Question	Answer	Marks	Guidance
1(i)	Use law for the logarithm of a product or quotient	**M1**	
	Use $\log_{10}100 = 2$ or $10^2 = 100$	**M1**	
	Obtain $x^2 - 4x - 100 = 0$, or equivalent	**A1**	
		3	
1(ii)	Solve a 3-term quadratic equation	**M1**	
	Obtain answer 12.2 only	**A1**	
		2	

Question	Answer	Marks	Guidance
2(i)	Use the iterative formula correctly at least once	**M1**	
	Obtain answer 1.3195	**A1**	
	Show sufficient iterations to 6 d.p. to justify 1.3195 to 4 d.p., or show there is a sign change in (1.31945, 1.31955)	**A1**	
		3	
2(ii)	State $x = \dfrac{2x^6 + 12x}{3x^5 + 8}$, or equivalent	**B1**	
	State answer $\sqrt[5]{4}$, or exact equivalent	**B1**	
		2	

Question	Answer	Marks	Guidance
3(i)	Use trig formulae and obtain an equation in sin θ and cos θ	**M1**	
	Obtain a correct equation in any form	**A1**	
	Substitute exact trig ratios and obtain an expression for tan θ	**M1**	
	Obtain answer $\tan\theta = \dfrac{2\sqrt{2}-1}{1-\sqrt{6}}$, or equivalent	**A1**	
		4	
3(ii)	State answer, e.g. $\theta = 128.4°$	**B1**	
	State second answer, e.g. $\theta = 308.4°$	**B1 ft**	
		2	

Question	Answer	Marks	Guidance
4	Integrate by parts and reach $ax^{-\frac{1}{2}}\ln x + b\int x^{-\frac{1}{2}}.\dfrac{1}{x}\,\mathrm{d}x$	**M1***	
	Obtain $-2x^{-\frac{1}{2}}\ln x + 2\int x^{-\frac{1}{2}}.\dfrac{1}{x}\,\mathrm{d}x$, or equivalent	**A1**	
	Complete the integration, obtaining $-2x^{-\frac{1}{2}}\ln x - 4x^{-\frac{1}{2}}$, or equivalent	**A1**	
	Substitute limits correctly, having integrated twice	**M1(dep*)**	
	Obtain the given answer following full and correct working	**A1**	
		5	

Question	Answer	Marks	Guidance
5	State $\cos y \frac{\mathrm{d}y}{\mathrm{d}x}$ as derivative of $\sin y$	**B1**	
	State correct derivative in terms of x and y, e.g. $\sec^2 x / \cos y$	**B1**	
	State correct derivative in terms of x, e.g. $\frac{\sec^2 x}{\sqrt{1-\tan^2 x}}$	**B1**	
	Use double angle formula	**M1**	
	Obtain the given answer correctly	**A1**	
		5	

Question	Answer	Marks	Guidance
6	Separate variables correctly and attempt integration of at least one side	**B1**	
	Obtain term $-\frac{1}{2y^2}$, or equivalent	**B1**	
	Obtain term $-k\ e^{-x}$	**B1**	
	Use a pair of limits, e.g. $x = 0$, $y = 1$ to obtain an equation in k and an arbitrary constant c	**M1**	
	Use a second pair of limits, e.g. $x = 1$, $y = \sqrt{e}$, to obtain a second equation and solve for k or for c	**M1**	
	Obtain $k = \frac{1}{2}$ and $c = 0$	**A1**	
	Obtain final answer $y = e^{\frac{1}{2}x}$, or equivalent	**A1**	
		7	

Question	Answer	Marks	Guidance
7(a)	Use quadratic formula to solve for z	**M1**	
	Use $i^2 = -1$ throughout	**M1**	
	Obtain correct answer in any form	**A1**	
	Multiply numerator and denominator by 1 – i, or equivalent	**M1**	
	Obtain final answer, e.g. 1 – i	**A1**	
	Obtain second final answer, e.g. $\frac{5}{2}+\frac{1}{2}i$	**A1**	
		6	
7(b)	Show the point representing u in relatively correct position	**B1**	
	Show the horizontal line through $z = i$	**B1**	
	Show correct half-lines from u, one of gradient 1 and the other vertical	**B1ft**	
	Shade the correct region	**B1**	
		4	

Question	Answer	Marks	Guidance
8(i)	State or imply the form $A+\frac{B}{2+x}+\frac{C}{3-2x}$	**B1**	
	Use a correct method for finding a constant	**M1**	
	Obtain one of $A = 2$, $B = -4$ and $C = 6$	**A1**	
	Obtain a second value	**A1**	
	Obtain the third value	**A1**	
		5	
8(ii)	Use correct method to find the first two terms of the expansion of $(2+x)^{-1}$ or $(3-2x)^{-1}$, or equivalent	**M1**	
	Obtain correct unsimplified expansions up to the term in x^2 of each partial fraction	**A1ft +A1ft**	The ft is on B and C
	Add the value of A to the sum of the expansions	**M1**	
	Obtain final answer $2+\frac{7}{3}x+\frac{7}{18}x^2$	**A1**	
		5	

Question	Answer	Marks	Guidance
9(i)	State or imply a correct normal vector to either plane, e.g. $2\mathbf{i} + 3\mathbf{j} - \mathbf{k}$, or $\mathbf{i} - 2\mathbf{j} + \mathbf{k}$	**B1**	
	Carry out correct process for evaluating the scalar product of two normal vectors	**M1**	
	Using the correct process for the moduli, divide the scalar product of the two normal vectors by the product of their moduli and evaluate the inverse cosine of the result	**M1**	
	Obtain answer 56.9° or 0.994 radians	**A1**	
		4	
9(ii)	*EITHER*: Carry out a complete strategy for finding a point on the line (call the line l)	**M1**	
	Obtain such a point, e.g. (1, 1, 4)	**A1**	
	EITHER: State a correct equation for a direction vector $a\mathbf{i} + b\mathbf{j} + c\mathbf{k}$ for l, e.g. $2a + 3b - c = 0$	**B1**	
	State a second equation, e.g. $a - 2b + c = 0$, and solve for one ratio, e.g. $a : b$	**M1**	
	Obtain $a : b : c = 1 : -3 : -7$, or equivalent	**A1**	
	State a correct answer, e.g. $\mathbf{r} = \mathbf{i} + \mathbf{j} + 4\mathbf{k} + \lambda(\mathbf{i} - 3\mathbf{j} - 7\mathbf{k})$	**A1**	
	*OR*1: Attempt to calculate the vector product of the two normal vectors	**M1**	
	Obtain two correct components	**A1**	
	Obtain $\mathbf{i} - 3\mathbf{j} - 7\mathbf{k}$, or equivalent	**A1**	
	State a correct answer, e.g. $\mathbf{r} = \mathbf{i} + \mathbf{j} + 4\mathbf{k} + \lambda(\mathbf{i} - 3\mathbf{j} - 7\mathbf{k})$, or equivalent	**A1**	

Question	Answer	Marks	Guidance
9(ii)	*OR*2: Obtain a second point on l e.g. (0, 4, 11)	**B1**	
	Subtract position vectors and obtain a direction vector for l	**M1**	
	Obtain $\mathbf{i} - 3\mathbf{j} - 7\mathbf{k}$, or equivalent	**A1**	
	State a correct answer, e.g. $\mathbf{r} = 4\mathbf{j} + 11\mathbf{k} + \mu(\mathbf{i} - 3\mathbf{j} - 7\mathbf{k})$, or equivalent	**A1**	
	*OR*3: Express one variable in terms of a second	**M1**	
	Obtain a correct simplified expression, e.g. $y = 4 - 3x$	**A1**	
	Express the third variable in terms of the second	**M1**	
	Obtain a correct simplified expression, e.g. $z = 11 - 7x$	**A1**	
	Form a vector equation for the line	**M1**	
	State a correct answer, e.g. $\mathbf{r} = 4\mathbf{j} + 11\mathbf{k} + \lambda(\mathbf{i} - 3\mathbf{j} - 7\mathbf{k})$, or equivalent	**A1**	
		6	

Question	Answer	Marks	Guidance
9(ii)	*OR*4: Express one variable in terms of a second	**M1**	
	Obtain a correct simplified expression, e.g. $x = \frac{4}{3} - \frac{y}{3}$	**A1**	
	Express the same variable in terms of the third	**M1**	
	Obtain a correct simplified expression, e.g. $x = \frac{11}{7} - \frac{z}{7}$	**A1**	
	Form a vector equation for the line	**M1**	
	Obtain a correct answer, e.g. $\mathbf{r} = 4\mathbf{j} + 11\mathbf{k} + \mu(\mathbf{i} - 3\mathbf{j} - 7\mathbf{k})$, or equivalent	**A1**	
		6	

Question	Answer	Marks	Guidance
10(i)	State or imply $\mathrm{d}u = -\sin x\,\mathrm{d}x$	**B1**	
	Using Pythagoras express the integral in terms of u	**M1**	
	Obtain integrand $\pm\sqrt{u}\left(1-u^2\right)$	**A1**	
	Integrate and obtain $-\frac{2}{3}u^{\frac{3}{2}}+\frac{2}{7}u^{\frac{7}{2}}$, or equivalent	**A1**	
	Change limits correctly and substitute correctly in an integral of the form $au^{\frac{3}{2}}+bu^{\frac{7}{2}}$	**M1**	Or substitute original limits correctly in an integral of the form $a(\cos x)^{\frac{3}{2}} + b(\cos x)^{\frac{7}{2}}$
	Obtain answer $\frac{8}{21}$	**A1**	
		6	
10(ii)	Use product rule and chain rule at least once	**M1**	
	Obtain correct derivative in any form	**A1 + A1**	
	Equate derivative to zero and obtain a horizontal equation in integral powers of $\sin x$ and $\cos x$	**M1**	
	Use correct methods to obtain an equation in one trig function	**M1**	
	Obtain $\tan^2 x = 6$, $7\cos^2 x = 1$ or $7\sin^2 x = 6$, or equivalent, and obtain answer 1.183	**A1**	
		6	