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 $\dfrac{dx}{dt} = 6\sin t\cos t$, or equivalent	A1	
	obtain $\dfrac{dy}{dt} = -6\cos^2 t\sin t$, or equivalent	A1	
	Use $\dfrac{dy}{dx} = \dfrac{dy}{dt} \div \dfrac{dx}{dt}$	M1	
	Obtain final answer $\dfrac{dy}{dx} = -\cos t$	A1	
	OR: Express y in terms of x and use chain rule	M1	
	Obtain $\dfrac{dy}{dx} = k(2 - \dfrac{x}{3})^{\frac{1}{2}}$, or equivalent	A1	
	Obtain $\dfrac{dy}{dx} = -(2 - \dfrac{x}{3})^{\frac{1}{2}}$, or equivalent	A1	
	Express derivative in terms of t	M1	
	Obtain final answer $\dfrac{dy}{dx} = -\cos t$	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 $\pm$ 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.]