Question	Answer	Marks	Guidance
1	Use law of the logarithm of a product or quotient	**M1**	
	Use law of the logarithm of power **twice**	**M1**	
	Obtain a correct linear equation in x, e.g. $(3-2x)\ln 5=\ln 4+x\ln 7$	**A1**	
	Obtain answer $x = 0.666$	**A1**	
		4	

Question	Answer	Marks	Guidance
2	Commence integration and reach $ax^2 \sin 2x + b\int x\sin 2x\,dx$	**M1***	
	Obtain $\frac{1}{2}x^2\sin 2x-\int x\sin 2x\,dx$, or equivalent	**A1**	
	Complete the integration and obtain $\frac{1}{2}x^2\sin 2x+\frac{1}{2}x\cos 2x-\frac{1}{4}\sin 2x$, or equivalent	**A1**	
	Use limits correctly, having integrated twice	**DM1**	
	Obtain given answer correctly	**A1**	
		5	

Question	Answer	Marks	Guidance
3(i)	Use double angle formulae and express entire fraction in terms of $\sin\theta$ and $\cos\theta$	M1	
	Obtain a correct expression	A1	
	Obtain the given answer	A1	
		3	
3(ii)	State integral of the form $\pm\ln\cos\theta$	M1*	
	Use correct limits correctly and insert exact values for the trig ratios	DM1	
	Obtain a correct expression, e.g. $-\ln\frac{1}{\sqrt{2}} + \ln\frac{\sqrt{3}}{2}$	A1	
	Obtain the given answer following full and exact working	A1	
		4	

Question	Answer	Marks	Guidance
4(i)	Use the quotient or product rule	M1	
	Obtain correct derivative in any form	A1	
	Reduce to $-\frac{2e^{-x}}{\left(1-e^{-x}\right)^2}$, or equivalent, and explain why this is always negative	A1	
		3	

Question	Answer	Marks	Guidance
4(ii)	Equate derivative to – 1 and obtain the given equation	**B1**	
	State or imply $u^2 - 4u + 1 = 0$, or equivalent in e^a	**B1**	
	Solve for a	**M1**	
	Obtain answer $a = \ln\left(2 + \sqrt{3}\right)$ and no other	**A1**	
		4	

Question	Answer	Marks	Guidance
5	Separate variables correctly and integrate at least one side	**B1**	
	Obtain term $\ln(x+1)$	**B1**	
	Obtain term of the form $a\ln\left(y^2 + 5\right)$	**M1**	
	Obtain term $\frac{1}{2}\ln(y^2 + 5)$	**A1**	
	Use $y = 2$, $x = 0$ to determine a constant, or as limits, in a solution containing terms $a\ln(y^2 + 5)$ and $b\ln(x+1)$, where $ab \neq 0$	**M1**	
	Obtain correct solution in any form	**A1**	
	Obtain final answer $y^2 = 9(x+1)^2 - 5$	**A1**	
		7	

Question	Answer	Marks	Guidance
6(i)	State $b = 3$	B1	
		1	
6(ii)	Commence division by $x - b$ and reach partial quotient $x^3 + kx^2$	M1	
	Obtain quotient $x^3 + x^2 + 3x + 2$	A1	There being no remainder
	Equate quotient to zero and rearrange to make the subject a	M1	
	Obtain the given equation	A1	
		4	
6(iii)	Use the iterative formula $a_{n+1} = -\frac{1}{3}\left(2 + a_n^{\ 2} + a_n^{\ 3}\right)$ correctly at least once	M1	
	Obtain final answer –0.715	A1	
	Show sufficient iterations to 5 d.p. to justify –0.715 to 3 d.p., or show there is a sign change in the interval (–0.7145, –0.7155)	A1	
		3	

Question	Answer	Marks	Guidance
7(i)	Use product rule	**M1**	
	Obtain correct derivative in any form	**A1**	
		2	
7(ii)	Equate derivative to zero and use correct $\cos(A+B)$ formula	**M1**	
	Obtain the given equation	**A1**	
		2	
7(iii)	Use correct method to solve for x	**M1**	
	Obtain answer, e.g. $x = \frac{1}{12}\pi$	**A1**	
	Obtain second answer, e.g. $\frac{7}{12}\pi$, and no other	**A1**	
		3	

Question	Answer	Marks	Guidance
8(i)	Multiply numerator and denominator by $1+\sqrt{3}\mathrm{i}$, or equivalent	**M1**	
	$4\mathrm{i} - 4\sqrt{3}$ and $3 + 1$	**A1**	
	Obtain final answer $-\sqrt{3}+\mathrm{i}$	**A1**	
		3	

Question	Answer	Marks	Guidance
8(ii)	State that the modulus of u is 2	B1	
	State that the argument of u is $\frac{5}{6}\pi$ (or 150°)	B1	
		2	
8(iii)	Show a circle with centre the origin and radius 2	B1	
	Show u in a relatively correct position	B1	FT
	Show the perpendicular bisector of the line joining u and the origin	B1	FT
	Shade the correct region	B1	
		4	

Question	Answer	Marks	Guidance
9(i)	State or imply the form $\frac{A}{3+x}+\frac{B}{1-x}+\frac{C}{(1-x)^2}$	B1	
	Use a correct method for finding a constant	M1	
	Obtain one of $A=-3$, $B=-1$, $C=2$	A1	
	Obtain a second value	A1	
	Obtain the third value	A1	Mark the form $\frac{A}{3+x}+\frac{Dx+E}{(1-x)^2}$, where $A=-3$, $D=1$ and $E=1$, B1M1A1A1A1 as above.
		5	
9(ii)	Use a correct method to find the first two terms of the expansion of $(3+x)^{-1}$, $(1+\frac{1}{3}x)^{-1}$, $(1-x)^{-1}$ or $(1-x)^{-2}$	M1	
	Obtain correct unsimplified expansions up to the term in x^3 of each partial fraction	A1	**FT** on A
		A1	**FT** on B
		A1	**FT** on C
	Obtain final answer $\frac{10}{3}x+\frac{44}{9}x^2+\frac{190}{27}x^3$	A1	For the *A*, *D*, *E* form of fractions give M1A1ftA1ft for the expanded partial fractions, then, if $D\neq 0$, M1 for multiplying out fully, and A1 for the final answer.
		5	

Question	Answer	Marks	Guidance
10(i)	Find $\overrightarrow{PQ}$ for a general point Q on l, e.g. $-3\mathbf{i}+6\mathbf{k}+\mu(2\mathbf{i}-\mathbf{j}-2\mathbf{k})$	B1	
	Calculate scalar product of $\overrightarrow{PQ}$ and a direction vector for l and equate the result to zero	M1	
	Solve for μ and obtain $\mu = 2$	A1	
	Carry out a complete method for finding the length of $\overrightarrow{PQ}$	M1	
	Obtain answer 3	A1	
	Alternative method for question 10(i)		
	Calling the point (1, 2, 3) A, state $\overrightarrow{AP}$ (or $\overrightarrow{PA}$) in component form, e.g. $3\mathbf{i} - 6\mathbf{k}$	B1	
	Use a scalar product with a direction vector for l to find the projection of $\overrightarrow{AP}$ (or $\overrightarrow{PA}$) on l	M1	
	Obtain correct answer in any form, e.g. $\frac{18}{\sqrt{9}}$	A1	
	Use Pythagoras to find the perpendicular	M1	
	Obtain answer 3	A1	

Question	Answer	Marks	Guidance
10(i)	**Alternative method for question 10(i)**		
	State $\overrightarrow{AP}$ (or $\overrightarrow{PA}$) in component form	**B1**	
	Calculate a vector product with a direction vector for *l*	**M1**	
	Obtain correct answer, e.g. 6**i** – 6**j** – 3**k**	**A1**	
	Divide modulus of the product by that of the direction vector	**M1**	
	Obtain answer 3	**A1**	
		5	

Question	Answer	Marks	Guidance
10(ii)	Substitute coordinates of a general point of l in the plane equation and equate constant terms	**M1**	
	Obtain a correct equation, e.g. $a + 2b + 6 = 13$	**A1**	
	Equate the coefficient of μ to zero	**M1**	
	Obtain a correct equation, e.g. $2a – b – 4 = 0$	**A1**	
	Substitute (1, 2, 3) in the plane equation	**M1**	
	Obtain a correct equation, e.g. $a + 2b + 6 = 13$	**A1**	
	Alternative method for question 10(ii)		
	Find a second point on l and obtain an equation in a and/or b	**M1**	
	Obtain a correct equation, e.g. $5a – 2 = 13$	**A1**	
	Equate scalar product of a direction vector for l and a vector normal for the plane to zero	**M1**	
	Obtain a correct equation, e.g. $2a – b – 4 = 0$	**A1**	
	Solve for a or for b	**M1**	
	Obtain $a = 3$ and $b = 2$	**A1**	
		6	