Question Number	Scheme	Marks
6 (a)	$y=(4x-7)^{\frac{1}{2}} \Rightarrow \left(\frac{dy}{dx}=\right) 2(4x-7)^{-\frac{1}{2}}$ (see notes)	M1 A1
	At $(8,5)$ gradient of tangent is $2(4\times8-7)^{-\frac{1}{2}}\left(=\frac{2}{5}\right)$	dM1
	Equation for l is $y-5=-\frac{5}{2}(x-8)$	ddM1
	$2y-10=-5x+40 \Rightarrow 5x+2y-50=0$ *	A1*
		(5)
(b)	$\int (4x-7)^{\frac{1}{2}}\,dx=\left[\frac{(4x-7)^{\frac{3}{2}}}{6}\right]$ (see notes)	M1, A1
	Complete area $=\int_{\frac{7}{4}}^{8}(4x-7)^{\frac{1}{2}}\,dx=\left[\frac{(4x-7)^{\frac{3}{2}}}{6}\right]_{\frac{7}{4}}^{8}+5$	dM1
	$=\frac{155}{6}$	A1
		(4)
		(9 marks)

9(a)	$\frac{\cos 2x}{\sin x}+\frac{\sin 2x}{\cos x}=\frac{\cos 2x}{\sin x}+\frac{2\sin x\cos x}{\cos x}$ (One Correct identity)	B1
	$=\frac{1-2\sin^2 x}{\sin x}+\frac{2\sin x\cancel{\cos x}}{\cancel{\cos x}}$	M1
	$=\frac{1}{\sin x}-\frac{2\sin^{\cancel{2}} x}{\cancel{\sin x}}+2\sin x=\frac{1}{\sin x}=\text{cosec } x$ *	A1*
		(3)
(b)	E.g. Equation is $\text{cosec}^2\theta=6\cot\theta-4 \Rightarrow 1+\cot^2\theta=6\cot\theta-4$	M1
	E.g. $\cot^2\theta-6\cot\theta+5=0$	A1
	E.g. $\tan\theta=\frac{1}{5},1$	dM1
	$\theta=0.197,\frac{\pi}{4}$	A1, A1
		(5)
(c)	$\int_{\frac{\pi}{6}}^{\frac{\pi}{4}}\text{cosec}x\cot x\,dx=\left[-\text{cosec}x\right]_{\frac{\pi}{6}}^{\frac{\pi}{4}}$	M1
	$=2-\sqrt{2}$	A1
		(2)
		10 marks

6. (a)	$\mathrm{f}'(x) = 6(2x-3)^2\,\mathrm{e}^{4x-2} + 4(2x-3)^3\,\mathrm{e}^{4x-2}$	M1 A1
	$= 2(2x-3)^2\,\mathrm{e}^{4x-2}\{3+2(2x-3)\} = 2(4x-3)(2x-3)^2\,\mathrm{e}^{4x-2}$	dM1 A1
		(4)
(b) (i)	$x = \frac{3}{2}, \frac{3}{4}$	B1 ft
(ii)	Attempts $\mathrm{f}\left(\frac{3}{4}\right) = \left(-\frac{3}{2}\right)^3 \mathrm{e}^1 = -\frac{27}{8}\mathrm{e}, \Rightarrow \mathrm{g}\left(\frac{3}{4}\right) = -27\mathrm{e}$	M1, A1
	$-27\mathrm{e}$ „ $\mathrm{g}(x)$ „ 0g g ς	A1
		(4) **(8 marks)**

8. (a)	$\mathrm{f}'(x) = 6(2x+1)^2\,\mathrm{e}^{-4x} - 4(2x+1)^3\,\mathrm{e}^{-4x}$	M1 A1
	$= 2(2x+1)^2\,\mathrm{e}^{-4x}\{3-2(2x+1)\}$	dM1
	$= 2(2x+1)^2(1-4x)\mathrm{e}^{-4x}$	A1
		(4)
(b)	Sets $\mathrm{f}'(x) = 0 \Rightarrow x = -\frac{1}{2}, \frac{1}{4}$	B1
	Either $\mathrm{f}\left(\text{"}-\frac{1}{2}\text{"}\right) = \ldots$ or $\mathrm{f}\left(\text{"}\frac{1}{4}\text{"}\right) = \ldots$	M1
	Both $\left(-\frac{1}{2}, 0\right)$ and $\left(\frac{1}{4}, \frac{27}{8\mathrm{e}}\right)$	A1
		(3)
(c)	$\left(\frac{9}{4}, \frac{27}{\mathrm{e}}\right)$	B1ft B1ft
		(2) **9 marks**

10 (a)	$x = \frac{2y^2+6}{3y-3} \Rightarrow \left(\frac{\mathrm{d}x}{\mathrm{d}y} = \right)\frac{4y(3y-3)-3(2y^2+6)}{(3y-3)^2}$	M1 A1
	$\frac{\mathrm{d}x}{\mathrm{d}y} = \frac{6y^2-12y-18}{9(y-1)^2} = \frac{2y^2-4y-6}{3(y-1)^2}$ o.e	dM1, A1
		(4)
(b)	P and Q are where $\frac{\mathrm{d}x}{\mathrm{d}y} = 0$ 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 $x = \frac{2y^2+6}{3y-3} \Rightarrow x = ..$	dM1
	Achieves $x = -\frac{4}{3}$ and $x = 4$	A1cso
		(4) **8 marks**

7(a)	$\mathrm{f}(0)=(0-3)^2=9$	M1
	$0\leqslant \mathrm{f}(x)\leqslant 9$	A1
		(2)
(b)	$\mathrm{f}'(x)=-2x\mathrm{e}^{-x^2}(2x^2-3)^2+\mathrm{e}^{-x^2}\times 8x(2x^2-3)$	M1A1
	$=2x(2x^2-3)\mathrm{e}^{-x^2}\left(-(2x^2-3)+4\right)=2x\mathrm{e}^{-x^2}(2x^2-3)\left(7-2x^2\right)$	dM1A1
		(4)
(c)	$x^2=\frac{3}{2},\frac{7}{2}\Rightarrow \mathrm{f}\left(\sqrt{\frac{7}{2}}\right)=\mathrm{e}^{-\frac{7}{2}}\left(2\times\frac{7}{2}-3\right)^2=16\mathrm{e}^{-\frac{7}{2}}$	M1A1
	$16\mathrm{e}^{-\frac{7}{2}}<k<9$	dM1A1
		(4)

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

9 (a)	$(k=)\ 4\sin^2\left(\frac{\pi}{3}\right)-1=2\quad *$	B1*
		(1)
(b)	(i) $x=4\sin^2 y-1\Rightarrow \frac{\mathrm{d}x}{\mathrm{d}y}=8\sin y\cos y$ o.e.	M1 A1
	(ii) Attempts either $\sin^2 y=\frac{\pm x\pm 1}{4}$ or $\cos^2 y=\pm 1\pm\frac{x+1}{4}$ (both for dM1)	M1 dM1
	$\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{1}{8\sin y\cos y}=\frac{1}{8\times\sqrt{\frac{x+1}{4}}\times\sqrt{\pm 1\pm\frac{x+1}{4}}}=\frac{1}{2\sqrt{x+1}\sqrt{3-x}}\quad *$	ddM1 A1*
		(6)
(c)	At $x=2$, gradient of curve $=\frac{1}{2\sqrt{3}}\Rightarrow$ gradient of normal is $-2\sqrt{3}$	M1
	Point N (base length of triangle) is solution of $\cancel{y}-\frac{\pi}{3}=-2\sqrt{3}\left(x-2\right)\Rightarrow x=2+\frac{\pi}{6\sqrt{3}}$ $(=2.3...)$	dM1
	Area $=\frac{1}{2}\times\left(2+\frac{\pi}{6\sqrt{3}}\right)\times\frac{\pi}{3}=\frac{\pi}{3}+\frac{\pi^2}{36\sqrt{3}}$	A1
		(3)
		(10 marks)

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

10.(a)	$x = 3\cos 2y \Rightarrow \left(\dfrac{dx}{dy} =\right) - 6\sin 2y$	M1 A1
		(2)
(b)	E.g. $\dfrac{dx}{dy} = -6\sqrt{1 - kx^2}$ or $\dfrac{dy}{dx} = \dfrac{1}{\text{their } \dfrac{dx}{dy}}$	M1
	$\dfrac{dy}{dx} = -\dfrac{1}{6\sqrt{1-\cos^2 2y}} = -\dfrac{1}{6\sqrt{1-\left(\dfrac{x}{3}\right)^2}} = -\dfrac{1}{2\sqrt{9-x^2}}$	dM1 A1
		(3)
(c)	Sets $\dfrac{dy}{dx} = -\dfrac{1}{2\sqrt{9-x^2}} = -\dfrac{1}{4}$	
	$x^2 = 5 \Rightarrow a = \sqrt{5}$	M1 A1
	$\sqrt{5} = 3\cos 2y \Rightarrow b = \dfrac{1}{2}\arccos\left(\dfrac{\sqrt{5}}{3}\right)$	dM1 A1
Alt (c)	Sets $\dfrac{dy}{dx} = -\dfrac{1}{6\sin 2y} = -\dfrac{1}{4}$	
	$\Rightarrow \sin 2y = \dfrac{2}{3} \Rightarrow y = \dfrac{1}{2}\arcsin\left(\dfrac{2}{3}\right)$	M1A1
	$x = 3\cos 2y = 3\sqrt{1 - \sin^2\left(\arcsin\dfrac{2}{3}\right)} = \sqrt{5}$	dM1 A1
		(4)
		(9 marks)

Question Number	Scheme	Marks
3. (a)	$\dfrac{dx}{dy}=\dfrac{8y(2y+1)-2(4y^2-3)}{(2y+1)^2}$	M1 A1
	$\dfrac{dy}{dx}=\dfrac{(2y+1)^2}{8y^2+8y+6}$	dM1, A1
		(4)
(b)	Sets $\dfrac{(2y+1)^2}{8y^2+8y+6}=\dfrac{1}{3}\Rightarrow 4y^2+4y-3=0$	M1, A1
	$\Rightarrow (2y-1)(2y+3)=0\Rightarrow y=\dfrac{1}{2}, x=\dots$	dM1
	$P=\left(-1,\ \dfrac{1}{2}\right)$ only	A1
		(4)
		(8 marks)