Question	Answer	Marks	Guidance
1	Divide at least as far as the x term in the quotient	M1	Allow use of $\left(x^2+2\right)\left(x^2+ax+b\right)+cx+d$
	Obtain at least x^2-3x	A1	
	Obtain x^2-3x+3 and remainder 5	A1	
		3	

Question	Answer	Marks	Guidance
2(i)	State or imply non-modular equation $(4x+5)^2=(x-7)^2$ or pair of different linear equations	B1	
	Attempt solution of 3-term quadratic equation or pair of linear equations	M1	
	Obtain $\frac{2}{5}$ and -4	A1	**SC** For $x=-4$ only, from correct work, allow B1
		3	
2(ii)	Apply logarithms and use power law for $2^y=k$ where $k>0$ from **(i)**	M1	
	Obtain -1.32 only	A1	AWRT
		2	

Question	Answer	Marks	Guidance
3	$\ln y = \ln k + a \ln x$	**B1**	SOI
	Equate gradient of line to a	**M1**	
	Obtain $a = -1.39$	**A1**	OE
	Substitute appropriate values into a correct equation to find $\ln k$	**M1**	
	Obtain $\ln k = 4.266...$ and $k = 71.2$	**A1**	**SC1** for gradient $= -1.39$ and no other relevant working
	Alternative method for question 3		
	$\ln y = \ln k + a \ln x$	**B1**	SOI
	$3.96 = \ln k + 0.22a$	**M1**	For one correct equation
	$2.43 = \ln k + 1.32a$	**M1**	For a second correct equation and attempt to solve to find one unknown
	Obtain $a = -1.39$	**A1**	OE
	Obtain $\ln k = 4.266...$ and $k = 71.2$	**A1**	**SC1** for gradient $= -1.39$ and no other relevant working
	Alternative method for question 3		
	$e^{3.96} = k \times 0.22^a$ and $e^{2.43} = k \times 1.32^a$	**B1**	
	Apply a correct method to obtain a	**M1**	
	Obtain $a = -1.39$	**A1**	OE
	Substitute appropriate values into a correct equation to find k	**M1**	
	Obtain $k = 71.2$	**A1**	AWRT
		5	

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Question	Answer	Marks	Guidance
4(i)	Use iteration correctly at least once	**M1**	Must see correct attempt at x_3
	Obtain final answer 1.359	**A1**	
	Show sufficient iterations to 6 sf to justify answer or show sign change in interval [1.3585, 1.3595]	**A1**	Answer required to exactly 4 sf Must see to at least x_5
		3	
4(ii)	Form correct equation in x (or α)	**B1**	$x = \dfrac{x}{\ln 2x}$ OE
	Obtain $\frac{1}{2}$e	**B1**	
		2	

Question	Answer	Marks	Guidance
5	Differentiate using the product rule	*M1	Must have u and v correct in a correct formula with $\dfrac{du}{dx} = 2$ and $\dfrac{dv}{dx} = me^{-\frac{1}{2}x}$
	Obtain correct $2e^{-\frac{1}{2}x} - \frac{1}{2}e^{-\frac{1}{2}x}(2x+5)$	A1	OE
	Equate first derivative to zero and solve for x	DM1	Solution must come from linear terms
	Obtain $x = -\frac{1}{2}$ only	A1	
	Obtain $4e^{\frac{1}{4}}$ or exact equivalent only	A1	
		5	

Question	Answer	Marks	Guidance
6(a)	Obtain $\frac{3}{2}\ln x$ or $\frac{3}{2}\ln(2x)$ or $\frac{3}{2}\ln(kx)$	B1	
	Use subtraction law of logarithms correctly, showing sufficient detail	M1	$\ln 216 - \ln 8 = \ln\left(\dfrac{216}{8}\right)$
	Use power law of logarithms correctly	M1	$n\ln(kx) = \ln(kx)^n$
	Confirm $\ln 27$ with sufficient working and no incorrect working	A1	AG
		4	
6(b)	Use appropriate identity to express integrand in form $k_1 + k_2\cos 3x$	*M1	$k_1 \neq 0$. Allow $2 \times \dfrac{3}{2}x$ for $3x$
	Obtain correct $2 - 2\cos 3x$	A1	
	Integrate to obtain form $k_3 x + k_4 \sin 3x$	DM1	
	Obtain correct $2x - \frac{2}{3}\sin 3x$	A1	
	Use limits to obtain $\frac{1}{3}\pi - \frac{2}{3}$ or exact equivalent	A1	
		5	

Question	Answer	Marks	Guidance
7(i)	Obtain $\frac{dx}{d\theta} = 6\cos 2\theta$	**B1**	
	Obtain $\frac{dy}{d\theta} = 4\sec^2 2\theta$	**B1**	
	Divide $\frac{dy}{d\theta}$ by $\frac{dx}{d\theta}$ with θ equated to $\frac{1}{6}\pi$	**M1**	
	Obtain $\frac{16}{3}$ or exact equivalent	**A1**	Allow FT on A1 if $\frac{dx}{d\theta} = 3\cos 2\theta$ and $\frac{dy}{d\theta} = 2\sec^2 2\theta$
		4	
7(ii)	Equate expression for $\frac{dy}{dx}$ to 2 with only one trigonometry ratio used	***M1**	Either $\cos 2\theta$ or $\sec 2\theta$
	Obtain $\cos^3 2\theta = \frac{1}{3}$ or $\sec^3 = 3$	**A1**	
	Attempt correct steps to find a value of θ from $\cos^3 2\theta = m$, $0 < m < 1$	**DM1**	
	Obtain $\theta = 0.402$ and no others within the range	**A1**	AWRT **SC**: Allow FT if $\frac{dx}{d\theta} = 3\cos 2\theta$ and $\frac{dy}{d\theta} = 2\sec^2 2\theta$
		4	

Question	Answer	Marks	Guidance
8(i)	State $R = 1.3$ or $\dfrac{10}{3}$	**B1**	Not $\sqrt{1.69}$
	Use appropriate trigonometry to find α	**M1**	AWRT ± 1.18 rads, AWRT ± 0.391 rads, AWRT $\pm 67.4^{\circ}$, AWRT $\pm 22.6^{\circ}$
	Obtain 67.38 with no errors seen	**A1**	AWRT
		3	
8(ii)	Carry out correct method to find one value of θ between 0 and 360	**M1**	
	Obtain 240.6 (or 344.6)	**A1**	
	Carry out correct method to find second value of θ between 0 and 360	**M1**	Must be using either degrees throughout or radians throughout for M marks
	Obtain 344.6 (or 240.6)	**A1**	
		4	
8(iii)	Recognise expression as $[3 - 2R\cos(\theta + \alpha)]^2$	**M1**	
	Obtain $[3 - 2 \times (-1.3)]^2$ and hence 31.36 or 31.4	**A1**	
	Obtain $[3 - 2 \times 1.3]^2$ and hence 0.16	**A1**	
		3	