Question	Answer	Marks
1	Use law for the logarithm of a product, quotient or power	**M1**
	Obtain a correct equation free of logarithms, e.g. $4(x^4 - 4) = x^4$	**A1**
	Solve for x	**M1**
	Obtain answer x = 1.52 only	**A1**
		4

Question	Answer	Marks
2(i)	Use trig formulae and obtain an equation in sin x and cos x	**M1***
	Obtain a correct equation in any form	**A1**
	Substitute exact trig ratios and obtain an expression for tan x	**M1(dep*)**
	Obtain answer $\tan x = \dfrac{-\left(6+\sqrt{6}\right)}{\left(6-\sqrt{2}\right)}$ or equivalent	**A1**
		4
2(ii)	State answer, e.g. 118.5°	**B1**
	State second answer, e.g. 298.5°	**B1ft**
		2

Question	Answer	Marks
3	Use quotient or product rule	**M1**
	Obtain correct derivative in any form	**A1**
	Equate derivative to zero and obtain a quadratic in $\tan\frac{1}{2}x$ or an equation of the form $a \sin x = b$	**M1 ***
	Solve for x	**M1(dep*)**
	Obtain answer 0.340	**A1**
	Obtain second answer 2.802 and no other in the given interval	**A1**
		6

Question	Answer	Marks
4	*EITHER:* Commence division by $x^2 - x + 1$ and reach a partial quotient of the form $x^2 + kx$	M1
	Obtain quotient $x^2 + 3x + 2$	A1
	Either Set remainder identically equal to zero and solve for a or for b, *or* multiply given divisor and found quotient and obtain a or b	M1
	Obtain $a = 1$	A1
	Obtain $b = 2$	A1
	OR: Assume an unknown factor $x^2 + Bx + C$ and obtain an equation in B and/or C	M1
	Obtain $B = 3$ and $A = 2$	A1
	Either Use equations to obtain a or b *or* multiply given divisor and found factor to obtain a or b	M1
	Obtain $a = 1$	A1
	Obtain $b = 2$	A1
		5

Question	Answer	Marks
5(i)	State or imply $dx = -2\cos\theta \sin\theta \, d\theta$, or equivalent	B1
	Substitute for x and dx, and use Pythagoras	M1
	Obtain integrand $\pm 2\cos^2\theta$	A1
	Justify change of limits and obtain given answer correctly	A1
		4
5(ii)	Obtain indefinite integral of the form $a\theta + b\sin 2\theta$	M1*
	Obtain $\theta + \frac{1}{2}\sin 2\theta$	A1
	Use correct limits correctly	M1(dep*)
	Obtain answer $\frac{1}{6}\pi$ with no errors seen	A1
		4

Question	Answer	Marks
6(i)	Separate variables correctly and integrate at least one side	B1
	Obtain term ln x	B1
	Obtain term $-\frac{2}{3}kt\sqrt{t}$, or equivalent	B1
	Evaluate a constant, or use limits $x = 100$ and $t = 0$, in a solution containing terms $a \ln x$ and $bt\sqrt{t}$	M1
	Obtain correct solution in any form, e.g. $\ln x = -\frac{2}{3}kt\sqrt{t} + \ln 100$	A1
		5
6(ii)	Substitute $x = 80$ and $t = 25$ to form equation in k	M1
	Substitute $x = 40$ and eliminate k	M1
	Obtain answer $t = 64.1$	A1
		3

Question	Answer	Marks
7(i)	Use quadratic formula, or completing the square, or the substitution $z = x + iy$ to find a root, using $i^2 = -1$	M1
	Obtain a root, e.g. $-\sqrt{6} - \sqrt{2}i$	A1
	Obtain the other root, e.g. $-\sqrt{6} - \sqrt{2}i$	A1
		3
7(ii)	Represent both roots in relatively correct positions	B1ft
		1
7(iii)	State or imply correct value of a relevant length or angle, e.g. OA, OB, AB, angle between OA or OB and the real axis	B1ft
	Carry out a complete method for finding angle OAB	M1
	Obtain $AOB = 60°$ correctly	A1
		3
7(iv)	Give a complete justification of the given statement	B1
		1

Question	Answer	Marks
8(i)	Integrate by parts and reach $lxe^{-\frac{1}{2}x} + m\int e^{-\frac{1}{2}x}\,dx$	**M1***
	Obtain $-2xe^{-\frac{1}{2}x} + 2\int e^{-\frac{1}{2}x}\,dx$	**A1**
	Complete the integration and obtain $-2xe^{-\frac{1}{2}x} - 4e^{-\frac{1}{2}x}$, or equivalent	**A1**
	Having integrated twice, use limits and equate result to 2	**M1(dep*)**
	Obtain the given equation correctly	**A1**
		5
8(ii)	Calculate values of a relevant expression or pair of expressions at $a = 3$ and $a = 3.5$	**M1**
	Complete the argument correctly with correct calculated values	**A1**
		2
8(iii)	Use the iterative formula $a_{n+1} = 2\ln(a_n + 2)$ correctly at least once	**M1**
	Obtain final answer 3.36	**A1**
	Show sufficient iterations to 4 d.p. to justify 3.36 to 2 d.p., or show there is a sign change in the interval (3.355, 3.365)	**A1**
		3

Question	Answer	Marks
9(i)	State or imply the form $A+\dfrac{B}{x-1}+\dfrac{C}{3x+2}$	**B1**
	State or obtain $A = 4$	**B1**
	Use a correct method to obtain a constant	**M1**
	Obtain one of $B = 3$, $C = -1$	**A1**
	Obtain the other value	**A1**
		5
9(ii)	Use correct method to find the first two terms of the expansion of $(x-1)^{-1}$ or $(3x+2)^{-1}$, or equivalent	**M1**
	Obtain correct unsimplified expansions up to the term in x^2 of each partial fraction	**A1ft + A1ft**
	Add the value of A to the sum of the expansions	**M1**
	Obtain final answer $\dfrac{1}{2}-\dfrac{9}{4}x-\dfrac{33}{8}x^2$	**A1**
		5

Question	Answer	Marks
10(a)	*EITHER*: Find $\overrightarrow{PQ}$ (or $\overrightarrow{QP}$) for a general point Q on l, e.g. $(1+\mu)\,\mathbf{i}+(4+2\mu)\mathbf{j}+(4+3\mu)\mathbf{k}$	**B1**
	Calculate the scalar product of $\overrightarrow{PQ}$ and a direction vector for l and equate to zero	**M1**
	Solve and obtain correct solution e.g. $\mu=-\frac{3}{2}$	**A1**
	Carry out method to calculate PQ	**M1**
	Obtain answer 1.22	**A1**
	*OR*1: Find $\overrightarrow{PQ}$ (or $\overrightarrow{QP}$) for a general point Q on l	**B1**
	Use a correct method to express PQ^2 (or PQ) in terms of μ	**M1**
	Obtain a correct expression in any form	**A1**
	Carry out a complete method for finding its minimum	**M1**
	Obtain answer 1.22	**A1**
	*OR*2: Calling (4, 2, 5) A, state $\overrightarrow{PA}$ (or $\overrightarrow{AP}$) in component form, e.g. $\mathbf{i}+4\mathbf{j}+4\mathbf{k}$	**B1**
	Use a scalar product to find the projection of $\overrightarrow{PA}$ (or $\overrightarrow{AP}$) on l	**M1**
	Obtain correct answer $21/\sqrt{14}$, or equivalent	**A1**
	Use Pythagoras to find the perpendicular	**M1**
	Obtain answer 1.22	**A1**
	*OR*3: State $\overrightarrow{PA}$ (or $\overrightarrow{AP}$) in component form	**B1**
	Calculate vector product of $\overrightarrow{PA}$ and a direction vector for l	**M1**
	Obtain correct answer, e.g. $4\mathbf{i}+\mathbf{j}-2\mathbf{k}$	**A1**
	Divide modulus of the product by that of the direction vector	**M1**
	Obtain answer 1.22	**A1**
		5

Question	Answer	Marks
10(ii)	*EITHER*: Use scalar product to obtain a relevant equation in a, b and c, e.g. $a + 2b + 3c = 0$	**B1**
	Obtain a second relevant equation, e.g. using $\overrightarrow{PA}$ $a + 4b + 4c = 0$, and solve for one ratio	**M1**
	Obtain $a : b : c = 4 : 1 : -2$, or equivalent	**A1**
	Substitute a relevant point and values of a, b, c in general equation and find d	**M1**
	Obtain correct answer, $4x + y - 2z = 8$, or equivalent	**A1**
	*OR*1: Attempt to calculate vector product of relevant vectors, e.g. $(\mathbf{i} + 4\mathbf{j} + 4\mathbf{k}) \times (\mathbf{i} + 2\mathbf{j} + 3\mathbf{k})$	**M1**
	Obtain two correct components	**A1**
	Obtain correct answer, e.g. $4\mathbf{i} + \mathbf{j} - 2\mathrm{k}$	**A1**
	Substitute a relevant point and find d	**M1**
	Obtain correct answer, $4x + y - 2z = 8$, or equivalent	**A1**
	*OR*2: Using a relevant point and relevant vectors form a 2-parameter equation for the plane	**M1**
	State a correct equation, e.g. $\mathbf{r} = 4\mathbf{i} + 2\mathbf{j} + 5\mathbf{k} + \lambda(\mathbf{i} + 4\mathbf{j} + 4\mathbf{k}) + \mu(\mathbf{i} + 2\mathbf{j} + 3\mathbf{k})$	**A1**
	State three correct equations in x, y, z, λ and μ	**A1**
	Eliminate λ and μ	**M1**
	Obtain correct answer $4x + y - 2z = 8$, or equivalent	**A1**
		5