Question	Answer	Marks
1	Express the LHS in terms of either cos x and sin x or in terms of tan x	B1
	Use Pythagoras	M1
	Obtain the given answer	A1
	Total:	**3**
2	*EITHER:* State a correct unsimplified version of the x or x^2 term in the expansion of $\left(1+\frac{2}{3}x\right)^{-3}$ or $(3+2x)^{-3}$ [Symbolic binomial coefficients, e.g. $\begin{pmatrix}-3\\2\end{pmatrix}$, are not sufficient for **M1**.]	(M1
	State correct first term $\frac{1}{27}$	B1
	Obtain term $-\frac{2}{27}x$	A1
	Obtain term $\frac{8}{81}x^2$	A1)
	OR: Differentiate expression and evaluate $f(0)$ and $f'(0)$, where $f'(x)=k(3+2x)^{-4}$	(M1
	State correct first term $\frac{1}{27}$	B1
	Obtain term $-\frac{2}{27}x$	A1
	Obtain term $\frac{8}{81}x^2$	A1)
	Total:	**4**
3	Rearrange as $3u^2+4u-4=0$, or $3e^{2x}+4e^x-4=0$, or equivalent	B1
	Solve a 3-term quadratic for e^x or for u	M1
	Obtain $e^x=\frac{2}{3}$ or $u=\frac{2}{3}$	A1
	Obtain answer $x=-0.405$ and no other	A1
	Total:	**4**

Question	Answer	Marks
4	Integrate by parts and reach $a\theta\cos\frac{1}{2}\theta + b\int\cos\frac{1}{2}\theta\,\mathrm{d}\theta$	*M1
	Complete integration and obtain indefinite integral $-2\theta\cos\frac{1}{2}\theta + 4\sin\frac{1}{2}\theta$	A1
	Substitute limits correctly, having integrated twice	DM1
	Obtain final answer $(4-\pi)/\sqrt{2}$, or exact equivalent	A1
	Total:	**4**
5(i)	Use the chain rule	M1
	Obtain correct derivative in any form	A1
	Use correct trigonometry to express derivative in terms of $\tan x$	M1
	Obtain $\frac{\mathrm{d}y}{\mathrm{d}x} = -\frac{4\tan x}{4+\tan^2 x}$, or equivalent	A1
	Total:	**4**
5(ii)	Equate derivative to –1 and solve a 3–term quadratic for tan x	M1
	Obtain answer x=1.11 and no other in the given interval	A1
	Total:	**2**
6(i)	Calculate the value of a relevant expression or expressions at $x = 2.5$ and at another relevant value, e.g. $x = 3$	M1
	Complete the argument correctly with correct calculated values	A1
	Total:	**2**
6(ii)	State a suitable equation, e.g. $x = \pi + \tan^{-1}\left(1/(1-x)\right)$ without suffices	B1
	Rearrange this as $\cot x = 1 - x$, or commence working *vice versa*	B1
	Total:	**2**
6(iii)	Use the iterative formula correctly at least once	M1
	Obtain final answer 2.576 only	A1
	Show sufficient iterations to 5 d.p. to justify 2.576 to 3 d.p., or show there is a sign change in the interval (2.5755, 2.5765)	A1
	Total:	**3**

Question	Answer	Marks
7(i)	Use correct quotient rule or product rule	**M1**
	Obtain correct derivative in any form	**A1**
	Equate derivative to zero and solve for x	**M1**
	Obtain $x = 2$	**A1**
	Total:	**4**
7(ii)	State or imply ordinates 1.6487…, 1.3591…, 1.4938…	**B1**
	Use correct formula, or equivalent, with $h = 1$ and three ordinates	**M1**
	Obtain answer 2.93 only	**A1**
	Total:	**3**
7(iii)	Explain why the estimate would be less than E	**B1**
	Total:	**1**
8(i)	Justify the given differential equation	**B1**
	Total:	**1**
8(ii)	Separate variables correctly and attempt to integrate one side	**B1**
	Obtain term kt, or equivalent	**B1**
	Obtain term $-\ln(50 - x)$, or equivalent	**B1**
	Evaluate a constant, or use limits $x = 0$, $t = 0$ in a solution containing terms $a\ln(50 - x)$ and bt	**M1***
	Obtain solution $-\ln(50 - x) = kt - \ln 50$, or equivalent	**A1**
	Use $x = 25$, $t = 10$ to determine k	**DM1**
	Obtain correct solution in any form, e.g. $\ln 50 - \ln(50 - x) = \frac{1}{10}(\ln 2)t$	**A1**
	Obtain answer $x = 50(1 - \exp(-0.0693t))$, or equivalent	**A1**
	Total:	**8**

Question	Answer	Marks
9(i)	State or imply the form $\frac{A}{x}+\frac{B}{x^2}+\frac{C}{3x+2}$	B1
	Use a relevant method to determine a constant	M1
	Obtain one of the values $A=3$, $B=-2$, $C=-6$	A1
	Obtain a second value	A1
	Obtain the third value [Mark the form $\frac{Ax+B}{x^2}+\frac{C}{3x+2}$ using same pattern of marks.]	A1
	Total:	**5**
9(ii)	Integrate and obtain terms $3\ln x = \frac{2}{x} - 2\ln(3x+2)$ [The FT is on A, B and C] **Note:** Candidates who integrate the partial fraction $\frac{3x-2}{x^2}$ by parts should obtain $3\ln x + \frac{2}{x} - 3$ or equivalent	B3 FT
	Use limits correctly, having integrated all the partial fractions, in a solution containing terms $a\ln x + \frac{b}{x} + c\ln(3x+2)$	M1
	Obtain the given answer following full and exact working	A1
	Total:	**5**
10(i)	Carry out a correct method for finding a vector equation for AB	M1
	Obtain $\mathbf{r} = \mathbf{i} - 2\mathbf{j} + 2\mathbf{k} + \lambda(2\mathbf{i} + 3\mathbf{j} - \mathbf{k})$, or equivalent	A1
	Equate two pairs of components of general points on AB and l and solve for λ or for μ	M1
	Obtain correct answer for λ or μ, e.g. $\lambda = \frac{5}{7}$ or $\mu = \frac{3}{7}$	A1
	Obtain $m = 3$	A1
	Total:	**5**

Question	Answer	Marks
10(ii)	*EITHER:* Use scalar product to obtain an equation in a, b and c, e.g. $a-2b-4c=0$	(B1
	Form a second relevant equation, e.g. $2a+3b-c=0$ and solve for one ratio, e.g. $a : b$	M1
	Obtain final answer $a : b : c = 14 : -7 : 7$	A1
	Use coordinates of a relevant point and values of a, b and c and find d	M1
	Obtain answer $14x-7y+7z=42$, or equivalent	A1)
	OR 1: Attempt to calculate the vector product of relevant vectors, e.g. $(\mathbf{i}-2\mathbf{j}-4\mathbf{k})\times(2\mathbf{i}+3\mathbf{j}-\mathbf{k})$	(M1
	Obtain two correct components	A1
	Obtain correct answer, e.g. $14\mathbf{i}-7\mathbf{j}+7\mathbf{k}$	A1
	Substitute coordinates of a relevant point in $14x-7y+7z=d$, or equivalent, and find d	M1
	Obtain answer $14x-7y+7z=42$, 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. $\mathbf{r}=\mathbf{i}-2\mathbf{j}+2\mathbf{k}+s(\mathbf{i}-2\mathbf{j}-4\mathbf{k})+t(2\mathbf{i}+3\mathbf{j}-\mathbf{k})$	A1
	State 3 correct equations in x, y, z, s and t	A1
	Eliminate s and t	M1
	Obtain answer $2x-y+z=6$, or equivalent	A1)
	OR 3: Using a relevant point and relevant vectors, form a determinant equation for the plane	(M1
	State a correct equation, e.g. $\begin{vmatrix} x-1 & y+2 & z-1 \\ 1 & -2 & -4 \\ 2 & 3 & -1 \end{vmatrix}=0$	A1
	Attempt to expand the determinant	M1
	Obtain or imply two correct cofactors	A1
	Obtain answer $14x-7y+7z=42$, or equivalent	A1)
	Total:	5

Question	Answer	Marks
11(a)	Solve for z or for w	M1
	Use $i^2 = -1$	M1
	Obtain $w = \dfrac{i}{2-i}$ or $z = \dfrac{2+i}{2-i}$	A1
	Multiply numerator and denominator by the conjugate of the denominator	M1
	Obtain $w = -\frac{1}{5} + \frac{2}{5}i$	A1
	Obtain $z = \frac{3}{5} + \frac{4}{5}i$	A1
	Total:	**6**
11(b)	*EITHER:* Find $\pm\left[2 + \left(2 - 2\sqrt{3}\right)i\right]$	(B1
	Multiply by 2i (or –2i)	M1*
	Add result to v	DM1
	Obtain answer $4\sqrt{3} - 1 + 6i$	A1)
	OR: State $\dfrac{z-v}{v-u} = ki$, or equivalent	(M1
	State $k = 2$	A1
	Substitute and solve for z even if i omitted	M1
	Obtain answer $4\sqrt{3} - 1 + 6i$	A1)
	Total:	**4**