1	*EITHER*:	State or imply non-modular equation $(x-2)^2 = \left(\frac{1}{3}x\right)^2$,			
		or pair of equations $x - 2 = \pm\frac{1}{3}x$	M1		
		Obtain answer $x = 3$	A1		
		Obtain answer $x = \frac{3}{2}$, or equivalent	A1		
	OR:	Obtain answer $x = 3$ by solving an equation or by inspection	B1		
		State or imply the equation $x - 2 = -\frac{1}{3}$, or equivalent	M1		
		Obtain answer $x = \frac{3}{2}$, or equivalent	A1	[3]	
2	**(i)**	Use the iterative formula correctly at least once	M1		
		Obtain final answer 3.6840	A1		
		Show sufficient iterations to at least 6 d.p. to justify 3.6840, or show there is a sign change in the interval (3.68395, 3.68405)	A1	[3]	
	(ii)	State a suitable equation, e.g. $x = \dfrac{x(x^3+100)}{2(x^3+25)}$	B1		
		State that the value of α is $3\sqrt{50}$, or exact equivalent	B1	[2]	
3	*EITHER*:	State or imply $\ln y = \ln A - kx^2$	B1		
		Substitute values of $\ln y$ and x^2, and solve for k or $\ln A$	M1		
		Obtain $k = 0.42$ or $A = 2.80$	A1		
		Solve for $\ln A$ or k	M1		
		Obtain $A = 2.80$ or $k = 0.42$	A1		
	OR1:	State or imply $\ln y = \ln A - kx^2$	B1		
		Using values of $\ln y$ and x^2, equate gradient of line to $-k$ and solve for k	M1		
		Obtain $k = 0.42$	A1		
		Solve for $\ln A$	M1		
		Obtain $A = 2.80$	A1		
	OR2:	Obtain two correct equations in k and A and substituting y– and x^2 – values in $y = Ae^{-kx^2}$	B1		
		Solve for k	M1		
		Obtain $k = 0.42$	A1		
		Solve for A	M1		
		Obtain $A = 2.80$	A1	[5]	
		[SR: If unsound substitutions are made, e.g. using $x = 0.;64$ and $y = 0.76$, give B1M0A0M1A0 in the *EITHER* and *OR1* schemes, and B0M1A0M1A0 in the *OR2* scheme.]			

4	(i)	Substitute $x = -\frac{1}{3}$, or divide by $3x+1$, and obtain a correct equation, e.g. $-\frac{1}{27}a - \frac{20}{9} - \frac{1}{3} + 3 = 0$	B1	
		Solve for a an equation obtained by a valid method	M1	
		Obtain $a = 12$	A1	[3]
	(ii)	Commence division by $3x+1$ reaching a partial quotient $\frac{1}{3}ax^2 + kx$	M1	
		Obtain quadratic factor $4x^2 - 8x + 3$	A1	
		Obtain factorisation $(3x+1)(2x-1)(2x-3)$	A1	[3]
		[The M1 is earned if inspection reaches an unknown factor $\frac{1}{3}ax^2 + Bx + C$ and an equation in B and/or C, or an unknown factor $Ax^2 + Bx + 3$ and an equation in A and/or B, or if two coefficients with the correct moduli are stated without working.]		
		[If linear factors are found by the factor theorem, give B1B1 for $(2x - 1)$ and $(2x - 3)$, and B1 for the complete factorisation.]		
		[Synthetic division giving $12x^2 - 24x + 9$ as quadratic factor earns M1A1, but the final factorisation needs $(x + \frac{1}{3})$, or equivalent, in order to earn the second A1.]		
		[SR: If $x = \frac{1}{3}$ is used in substitution or synthetic division, give the M1 in part **(i)** but give M0 in part **(ii)**.]		
5	*EITHER*:	State $2ay\frac{dy}{dx}$ as derivative of ay^2	B1	
		State $y^2 + 2xy\frac{dy}{dx}$ as derivative of xy^2	B1	
		Equate derivative of LHS to zero and set $\frac{dy}{dx}$ equal to zero	M1	
		Obtain $3x^2 + y^2 - 6ax = 0$, or horizontal equivalent	A1	
		Eliminate y and obtain an equation in x	M1	
		Solve for x and obtain answer $x = \sqrt{3}a$	A1	
	OR1:	Rearrange equation in the form $y^2 = \frac{3ax^2 - x^3}{x+a}$ and attempt differentiation of one side	B1	
		Use correct quotient or product rule to differentiate RHS	M1	
		Obtain correct derivative of RHS in any form	A1	
		Set $\frac{dy}{dx}$ equal to zero and obtain an equation in x	M1	
		Obtain a correct horizontal equation free of surds	A1	
		Solve for x and obtain answer $x = \sqrt{3}a$	A1	
	OR2:	Rearrange equation in the form $y = \left(\frac{3ax^2 - x^3}{x+a}\right)^{\frac{1}{2}}$ and differentiation of RHS	B1	
		Use correct quotient or product rule and chain rule	M1	
		Obtain correct derivative in any form	A1	

		Equate derivative to zero and obtain an equation in x	M1	
		Obtain a correct horizontal equation free of surds	A1	
		Solve for x and obtain answer $x = \sqrt{3}a$	A1	[6]
6	(i)	Use correct quotient or chain rule to differentiate sec x	M1	
		Obtain given derivative, sec x tan x, correctly	A1	
		Use chain rule to differentiate y	M1	
		Obtain the given answer	A1	[4]
	(ii)	Using $\mathrm{d}x\sqrt{3}\sec^2\theta\,\mathrm{d}\theta$, or equivalent, express integral in terms of θ and dθ	M1	
		Obtain $\int \sec\theta\,\mathrm{d}\theta$	A1	
		Use limits $\frac{1}{6}\pi$ and $\frac{1}{3}\pi$ correctly in an integral form of the form $k\ln(\sec\theta + \tan\theta)$	M1	
		Obtain a correct exact final answer in the given form, e.g. $\ln\left(\frac{2+\sqrt{3}}{\sqrt{3}}\right)$	A1	[4]
7	(i)	Use cos ($A + B$) formula to express the given expression in terms of cos x and sin x	M1	
		Collect terms and reach $\frac{\cos x}{\sqrt{2}} - \frac{3}{\sqrt{2}}\sin x$, or equivalent	A1	
		Obtain $R = 2.236$	A1	
		Use trig formula to find α	M1	
		Obtain $\alpha = 71.57°$ with no errors seen	A1	[5]
	(ii)	Evaluate $\cos^{-1}$ (2/2.236) to at least 1 d.p. (26.56° to 2 d.p., use of $R = \sqrt{5}$ gives 26.57°)	B1√	
		Carry out an appropriate method to find a value of x in the interval $0° < x < 360°$	M1	
		Obtain answer, e.g. $x = 315°$ (315.0°)	A1	
		Obtain second answer, e.g. 261.9° and no others in the given interval	A1	[4]
		[Ignore answers outside the given range.]		
		[Treat answers in radians as a misread and deduct A1 from the answers for the angles.]		
		[SR: Conversion of the equation to a correct quadratic in sin x, cos x, or tan x earns B1, then M1 for solving a 3-term quadratic and obtaining a value of x in the given interval, and A1 + A1 for the two correct answers (candidates must reject spurious roots to earn the final A1).]		
8	(i)	Use any relevant method to determine a constant	M1	
		Obtain one of the values $A = 1, B = -2, C = 4$	A1	
		Obtain a second value	A1	
		Obtain the third value	A1	[4]
		[If A and C are found by the cover up rule, give B1 + B1 then M1A1 for finding B. If only one is found by the rule, give B1M1A1A1.]		
	(ii)	Separate variables and obtain one term by integrating $\frac{1}{y}$ or a partial fraction	M1	
		Obtain $\ln y = -\frac{1}{2} - 2\ln(2x+1) + c$, or equivalent	A3√	

		Evaluate a constant, or use limits $x = 1$, $y = 1$, in a solution containing at least three terms of the form $k \ln y$, l/x, $m \ln x$ and $n \ln (2x + 1)$, or equivalent	M1	
		Obtain solution $\ln y = -\frac{1}{2} - 2\ln x + 2\ln(2x+1) + c$, or equivalent	A1	
		Substitute $x = 2$ and obtain $y = \frac{25}{36}e^{\frac{1}{2}}$, or exact equivalent free of logarithms	A1	[7]
		(The f.t. is on A, B, C. Give A2√ if there is only one error or omission in the integration; A1√ if two.)		
9	**(a)**	Substitute $w = x + iy$ and state a correct equation in x and y	B1	
		Use $i^2 = -1$ and equate real parts	M1	
		Obtain $y = -2$	A1	
		Equate imaginary parts and solve for x	M1	
		Obtain $x = 2\sqrt{2}$, or equivalent, only	A1	[5]
	(b)	Show a circle with centre 2i	B1	
		Show a circle with radius 2	B1	
		Show half line from –2 at $\frac{1}{4}\pi$ to real axis	B1	
		Shade the correct region	B1	
		Carry out a complete method for calculating the greatest value of $\lvert z \rvert$	M1	
		Obtain answer 3.70	A1	[6]
10	**(i)**	Carry out a correct method for finding a vector equation for AB	M1	
		Obtain $\mathbf{r} = 2\mathbf{i} - 3\mathbf{j} + 2\mathbf{k} + \lambda(3\mathbf{i} + \mathbf{j} - \mathbf{k})$ or $\mathbf{r} = \mu(2\mathbf{i} + 3\mathbf{j} + 2\mathbf{k}) + (1 - \mu)(5\mathbf{i} - 2\mathbf{j} + \mathbf{k})$, or equivalent	A1	
		Substitute components in equation of p and solve for λ or for μ	M1	
		Obtain $\lambda = \frac{3}{2}$ or $\mu = -\frac{1}{2}$ and final answer $\frac{13}{2}\mathbf{i} - \frac{3}{2}\mathbf{j} + \frac{1}{2}\mathbf{k}$, or equivalent	A1	[4]
	(ii)	Either equate scalar product of direction vector of AB and normal to q to zero or substitute for A and B in the equation of q and subtract expressions	M1*	
		Obtain $3 + b - c = 0$, or equivalent	A1	
		Using the correct method for the moduli, divide the scalar product of the normals to p and q by the product of their moduli and equate to $\pm\frac{1}{2}$, or form horizontal equivalent	M1*	
		Obtain correct equation in any form, e.g. $\frac{1+b}{\sqrt{(1+b^2+c^2)}\sqrt{(1+1)}} = \pm\frac{1}{2}$	A1	
		Solve simultaneous equations for b or for c	M1 (dep*)	
		Obtain $b = -4$ and $c = -1$	A1	
		Use a relevant point and obtain final answer $x - 4y - z = 12$, or equivalent	A1√	[7]
		(The f.t. is on b and c.)		