/2 – 1.1)	**M1**	Expect 8.39. (or 8.38).
	Perimeter $= 17.8 - 10 + 10 + \textit{their}\ \text{arc}\, QR$	**M1**	
	26.2	**A1**	For both parts allow correct methods in degrees
		4	

Question	Answer	Marks	Guidance
7(i)	$\overrightarrow{CE} = -4\mathbf{i} - \mathbf{j} + 8\mathbf{k}$	B1	
	$\lvert\overrightarrow{CE}\rvert = \sqrt{((their-4)^2 + (their-1)^2 + (their\,8)^2} = 9$	M1A1	Could use Pythagoras' theorem on triangle *CDE*
		3	
7(ii)	$\overrightarrow{CA} = 3\mathbf{i} - 3\mathbf{j}$ or $\overrightarrow{AC} = -3\mathbf{i} + 3\mathbf{j}$	B1	
	$\overrightarrow{CE}.\overrightarrow{CA} = (-4\mathbf{i} - \mathbf{j} + 8\mathbf{k}).(3\mathbf{i} - 3\mathbf{j}) = -12 + 3$ (Both vectors reversed ok)	M1	Scalar product of *their* $\overrightarrow{CE}$, $\overrightarrow{CA}$. One vector reversed ok for all **M** marks
	$\lvert\overrightarrow{CE}\rvert\times\lvert\overrightarrow{CA}\rvert = \sqrt{16+1+64} \times \sqrt{9+9}$	M1	Product of moduli of *their* $\overrightarrow{CE}$, $\overrightarrow{CA}$
	$\cos^{-1}\left(\frac{-12+3}{9\sqrt{18}}\right) = \cos^{-1}\left(\frac{-1}{\sqrt{18}}\right)$ $\left[\text{or e.g. } \cos^{-1}\left(\frac{-3}{\sqrt{162}}\right), \cos^{-1}\left(\frac{-9}{\sqrt{1458}}\right)\right]$ etc.	A1A1	**A1** for any correct expression, **A1** for required form Equivalent answers must be in required form $m/\sqrt{n}$ (*m*, *n* integers)
		5	

Question	Answer	Marks	Guidance
8(i)	$\mathrm{d}y/\mathrm{d}x = x - 6x^{\frac{1}{2}} + 8$	B2,1,0	
	Set to zero and attempt to solve a quadratic for $x^{\frac{1}{2}}$	M1	Could use a substitution for $x^{\frac{1}{2}}$ or rearrange and square correctly*
	$x^{\frac{1}{2}} = 4$ or $x^{\frac{1}{2}} = 2$ [$x = 2$ *and* $x = 4$ gets **M1 A0**]	A1	Implies **M1**. 'Correct' roots for *their* $\mathrm{d}y/\mathrm{d}x$ also implies **M1**
	$x = 16$ or 4	A1FT	Squares of their solutions *Then **A1**,**A1** for each answer
		5	

Question	Answer	Marks	Guidance
8(ii)	$d^2y/dx^2 = 1 - 3x^{-½}$	**B1FT**	FT on *their* d*y*/d*x*, providing a fractional power of x is present
		1	
8(iii)	(When x = 16) d^2y/dx^2 = 1/4 > 0 hence MIN	**M1**	Checking both of their values in their d^2y/dx^2
	(When x = 4) d^2y/dx^2 = –1/2 < 0 hence MAX	**A1**	All correct Alternative methods ok but must be explicit about values of x being considered
		2	

Question	Answer	Marks	Guidance
9(i)	$1 + cx = cx^2 - 3x \rightarrow cx^2 - x(c+3) - 1\ (=0)$	**M1**	Multiply throughout by x and rearrange terms on one side of equality
	Use $b^2 - 4ac\left[= (c+3)^2 + 4c = c^2 + 10c + 9 \text{ or } (c+5)^2 - 16\right]$	**M1**	Select their correct coefficients which must contain 'c' twice Ignore = 0, < 0, >0 etc. at this stage
	(Critical values) –1, –9	**A1**	SOI
	$c \leqslant -9,\quad c \geqslant -1$	**A1**	
		4	

Question	Answer	Marks	Guidance
9(ii)	Sub their c to obtain a quadratic $\left[c=-1\rightarrow -x^2-2x-1(=0)\right]$	M1	
	$x=-1$	A1	
	Sub their c to obtain a quadratic $\left[c=(-9\rightarrow -9x^2+6x-1(=0)\right]$	M1	
	$x=1/3$	A1	[Alt 1: $dy/dx=-1/x^2=c$, when $c=-1, x=\pm 1, c=-9, x=\pm\frac{1}{3}$ Give M1 for equating the gradients, A1 for all four answers and M1A1 for checking and eliminating] [Alt 2: $dy/dx=-1/x^2=c$ leading to $1/x-1/x^2=(-1/x^2)(x)-3$ Give M1 A1 at this stage and M1A1 for solving]
		4	

Question	Answer	Marks	Guidance
10(i)(a)	$f(x)>2$	B1	Accept $y>2$, $(2,\infty)$, $(2,\infty]$, $range>2$
		1	
10(i)(b)	$g(x)>6$	B1	Accept $y>6$, $(6,\infty)$, $(6,\infty]$, $range>6$
		1	
10(i)(c)	$2<fg(x)<4$	B1	Accept $2<y<4$, $(2, 4)$, $2<range<4$
		1	

Question	Answer	Marks	Guidance
10(ii)	The range of f is (partly) outside the domain of g	B1	
		1	
10(iii)	$f'(x)=\frac{-8}{(x-2)^2}$	B1	SOI
	$y=\frac{8}{x-2}+2 \to y-2=\frac{8}{x-2} \to x-2=\frac{8}{y-2}$	M1	Order of operations correct. Accept sign errors
	$f^{-1}(x)=\frac{8}{x-2}+2$	A1	SOI
	$\frac{-48}{(x-2)^2}+\frac{16}{x-2}+4-5 \ (<0) \ \to \ x^2-20x+84 \ (<0)$	M1	Formation of 3-term quadratic in $x,(x-2)$ or $1/(x-2)$
	$(x-6)(x-14)$ or 6, 14	A1	SOI
	$2<x<6$, $x>14$	A1	CAO
		6	

Question	Answer	Marks	Guidance
11(i)	$\mathrm{d}y/\mathrm{d}x=[-2]-\left[3(1-2x)^2\right]\times[-2]$ $(=4-24x+24x^2)$	B2,1,0	Award for the accuracy within each set of square brackets
	At $x=½$ $\mathrm{d}y/\mathrm{d}x=-2$	B1	
	Gradient of line $y=1-2x$ is –2 (hence AB is a tangent) **AG**	B1	
		4	

Question	Answer	Marks	Guidance
11(ii)	Shaded region = $\int_0^{½}(1-2x)-\int_0^{½}[1-2x-(1-2x)^3]$ oe	M1	Note: If area triangle OAB – area under the curve is used the first part of the integral for the area under the curve must be evaluated
	$=\int_0^{½}(1-2x)^3\,dx$ **AG**	A1	
		2	
11(iii)	Area = $\left[\frac{(1-2x)^4}{4}\right][\div -2]$	*B1B1	
	0 – (–1/8) = 1/8	DB1	OR $\int 1-6x+12x^2-8x^3 = x-3x^2+4x^3-2x^4$ (**B2,1,0**) Applying limits 0 → ½
		3	