Question	Answer	Marks	Guidance
1	State or imply non-modular inequality $(x+2)^2 > (3x-1)^2$, or corresponding quadratic equation, or pair of linear equations $2(x + 2) = \pm (3x - 1)$	B1	
	Make reasonable attempt at solving a 3-term quadratic, or solve two linear equations for x	M1	
	Obtain critical values $x = -\frac{3}{5}$ and $x = 5$	A1	
	State final answer $-\frac{3}{5} < x < 5$	A1	
	Alternative method for question 1		
	Obtain critical value $x = 5$ from a graphical method, or by inspection, or by solving a linear equation or an inequality	B1	
	Obtain critical value $x = -\frac{3}{5}$ similarly	B2	
	State final answer $-\frac{3}{5} < x < 5$	B1	
		4	

Question	Answer	Marks	Guidance
2	Substitute $x=-\frac{1}{2}$, equate result to zero and obtain a correct equation, e.g. $-\frac{6}{8}+\frac{1}{4}a-\frac{1}{2}b-2=0$	B1	
	Substitute $x = -2$ and equate result to -24	*M1	
	Obtain a correct equation, e.g. $-48+4a-2b-2=-24$	A1	
	Solve for a or for b	DM1	
	Obtain $a = 5$ and $b = -3$	A1	
		5	

Question	Answer	Marks	Guidance
3	Reduce the equation to a horizontal equation in 3^{3x}, 3^{3x+1} or 27^x	M1	
	Simplify and reach $3(3^{3x})=5$, $3\left(27^x\right)=5$, or equivalent	A1	
	Use correct method for finding x from a positive value of 3^{3x}, 3^{3x+1} or 27^x	M1	
	Obtain answer $x = 0.155$	A1	
		4	

Question	Answer	Marks	Guidance
4(i)	Use tan $(A + B)$ formula to express the LHS in terms of tan $2x$ and tan x	**M1**	
	Using the tan $2A$ formula, express the entire equation in terms of tan x	**M1**	
	Obtain a correct equation in tan x in any form	**A1**	
	Obtain the given form correctly	**A1**	AG
		4	
4(ii)	Use correct method to solve the given equation for x	**M1**	
	Obtain answer, e.g. $x = 26.8°$	**A1**	
	Obtain second answer, e.g. $x = 73.7°$ and no other	**A1**	Ignore answers outside the given interval
		3	

Question	Answer	Marks	Guidance
5(i)	Sketch a relevant graph, e.g. $y = \ln(x + 2)$	**B1**	
	Sketch a second relevant graph, e.g. $y = 4e^{-x}$, and justify the given statement	**B1**	Consideration of behaviour for $x < 0$ is needed for the second B1
		2	
5(ii)	Calculate the values of a relevant expression or pair of expressions at $x = 1$ and $x = 1.5$	**M1**	
	Complete the argument correctly with correct calculated values	**A1**	
		2	

Question	Answer	Marks	Guidance
5(iii)	Use the iterative formula correctly at least **twice** using output from a previous iteration	**M1**	
	Obtain final answer 1.23	**A1**	
	Show sufficient iterations to 4 d.p. to justify 1.23 to 2 d.p., or show there is a sign change in the interval (1.225, 1.235)	**A1**	
		3	

Question	Answer	Marks	Guidance
6(i)	Obtain answer $w = \frac{1}{2} + \frac{\sqrt{3}}{2}\mathrm{i}$	**B1**	
		1	
6(ii)	Show point representing u	**B1**	
	Show point representing v in relatively correct position	**B1**	
		2	
6(iii)	Explain why the moduli are equal	**B1**	
	Explain why the arguments are equal	**B1**	
	Use $\mathrm{i}^2 = -1$ and obtain $2uw$ in the given form	**M1**	
	Obtain answer $1 - 2\sqrt{3} + \left(2 + \sqrt{3}\right)\mathrm{i}$	**A1**	
		4	

Question	Answer	Marks	Guidance
7(i)	Substitute coordinates (5, 2, – 2) in $x + 4y - 8z = d$	**M1**	
	Obtain plane equation $x + 4y - 8z = 29$, or equivalent	**A1**	
		2	
7(ii)	Attempt to use perpendicular formula to find perpendicular from (5, 2, – 2) to m	**M1**	
	Obtain a correct unsimplified expression, e.g. $\dfrac{5+8+16-2}{\sqrt{(1+16+64)}}$	**A1**	
	Obtain answer 3	**A1**	
	Alternative method 1 for question 7(ii)		
	State or imply perpendicular from O to m is $\dfrac{2}{9}$ or from O to n is $\dfrac{29}{9}$	**B1**	
	Find difference in perpendiculars	**M1**	
	Obtain answer 3	**A1**	
	Alternative method 2 for question 7(ii)		
	Obtain correct parameter value, or position vector or coordinates of the foot of the perpendicular from (5, 2, – 2) to m, e.g. $\mu = \pm\dfrac{1}{3}$; $\left(\dfrac{14}{3}, \dfrac{2}{3}, \dfrac{2}{3}\right)$	**B1**	
	Calculate the length of the perpendicular	**M1**	
	Obtain answer 3	**B1**	
		3	

Question	Answer	Marks	Guidance
7(iii)	Calling the direction vector $a\mathbf{i} + b\mathbf{j} + c\mathbf{k}$, use a scalar product to form a relevant equation in a, b and c, e.g. $a + 4b - 8c = 0$ or $5a + 2b - 2z = 0$	**B1**	
	Solve two relevant equations for the ratio $a : b : c$	**M1**	
	Obtain $a : b : c = 4 : -19 : -9$	**A1**	OE
	State answer $\mathbf{r} = 5\mathbf{i} + 2\mathbf{j} - 2\mathbf{k} + \lambda(4\mathbf{i} - 19\mathbf{j} - 9\mathbf{k})$	**A1**	OE
	Alternative method for question 7(iii)		
	Attempt to calculate vector product of two relevant vectors, e.g. $(\mathbf{i} + 4\mathbf{j} - 8\mathbf{k})\times(5\mathbf{i} + 2\mathbf{j} - 2k)$	**M1**	
	Obtain two correct components	**A1**	
	Obtain $8\mathbf{i} - 38\mathbf{j} - 18\mathbf{k}$	**A1**	OE
	State answer $\mathbf{r} = 5\mathbf{i} + 2\mathbf{j} - 2\mathbf{k} + \lambda(4\mathbf{i} - 19\mathbf{j} - 9\mathbf{k})$	**A1**	OE
		4	

Question	Answer	Marks	Guidance
8(i)	State or imply ordinates 1, 1.2116…, 2.7597...	**B1**	
	Use correct formula, or equivalent, with $h = 0.6$	**M1**	
	Obtain answer 1.85	**A1**	
		3	
8(ii)	Explain why the rule gives an overestimate	**B1**	
		1	
8(iii)	Differentiate using quotient or chain rule	**M1**	
	Obtain correct derivative in terms of $\sin x$ and $\cos x$	**A1**	
	Equate derivative to 2, use Pythagoras and obtain an equation in $\sin x$	**M1**	
	Obtain $2\sin^2 x + \sin x - 2 = 0$	**A1**	OE
	Solve a 3-term quadratic for x	**M1**	
	Obtain answer $x = 0.896$ only	**A1**	
		6	

Question	Answer	Marks	Guidance
9(i)	Separate variables correctly and integrate one side	**B1**	
	Obtain term $0.2t$, or equivalent	**B1**	
	Carry out a relevant method to obtain A and B such that $\frac{1}{(20-x)(40-x)} \equiv \frac{A}{20-x} + \frac{B}{40-x}$	***M1**	OE
	Obtain $A = \frac{1}{20}$ and $B = -\frac{1}{20}$	**A1**	
	Integrate and obtain terms $-\frac{1}{20}\ln(20-x) + \frac{1}{20}\ln(40-x)$ OE	**A1FT +A1FT**	The FT is on A and B
	Use $x = 10$, $t = 0$ to evaluate a constant, or as limits	**DM1**	
	Obtain correct answer in any form	**A1**	
	Obtain final answer $x = \frac{60e^{4t} - 40}{3e^{4t} - 1}$	**A1**	OE
		9	
9(ii)	State that x approaches 20	**B1**	
		1	

Question	Answer	Marks	Guidance
10(i)	Use product rule and chain rule at least once	M1	
	Obtain correct derivative in any form	A1	
	Equate derivative to zero, use Pythagoras and obtain an equation in cos x	M1	
	Obtain $\cos^2 x + 3\cos x - 1 = 0$, or 3-term equivalent	A1	
	Obtain answer $x = 1.26$	A1	
		5	
10(ii)	Using du = $\pm$ sin x dx express integrand in terms of u and du	M1	
	Obtain integrand $e^u\left(u^2 - 1\right)$	A1	OE
	Commence integration by parts and reach $ae^u\left(u^2-1\right) + b\int ue^u \, du$	*M1	
	Obtain $e^u\left(u^2-1\right) - 2\int ue^u \, du$	A1	OE
	Complete integration, obtaining $e^u\left(u^2 - 2u + 1\right)$	A1	OE
	Substitute limits $u = 1$ and $u = -1$ (or $x = 0$ and $x = \pi$), having integrated completely	DM1	
	Obtain answer $\frac{4}{e}$, or exact equivalent	A1	
		7	