Question	Answer	Marks	Guidance
1	*EITHER*: State or imply non-modular inequality $2^2(2x-a)^2 < (x+3a)^2$, or corresponding quadratic equation, or pair of linear equations $2(2x-a) = \pm(x+3a)$	B1	
	Make reasonable attempt at solving a 3-term quadratic, or solve two linear equations for x	M1	
	Obtain critical values $x = \frac{5}{3}a$ and $x = -\frac{1}{5}a$	A1	
	State final answer $-\frac{1}{5}a < x < \frac{5}{3}a$	A1	
	OR: Obtain critical value $x = \frac{5}{3}a$ from a graphical method, or by inspection, or by solving a linear equation or an inequality	B1	
	Obtain critical value $x = -\frac{1}{5}a$ similarly	B2	
	State final answer $-\frac{1}{5}a < x < \frac{5}{3}a$ [Do not condone $\leqslant$ for $<$ in the final answer.]	B1	
		4	

Question	Answer	Marks	Guidance
2	Rearrange the equation in the form $ae^{2x}=b$ or $ae^{x}=be^{-x}$	M1	
	Obtain correct equation in either form with $a = 2$ and $b = 5$	A1	
	Use correct method to solve for x	M1	
	Obtain answer $x = 0.46$	A1	
		4	

Question	Answer	Marks	Guidance
3 (i)	Sketch a relevant graph, e.g. $y=x^3$	B1	
	Sketch a second relevant graph, e.g. $y = 3 - x$, and justify the given statement	B1	Consideration of behaviour for $x < 0$ is needed for the second B1
		2	
3(ii)	State or imply the equation $x=\left(2x^3+3\right)/\left(3x^2+1\right)$	B1	
	Rearrange this in the form $x^3=3-x$, or commence work *vice versa*	B1	
		2	

Question	Answer	Marks	Guidance
3(iii)	Use the iterative formula correctly at least once	**M1**	
	Obtain final answer 1.213	**A1**	
	Show sufficient iterations to 5 d.p. or more to justify 1.213 to 3 d.p., or show there is a sign change in the interval (1.2125, 1.2135)	**A1**	
		3	

Question	Answer	Marks	Guidance
4(i)	Obtain $\dfrac{\mathrm{d}x}{\mathrm{d}\theta} = 2\cos\theta + 2\cos 2\theta$ or $\dfrac{\mathrm{d}y}{\mathrm{d}\theta} = -2\sin\theta - 2\sin 2\theta$	**B1**	
	Use $\mathrm{d}y/\mathrm{d}x = \mathrm{d}y/\mathrm{d}\theta \div \mathrm{d}x/\mathrm{d}\theta$	**M1**	
	Obtain correct $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ in any form, e.g. $-\dfrac{2\sin\theta + 2\sin 2\theta}{2\cos\theta + 2\cos 2\theta}$	**A1**	
		3	
4(ii)	Equate denominator to zero and use any correct double angle formula	**M1***	
	Obtain correct 3-term quadratic in $\cos\theta$ in any form	**A1**	
	Solve for θ	**depM1***	
	Obtain $x = 3\sqrt{3}/2$ and $y = \dfrac{1}{2}$, or exact equivalents	**A1**	
		4	

Question	Answer	Marks	Guidance
5	Separate variables correctly and integrate at least one side	**B1**	
	Obtain term ln y	**B1**	
	Obtain terms $2\ln x - \frac{1}{2}x^2$	**B1+B1**	
	Use $x = 1$, $y = 1$ to evaluate a constant, or as limits	**M1**	
	Obtain correct solution in any form, e.g. $\ln y = 2\ln x - \frac{1}{2}x^2 + \frac{1}{2}$	**A1**	
	Rearrange as $y = x^2 \exp\left(\frac{1}{2} - \frac{1}{2}x^2\right)$, or equivalent	**A1**	
		7	

Question	Answer	Marks	Guidance
6(i)	Rearrange in the form $\sqrt{3}\sin x - \cos x = \sqrt{2}$	**B1**	
	State $R = 2$	**B1**	
	Use trig formulae to obtain α	**M1**	
	Obtain $\alpha = 30°$ with no errors seen	**A1**	
		4	

Question	Answer	Marks	Guidance
6(ii)	Evaluate $\sin^{-1}\left(\frac{\sqrt{2}}{R}\right)$	**B1ft**	
	Carry out a correct method to find a value of x in the given interval	**M1**	
	Obtain answer $x = 75°$	**A1**	
	Obtain a second answer e.g. $x = 165°$ and no others [Treat answers in radians as a misread. Ignore answers outside the given interval.]	**A1ft**	
		4	

Question	Answer	Marks	Guidance
7(i)	Use product rule	**M1***	
	Obtain correct derivative in any form	**A1**	
	Equate derivative to zero and obtain an equation in a single trig function	**depM1***	
	Obtain a correct equation, e.g. $3\tan^2 x = 2$	**A1**	
	Obtain answer $x = 0.685$	**A1**	
		5	

Question	Answer	Marks	Guidance
7(ii)	Use the given substitution and reach $a\int\left(u^2 - u^4\right)\mathrm{d}u$	M1	
	Obtain correct integral with $a = 5$ and limits 0 and 1	A1	
	Use correct limits in an integral of the form $a\left(\frac{1}{3}u^3 - \frac{1}{5}u^5\right)$	M1	
	Obtain answer $\frac{2}{3}$	A1	
		4	

Question	Answer	Marks	Guidance
8(i)	*EITHER*: Multiply numerator and denominator by 1 + 2i, or equivalent, or equate to $x + iy$, obtain two equations in x and y and solve for x or for y	**M1**	
	Obtain quotient $-\frac{4}{5}+\frac{7}{5}\text{i}$, or equivalent	**A1**	
	Use correct method to find either r or θ	**M1**	
	Obtain $r = 1.61$	**A1**	
	Obtain $\theta = 2.09$	**A1**	
	OR: Find modulus or argument of 2 + 3i or of 1 – 2i	**B1**	
	Use correct method to find r	**M1**	
	Obtain $r = 1.61$	**A1**	
	Use correct method to find θ	**M1**	
	Obtain $\theta = 2.09$	**A1**	
		5	
8(ii)	Show a circle with centre 3 – 2i	**B1**	
	Show a circle with radius 1	**B1ft**	Centre not at the origin
	Carry out a correct method for finding the least value of $\lvert z\rvert$	**M1**	
	Obtain answer $\sqrt{13}-1$	**A1**	
		4	

Question	Answer	Marks	Guidance
9(i)	State or imply the form $\frac{A}{2-x} + \frac{B}{3+2x} + \frac{C}{(3+2x)^2}$	**B1**	
	Use a correct method to find a constant	**M1**	
	Obtain one of $A = 1$, $B = -1$, $C = 3$	**A1**	
	Obtain a second value	**A1**	
	Obtain the third value [Mark the form $\frac{A}{2-x} + \frac{Dx+E}{(3+2x)^2}$, where $A = 1$, $D = -2$ and $E = 0$, B1M1A1A1A1 as above.]	**A1**	
		5	
9(ii)	Integrate and obtain terms $-\ln(2-x) - \frac{1}{2}\ln(3+2x) - \frac{3}{2(3+2x)}$	**B3ft**	The f.t is on A, B, C; or on A, D, E.
	Substitute correctly in an integral with terms $a \ln(2-x)$, $b \ln(3+2x)$ and $c/(3+2x)$ where $abc \neq 0$	**M1**	
	Obtain the given answer after full and correct working [Correct integration of the A, D, E form gives an extra constant term if integration by parts is used for the second partial fraction.]	**A1**	
		5	

Question	Answer	Marks	Guidance
10(i)	*EITHER*: Expand scalar product of a normal to m and a direction vector of l	M1	
	Verify scalar product is zero	A1	
	Verify that one point of l does not lie in the plane	A1	
	OR: Substitute coordinates of a general point of l in the equation of the plane m	M1	
	Obtain correct equation in λ in any form	A1	
	Verify that the equation is not satisfied for any value of λ	A1	
		3	
10(ii)	Use correct method to evaluate a scalar product of normal vectors to m and n	M1	
	Using the correct process for the moduli, divide the scalar product by the product of the moduli and evaluate the inverse cosine of the result	M1	
	Obtain answer 74.5° or 1.30 radians	A1	
		3	
10(iii)	*EITHER*: Using the components of a general point P of l form an equation in λ by equating the perpendicular distance from n to 2	M1	
	OR: Take a point Q on l, e.g. (5, 3, 3) and form an equation in λ by equating the length of the projection of QP onto a normal to plane n to 2	M1	
	Obtain a correct modular or non-modular equation in any form	A1	
	Solve for λ and obtain a position vector for P, e.g. $7\mathbf{i} + 5\mathbf{j} + 7\mathbf{j}$ from $\lambda = 3$	A1	
	Obtain position vector of the second point, e.g. $3\mathbf{i} + \mathbf{j} - \mathbf{k}$ from $\lambda = -1$	A1	
		4	