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

3.	$\frac{dy}{dx}=\frac{4(x+3)^2-2(4x+1)(x+3)}{(x+3)^4}$	M1 A1
	Solves their $4(x+3)^2-2(4x+1)(x+3)=0$ $\Rightarrow (x+3)(10-4x)=0\Rightarrow x=...$	M1
	Critical value of $\frac{5}{2}$; Critical value of -3	A1; B1
	C increasing when $\frac{dy}{dx}>0\Rightarrow -3<x<\frac{5}{2}$	A1
		(6 marks)

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

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

10(a)	$\frac{1}{4} = \sin^2 4y \Rightarrow y = \frac{\pi}{24}$	M1A1
		(2)
(b)	$\frac{dx}{dy} = \underline{8\sin 4y \cos 4y}$	<u>M1A1</u>
		(2)
(c)	$\frac{dx}{dy} = 8\sin 4y \cos 4y \rightarrow \frac{dy}{dx} = \frac{1}{8\sin 4y \cos 4y}$	M1
	$\frac{dy}{dx} = \frac{1}{8\sqrt{x(1-x)}}$	M1
	$\frac{dy}{dx} = \frac{1}{\sqrt{16-64\left(x-\frac{1}{2}\right)^2}}$	A1
		(3)
(d)(i)	$x = \frac{1}{2}$	B1ft
(ii)	$\frac{dy}{dx} = \frac{1}{4}$	B1ft
		(2)
		(9 marks)

9 (a)	$(k=)\ 4\sin^2\left(\frac{\pi}{3}\right)-1=2$ *	B1*
		(1)
(b)	(i) $x=4\sin^2 y-1\Rightarrow \quad \frac{dx}{dy}=8\sin y\cos y$ 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
	$\frac{dy}{dx}=\frac{1}{8\sin y\cos y}=\frac{1}{8\times\sqrt{\frac{x+1}{4}}\times\sqrt{\pm 1\pm\frac{x+1}{4}}}=\frac{1}{2\sqrt{x+1}\sqrt{3-x}}$ *	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 $y-\frac{\pi}{3}=-2\sqrt{3}(x-2)\Rightarrow x=2+\frac{\pi}{6\sqrt{3}}$ $(=2.3...)$	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)

5(a)	$\frac{dy}{dx}=\frac{(x^2+k)\times\frac{2x}{x^2+k}-2x\ln(x^2+k)}{(x^2+k)^2}$	M1
	$\frac{dy}{dx}=\frac{2x-2x\ln(x^2+k)}{(x^2+k)^2}=\frac{2x(1-\ln(x^2+k))}{(x^2+k)^2}$	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)

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)

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