10 (a)	$x=\dfrac{2y^2+6}{3y-3}\Rightarrow\left(\dfrac{dx}{dy}=\right)\dfrac{4y(3y-3)-3(2y^2+6)}{(3y-3)^2}$	M1 A1
	$\dfrac{dx}{dy}=\dfrac{6y^2-12y-18}{9(y-1)^2}=\dfrac{2y^2-4y-6}{3(y-1)^2}$ o.e	dM1, A1
		(4)
(b)	P and Q are where $\dfrac{dx}{dy}=0$ or where $2y^2-4y-6=0$	B1
	Solves $2y^2-4y-6=0\Rightarrow 2(y-3)(y+1)=0\Rightarrow y=3,-1$	M1
	Subs $y=-1$ and 3 in $x=\dfrac{2y^2+6}{3y-3}\Rightarrow x=..$	dM1
	Achieves $x=-\dfrac{4}{3}$ and $x=4$	A1cso
		(4)
		8 marks

5(a)	$\dfrac{dy}{dx}=\dfrac{(x^2+k)\times\dfrac{2x}{x^2+k}-2x\ln(x^2+k)}{(x^2+k)^2}$	M1
	$\dfrac{dy}{dx}=\dfrac{2x-2x\ln(x^2+k)}{(x^2+k)^2}=\dfrac{2x(1-\ln(x^2+k))}{(x^2+k)^2}$	M1A1
		(3)
(b)	$x=0$	B1
	$"1"-\ln(x^2+k)=0\Rightarrow x^2=e^{"1"}\pm k$	M1
	$x=\pm\sqrt{e-k}$	A1ft
		(3)
(c)	Upper limit is e or $k<e$	B1ft
		(1)
		(7 marks)

Question Number	Scheme	Marks
7	$\left(\dfrac{dy}{dx}=\right)2e^{x^2+(3k-2)x}+2xe^{x^2+(3k-2)x}\times(2x+(3k-2))$	M1A1A1
	$\Rightarrow 2x^2+(3k-2)x+1=0\Rightarrow(3k-2)^2-4\times2\times1$	dM1A1
	$9k^2-12k-4(>0)$	
	$9k^2-12k-4=0\Rightarrow k=\dfrac{12\pm\sqrt{(-12)^2-4\times9\times(-4)}}{2\times9}\Rightarrow k=...$	
	$k<\dfrac{2-2\sqrt{2}}{3}$ or $k>\dfrac{2+2\sqrt{2}}{3}$	M1A1
		(7 marks)

2 (a)	$x = 2y^2 + 5y - 6$	
	$\frac{dx}{dy} = 4y + 5 \Rightarrow \frac{dy}{dx} = \frac{1}{4y+5}$	M1, A1
		(2)
(b)	Sets their $4y + 5 = 0 \Rightarrow y = -\frac{5}{4}$	M1
	Substitutes their $y = -\frac{5}{4}$ into $x = 2y^2 + 5y - 6$ to find x	dM1
	$\left(-\frac{73}{8}, -\frac{5}{4}\right)$	A1
		(3)

	$f(x) = 8\sin x \cos x + 4\cos^2 x - 3$	
4(a)	States or uses $\sin 2x = 2\sin x \cos x$ or $\cos 2x = \pm 2\cos^2 x \pm 1$	M1
	Uses $\sin 2x = 2\sin x \cos x$ and $\cos 2x = \pm 2\cos^2 x \pm 1$ in f (x)	dM1
	$\left(f(x) =\right) 8\sin x \cos x + 4\cos^2 x - 3 = 4\sin 2x + 2\cos 2x - 1$	A1
		(3)
(b)	$R^2 = a^2 + b^2 \Rightarrow R = \sqrt{20}$ or $2\sqrt{5}$	B1ft
	$\tan\alpha = \frac{b}{a} \Rightarrow \alpha = \ldots \left(= \text{"awrt 0.464"}\right)$	M1
	$\left(f(x) =\right) 2\sqrt{5}\sin\left(2x + 0.464\right) - 1$	A1
		(3)
(c)	(i) Maximum value = $\text{"}2\sqrt{5} - 1\text{"}$	B1 ft
	(ii) Solves $2x + \alpha = \frac{5\pi}{2} \Rightarrow x = \ldots$	M1
	$\left(x =\right)$ awrt 3.69 (or $\left(x =\right)$ awrt 3.70)	A1
		(3)
		(9 marks)

2(a)	$R = 25$	B1
	$\tan\alpha = \frac{24}{7} \Rightarrow \alpha = \ldots$	M1
	$\alpha = 1.287$	A1
		(3)
(b)(i)	$\text{Min} = \frac{5}{90 - 3\times\text{"25"}\times(-1)}$	M1
	$= \frac{1}{33}$	A1
(b)(ii)	$\left(2x + \text{"1.287"}\right) = \pi, \ldots \Rightarrow x = \ldots$	M1
	$\Rightarrow x = \frac{\pi - \text{"1.287"}}{2} = 0.927$	A1
		(4)
		Total 7

Question Number	Scheme	Marks
7(a)	$y=\frac{16}{9(3x-k)}=\frac{16}{27x-9k}\Rightarrow\frac{dy}{dx}=-\frac{432}{(27x-9k)^2}$	M1A0
(b)	$-\frac{432}{(27x-9k)^2}=-12\Rightarrow 12(27x-9k)^2=432$	M1
	$12(27x-9k)^2=432\Rightarrow(27x-9k)^2=36\Rightarrow 27-9k=\pm 6\Rightarrow k=...$	**d**M1
	$k=\frac{7}{3},\frac{11}{3}$	A1
(c)	$y=\frac{16}{27-21}$	M1 (B1 on ePEN)
	$y-"\frac{8}{3}"=\frac{1}{12}(x-1)$	**d**M1
	$12y-x-31=0$	A1
(d)	$\int\frac{16}{27x-9k}dx=\frac{16}{27}[\ln(27x-9k)]$	M1
	$=\frac{16}{27}[\ln(27x-21)]$	A1ft
	$\frac{16}{27}[\ln(27x-21)]_1^3=\frac{16}{27}(\ln(27(3)-21)-\ln(27-21))$	**d**M1
	$=\frac{16}{27}\ln(10)$	A1

5.(a)	$\frac{dy}{dx}=-10\sin 2x-24\cos 2x$	M1, A1
	$\left.\frac{dy}{dx}\right\|_{x=\frac{\pi}{3}}=-10\sin\left(\frac{2\pi}{3}\right)-24\cos\left(\frac{2\pi}{3}\right)=-5\sqrt{3}+12$	A1 **(3)**
(b)	$R=13$	B1
	$\tan\alpha=\frac{12}{5}\Rightarrow\alpha=$ awrt 1.176	M1A1 **(3)**
(c)	Sets $-26\sin(2x+1.176)=6$	M1
	$\sin(2x+"1.176")=-\frac{3}{13}$	A1 ft
	$x=\frac{\arcsin\left(-\frac{3}{13}\right)-1.176}{2}=$ awrt 2.44	dM1, A1 **(4)**
		(10 marks)

Question Number	Scheme	Marks
6(i)	$\left(\frac{dy}{dx}=\right)\ \frac{4x}{2x^2+5}$	M1A1
		(2)
(ii)	$\int \frac{21x}{3x^2+k}dx=\frac{7}{2}\ln(3x^2+k)\ \ (+c)$	M1A1
	$\left[\frac{7}{2}\ln(3x^2+k)\right]_1^k<7\ln 8\Rightarrow\frac{7}{2}\ln\left(\frac{3k^2+k}{3+k}\right)<7\ln 8\Rightarrow\frac{3k^2+k}{3+k}<64$	M1
	$\frac{3k^2+k}{3+k}(<)64\Rightarrow 3k^2-63k-192\ \ (<0)\Rightarrow k=...$	dM1
	$k=23$	A1
		(5)
		(7 marks)

1	$3\tan^2\theta+7\sec\theta-3=0\Rightarrow 3\left(\sec^2\theta-1\right)+7\sec\theta-3=0$	M1
	$3\sec^2\theta+7\sec\theta-6=0$	A1
	$(3\sec\theta-2)(\sec\theta+3)=0\Rightarrow\sec\theta=...\Rightarrow\cos\theta=...$	dM1
	$\theta=109.5°,250.5°$	A1, A1
		(5)