Question	Answer	Marks
1	Use correct logarithm property to produce one term on LHS	**M1**
	Use correct process to obtain equation without logarithms	**M1**
	Obtain $\dfrac{x+1}{x}=4$ or equivalent and hence $x=\dfrac{1}{3}$	**A1**
		3

Question	Answer	Marks
2	Substitute $x=2$ and equate to zero	**M1**
	Substitute $x=-\dfrac{1}{2}$ and equate to zero	**M1**
	Obtain $4a+b+66=0$ and $\dfrac{1}{4}a+b-\dfrac{21}{4}=0$ or equivalents	**A1**
	Solve a relevant pair of linear simultaneous equations (Dependent on at least one M mark)	**DM1**
	Obtain $a=-19,\quad b=10$	**A1**
		5

Question	Answer	Marks
3	State $\dfrac{\mathrm{d}x}{\mathrm{d}t} = \mathrm{e}^t + 2\mathrm{e}^{-t}, \quad \dfrac{\mathrm{d}y}{\mathrm{d}t} = 6\mathrm{e}^{2t}$	B1
	Use $\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{\mathrm{d}y}{\mathrm{d}t} \Big/ \dfrac{\mathrm{d}x}{\mathrm{d}t}$ either in terms of t or after substitution of $t = 0$	*M1
	Obtain gradient of tangent is 2	A1
	Attempt equation of tangent with numerical gradient and coordinates	DM1
	Obtain $y = 2x + 6$ or equivalent	A1
5		5

Question	Answer	Marks
4(a)	Draw two V-shaped graphs with one vertex on negative x-axis and one vertex on positive x-axis	M1
	Draw correct graphs related correctly to each other	A1
	State correct coordinates $-\dfrac{2}{3}a, \ 2a, \ \dfrac{4}{3}a, \ 4a$	A1
3		3
4(b)	Solve linear equation with signs of $3x$ different or solve non-modulus equation $(3x + 2a)^2 = (3x - 4a)^2$	M1
	Obtain $x = \tfrac{1}{3}a$	A1
	Obtain $y = 3a$	A1
3		3

Question	Answer	Marks
4(c)	State $x < \dfrac{1}{3}a$ (**FT** from part **(b)**)	**B1FT**
		1

Question	Answer	Marks
5(a)	Differentiate using the product rule to obtain $ax^2 \cos 2x - bx^3 \sin 2x$	**M1**
	Obtain $3x^2 \cos 2x - 2x^3 \sin 2x$	**A1**
	Equate first derivative to zero and confirm $x = \sqrt[3]{1.5x^2 \cot 2x}$ **AG**	**A1**
		3
5(b)	Consider sign of $x - \sqrt[3]{1.5x^2 \cot 2x}$ or equivalent for 0.59 and 0.60	**M1**
	Obtain $-0.009...$ and $0.005...$ or equivalents and justify conclusion	**A1**
		2
5(c)	Use iteration correctly at least once	**M1**
	Obtain final answer 0.596	**A1**
	Show sufficient iterations to 5 sf to justify answer or show sign change in interval $[0.5955,\ 0.5965]$	**A1**
		3

Question	Answer	Marks
6(a)	Express left-hand side in terms of $\sin\theta$ and $\cos\theta$	**M1**
	Obtain $2\cos\theta - 2\sin\theta$	**A1**
	Attempt to express $a\cos\theta + b\sin\theta$ in $R\cos(\theta + \beta)$ form	**M1**
	Confirm $R = \sqrt{8}$ AG	**A1**
	Carry out necessary trigonometry and confirm $\frac{1}{4}\pi$ AG	**A1**
5		**5**
6(b)	Carry out correct process to find θ from $\cos\left(\theta + \frac{1}{4}\pi\right) = \frac{1}{\sqrt{8}}$	**M1**
	Obtain 0.424	**A1**
2		**2**
6(c)	Express integrand as $\sqrt{8}\cos\left(\frac{1}{2}x + \frac{1}{4}\pi\right)$ or as $2\cos\frac{1}{2}x - 2\sin\frac{1}{2}x$	**B1**
	Integrate to obtain $k\sin\left(\frac{1}{2}x + \frac{1}{4}\pi\right)$ or $k_1\sin\frac{1}{2}x + k_2\cos\frac{1}{2}x$	**M1**
	Obtain correct $2\sqrt{8}\sin\left(\frac{1}{2}x + \frac{1}{4}\pi\right)$ or $4\sin\frac{1}{2}x + 4\cos\frac{1}{2}x$	**A1**
3		**3**

Question	Answer	Marks
7(a)	Carry out division at least as far as $3x^2 + kx$	M1
	Obtain quotient $3x^2 - 4x - 4$	A1
	Confirm remainder is 9 AG	A1
		3
7(b)	Integrate to obtain at least $k_1 x^3$ and $k_2 \ln(3x+2)$ terms	*M1
	Obtain $x^3 - 2x^2 - 4x + 3\ln(3x+2)$ (**FT** from quotient in part **(a)**)	A1FT
	Apply limits correctly	DM1
	Apply appropriate logarithm properties correctly	M1
	Obtain $125 + \ln 64$	A1
		5
7(c)	State or imply $9x^3 - 6x^2 - 20x - 8 = (3x+2)(3x^2 - 4x - 4)$ (**FT** from quotient in part **(a)**)	B1FT
	Attempt to solve cubic eqn to find positive value of x (or of e^{3y})	M1
	Use logarithms to solve equation of form $e^{3y} = k$ where $k > 0$	M1
	Obtain $\dfrac{1}{3}\ln 2$ or exact equivalent	A1
		4