1	Rearrange as $e^{2x} - e^x - 6 = 0$, or $u^2 - u - 6 = 0$, or equivalent		B1	
	Solve a 3-term quadratic for e^x or for u		M1	
	Obtain simplified solution $e^x = 3$ or $u = 3$		A1	
	Obtain final answer $x = 1.10$ and no other		A1	[4]
2	*EITHER*:	Use chain rule	M1	
		obtain $\frac{dx}{dt} = 6\sin t\cos t$, or equivalent	A1	
		obtain $\frac{dy}{dt} = -6\cos^2 t\sin t$, or equivalent	A1	
		Use $\frac{dy}{dx} = \frac{dy}{dt} \div \frac{dx}{dt}$	M1	
		Obtain final answer $\frac{dy}{dx} = -\cos t$	A1	
	OR:	Express y in terms of x and use chain rule	M1	
		Obtain $\frac{dy}{dx} = k(2 - \frac{x}{3})^{\frac{1}{2}}$, or equivalent	A1	
		Obtain $\frac{dy}{dx} = -(2 - \frac{x}{3})^{\frac{1}{2}}$, or equivalent	A1	
		Express derivative in terms of t	M1	
		Obtain final answer $\frac{dy}{dx} = -\cos t$	A1	[5]
3	**(i)** *EITHER*:	Attempt division by $x^2 - x + 1$ reaching a partial quotient of $x^2 + kx$	M1	
		Obtain quotient $x^2 + 4x + 3$	A1	
		Equate remainder of form lx to zero and solve for a, or equivalent	M1	
		Obtain answer $a = 1$	A1	
	OR:	Substitute a complex zero of $x^2 - x + 1$ in p(x) and equate to zero	M1	
		Obtain a correct equation in a in any unsimplified form	A1	
		Expand terms, use $i^2 = -1$ and solve for a	M1	
		Obtain answer $a = 1$	A1	[4]
	[SR: The first M1 is earned if inspection reaches an unknown factor $x^2 + Bx + C$ and an equation in B and/or C, or an unknown factor $Ax^2 + Bx + 3$ and an equation in A and/or B. The second M1 is only earned if use of the equation $a = B - C$ is seen or implied.]			
	(ii)	State answer, e.g. $x = -3$	B1	
		State answer, e.g. $x = -1$ and no others	B1	[2]
4	Separate variables and attempt integration of at least one side		M1	
	Obtain term $\ln(x + 1)$		A1	
	Obtain term $k \ln \sin 2\theta$, where $k = \pm 1, \pm 2$, or $\pm \frac{1}{2}$		M1	
	Obtain correct term $\frac{1}{2} \ln \sin 2\theta$		A1	
	Evaluate a constant, or use limits $\theta = \frac{1}{12}\pi$, $x = 0$ in a solution containing terms $a \ln(x + 1)$ and $b \ln \sin 2\theta$		M1	
	Obtain solution in any form, e.g. $\ln(x + 1) = \frac{1}{2}\ln\sin 2\theta - \frac{1}{2}\ln\frac{1}{2}$ (f.t. on $k = \pm 1, \pm 2$, or $\pm \frac{1}{2}$)		A1√	
	Rearrange and obtain $x = \sqrt{(2\sin 2\theta)} - 1$, or simple equivalent		A1	[7]

5	**(i)**	Make recognisable sketch of a relevant graph over the given interval	B1	
		Sketch the other relevant graph and justify the given statement	B1	[2]
	(ii)	Consider the sign of sec $x - (3 - \frac{1}{2}x^2)$ at $x = 1$ and $x = 1.4$, or equivalent	M1	
		Complete the argument with correct calculated values	A1	[2]
	(iii)	Convert the given equation to sec $x = 3 - \frac{1}{2}x^2$ or work *vice versa*	B1	[1]
	(iv)	Use a correct iterative formula correctly at least once	M1	
		Obtain final answer 1.13	A1	
		Show sufficient iterations to 4 d.p. to justify 1.13 to 2 d.p., or show there is a sign change in the interval (1.125, 1.135)	A1	[3]
		[SR: Successive evaluation of the iterative function with $x = 1, 2, \ldots$ scores M0.]		
6	**(i)**	State or imply $R = \sqrt{10}$	B1	
		Use trig formulae to find α	M1	
		Obtain $\alpha = 71.57°$ with no errors seen	A1	[3]
		[Do not allow radians in this part. If the only trig error is a sign error in $\cos(x - \alpha)$ give M1A0]		
	(ii)	Evaluate $\cos^{-1}(2/\sqrt{10})$ correctly to at least 1 d.p. (50.7684…°) (Allow 50.7° here)	B1√	
		Carry out an appropriate method to find a value of 2θ in $0° < 2\theta < 180°$	M1	
		Obtain an answer for θ in the given range, e.g. $\theta = 61.2°$	A1	
		Use an appropriate method to find another value of 2θ in the above range	M1	
		Obtain second angle, e.g. $\theta = 10.4°$, and no others in the given range	A1	[5]
		[Ignore answers outside the given range.]		
		[Treat answers in radians as a misread and deduct A1 from the answers for the angles.]		
		[SR: The use of correct trig formulae to obtain a 3-term quadratic in tan θ, sin 2θ, cos 2θ,or tan 2θ earns M1; then A1 for a correct quadratic, M1 for obtaining a value of θ in the given range, and A1 + A1 for the two correct answers (candidates who square must reject the spurious roots to get the final A1).]		

7 (i) Use a correct method to express $\overrightarrow{OP}$ in terms of λ — M1
Obtain the given answer — A1 [2]

(ii) *EITHER*: Use correct method to express scalar product of $\overrightarrow{OA}$ and $\overrightarrow{OP}$, or $\overrightarrow{OB}$ and $\overrightarrow{OP}$ in terms of λ — M1
Using the correct method for the moduli, divide scalar products by products of moduli and express cos AOP = cos BOP in terms of λ, or in terms of λ and OP — M1*

OR1: Use correct method to express $OA^2 + OP^2 - AP^2$, or $OB^2 + OP^2 - BP^2$ in terms of λ — M1
Using the correct method for the moduli, divide each expression by twice the product of the relevant moduli and express cos AOP = cos BOP in terms of λ, or λ and OP — M1*

Obtain a correct equation in any form, e.g. $\dfrac{9+2\lambda}{3\sqrt{(9+4\lambda+12\lambda^2)}} = \dfrac{11+14\lambda}{5\sqrt{(9+4\lambda+12\lambda^2)}}$ — A1

Solve for λ — M1(dep*)
Obtain $\lambda = \frac{3}{8}$ — A1 [5]

[SR: The M1* can also be earned by equating cos AOP or cos BOP to a sound attempt at cos $\frac{1}{2}$ AOB and obtaining an equation in λ. The exact value of the cosine is $\sqrt{(13/15)}$, but accept non-exact working giving a value of λ which rounds to 0.375, provided the spurious negative root of the quadratic in λ is rejected.]

[SR: Allow a solution reaching $\lambda = \frac{3}{8}$ after cancelling identical incorrect expressions for OP to score 4/5. The marking will run M1M1A0M1A1, or M1M1A1M1A0 in such cases.]

(iii) Verify the given statement correctly — B1 [1]

8 (i) Use any relevant method to determine a constant — M1
Obtain one of the values $A = 3$, $B = 4$, $C = 0$ — A1
Obtain a second value — A1
Obtain the third value — A1 [4]

(ii) Integrate and obtain term $-3\ln(2-x)$ — B1√
Integrate and obtain term $k\ln(4+x^2)$ — M1
Obtain term $2\ln(4+x^2)$ — A1√
Substitute correct limits correctly in a complete integral of the form $a\ln(2-x) + b\ln(4+x^2)$, $ab \neq 0$ — M1
Obtain given answer following full and correct working — A1 [5]

9	**(i)**	Use product rule	M1	
		Obtain correct derivative in any form	A1	
		Equate derivative to zero and solve for x	M1	
		Obtain answer $x = e^{-\frac{1}{2}}$, or equivalent	A1	
		Obtain answer $y = -\frac{1}{2}e^{-1}$, or equivalent	A1	[5]
	(ii)	Attempt integration by parts reaching $kx^3 \ln x \pm k \int x^3 . \frac{1}{x} dx$	M1*	
		Obtain $\frac{1}{3}x^3 \ln x - \frac{1}{3}\int x^2\, dx$, or equivalent	A1	
		Integrate again and obtain $\frac{1}{3}x^3 \ln x - \frac{1}{9}x^3$, or equivalent	A1	
		Use limits $x = 1$ and $x = e$, having integrated twice	M1(dep*)	
		Obtain answer $\frac{1}{9}(2e^3 + 1)$, or exact equivalent	A1	[5]
		[SR: An attempt reaching $ax^2(x \ln x - x) + b\int 2x(x \ln x - x)\, dx$ scores M1. Then give the first A1 for $I = x^2(x \ln x - x) - 2I + \int 2x^2\, dx$, or equivalent.]		

10	**(a)**	*EITHER*:	Square $x + iy$ and equate real and imaginary parts to 1 and $-2\sqrt{6}$ respectively	M1*	
			Obtain $x^2 - y^2 = 1$ and $2xy = -2\sqrt{6}$	A1	
			Eliminate one variable and find an equation in the other	M1(dep*)	
			Obtain $x^4 - x^2 - 6 = 0$ or $y^4 + y^2 - 6 = 0$, or 3-term equivalent	A1	
			Obtain answers $\pm(\sqrt{3} - i\sqrt{2})$	A1	[5]
		OR:	Denoting $1 - 2\sqrt{6}i$ by $R\text{cis}\theta$, state, or imply, square roots are $\pm\sqrt{R}\text{cis}(\frac{1}{2}\theta)$ and find values of R and either $\cos\theta$ or $\sin\theta$ or $\tan\theta$	M1*	
			Obtain $\pm\sqrt{5}(\cos\frac{1}{2}\theta + i\sin\frac{1}{2}\theta)$, and $\cos\theta = \frac{1}{5}$ or $\sin\theta = -\frac{2\sqrt{6}}{5}$ or $\tan\theta = -2\sqrt{6}$	A1	
			Use correct method to find an exact value of $\cos\frac{1}{2}\theta$ or $\sin\frac{1}{2}\theta$	M1(dep*)	
			Obtain $\cos\frac{1}{2}\theta = \pm\sqrt{\frac{3}{5}}$ and $\sin\frac{1}{2}\theta = \pm\sqrt{\frac{2}{5}}$, or equivalent	A1	
			Obtain answers $\pm(\sqrt{3} - i\sqrt{2})$, or equivalent	A1	
			[Condone omission of ± except in the final answers.]		
	(b)		Show point representing 3i on a sketch of an Argand diagram	B1	
			Show a circle with centre at the point representing 3i and radius 2	B1√	
			Shade the interior of the circle	B1√	
			Carry out a complete method for finding the greatest value of arg z	M1	
			Obtain answer 131.8° or 2.30 (or 2.3) radians	A1	[5]
			[The f.t. is on solutions where the centre is at the point representing –3i.]		