1	Obtain first derivative of form $k_1e^{4x} + \frac{k_2}{2x+3}$		**M1**	
	Obtain correct $12e^{4x} - \frac{12}{2x+3}$		**A1**	
	Obtain 8		**A1**	[3]
2	Use $\cot\theta = 1 \div \tan\theta$		**B1**	
	Form equation involving $\tan\theta$ only and with no denominators involving θ		**M1**	
	Obtain $\tan^2\theta = \frac{2}{7}$		**A1**	
	Obtain 28.1		**A1**	
	Obtain 151.9		**A1**	[5]
	Allow other valid methods			
3	Rearrange to $3e^{2x} - 14e^x + 8 = 0$ or equivalent involving substitution		**B1**	
	Solve quadratic equation in e^x to find two values of e^x		***M1**	
	Obtain $\frac{2}{3}$ and 4		**A1**	
	Use natural logarithms to solve equation of form $e^x = k$ where $k > 0$ dep on		**DM1**	
	Allow M mark if left in exact form		**M1**	
	Obtain -0.405		**A1**	
	Obtain 1.39		**A1**	[6]
4	**(i)** Carry out division, or equivalent, at least as far as $8x^2 + kx$		**M1**	
	Obtain correct quotient $8x^2 + 14x - 15$		**A1**	
	Confirm remainder is 5		**A1**	[3]
	(ii) State or imply expression is $(x+2)(...\text{their quadratic quotient}...)$		**B1**√	
	Attempt factorisation of their quadratic quotient		**M1**	
	Obtain $(x+2)(2x+5)(4x-3)$		**A1**	[3]
	(iii) State $\pm\frac{3}{4}$ and no others, following their 3 linear factors		**B1**√	[1]
5	**(i)** Obtain $\frac{dx}{d\theta} = 2\sec^2\theta$ and $\frac{dy}{d\theta} = 6\cos 2\theta$		**B1**	
	Use $\cos 2\theta = 2\cos^2\theta - 1$ or equivalent		**B1**	
	Form expression for $\frac{dy}{dx}$ in terms of $\cos\theta$		**M1**	
	Confirm $6\cos^4\theta - 3\cos^2\theta$ with no errors seen		**A1**	[4]
	(ii) Equate first derivative to zero and obtain at least $\cos\theta = \pm\frac{1}{\sqrt{2}}$		**B1**	
	Obtain $\theta = \frac{1}{4}\pi$ or equivalent		**B1**	
	Obtain $(2, 3)$		**B1**	[3]
	(iii) State or imply $\theta = \frac{1}{3}\pi$ or equivalent		**B1**	
	Obtain $-\frac{3}{8}$ or equivalent only		**B1**	[2]

6 **(i)** Use quotient rule or equivalent ***M1**

Obtain $\frac{6x(x^2+4)-6x^3}{(x^2+4)^2}$ or equivalent **A1**

Equate first derivative to $\frac{1}{2}$ and remove algebraic denominators dep on *M1 **DM1**

Obtain $48p = p^4 + 8p^2 + 16$ or $48x = x^4 + 8x^2 + 16$ or equivalent **A1**

Confirm given result $p = \sqrt{\frac{48p-16}{p^2+8}}$ **A1** [5]

(ii) Consider sign of $p - \sqrt{\frac{48p-16}{p^2+8}}$ at 2 and 3 or equivalent **M1**

Complete argument correctly with appropriate calculations **A1** [2]

(iii) Carry out iteration process correctly at least once **M1**

Obtain final answer 2.728 **A1**

Show sufficient iterations to justify accuracy to 4 sf or show sign change in interval $(2.7275, 2.7285)$ **B1** [3]

7 **(a)** Rewrite integrand as $\sec^2 2x + \cos^2 2x$ **B1**

Express $\cos^2 2x$ in form $k_1 + k_2 \cos 4x$ **M1**

State correct $\frac{1}{2} + \frac{1}{2}\cos 4x$ **A1**

Integrate to obtain at least terms involving $\tan 2x$ and $\sin 4x$ **M1**

Obtain $\frac{1}{2}\tan 2x + \frac{1}{2}x + \frac{1}{8}\sin 4x$, condoning absence of $+c$ **A1** [5]

(b) Integrate to obtain $2x + 2\ln(3x-2)$ **B1**

Show correct use of $p \ln k = \ln k^p$ law at least once, must be using $\ln(3x-2)$ **M1**

Show correct use of $\ln m - \ln n = \ln \frac{m}{n}$ law, must be using $\ln(3x-2)$ **M1**

Use or imply $20 = \ln(e^{20})$ **B1**

Obtain $\ln(16e^{20})$ **A1** [5]