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
	$\Rightarrow 2x^2+(3k-2)x+1=0 \Rightarrow (3k-2)^2-4\times2\times1$	dM1A1
	$9k^2-12k-4(>0)$	
	$9k^2-12k-4=0 \Rightarrow k=\frac{12\pm\sqrt{(-12)^2-4\times9\times(-4)}}{2\times9} \Rightarrow k=\dots$	
	$k<\frac{2-2\sqrt{2}}{3}$ or $k>\frac{2+2\sqrt{2}}{3}$	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)

4(a)	$\frac{49x}{x^2+x-12}+\frac{7x}{x+4}=\frac{49x+7x(x-3)}{(x+4)(x-3)}$ or e.g. $\frac{49x(x+4)}{(x^2+x-12)(x+4)}+\frac{7x(x^2+x-12)}{(x+4)(x^2+x-12)}=\frac{49x(x+4)+7x(x^2+x-12)}{(x+4)(x^2+x-12)}$	M1A1
	$\frac{49x+7x(x-3)}{(x+4)(x-3)}=\frac{49x+7x^2-21x}{(x+4)(x-3)}=\frac{7x^2+28x}{(x+4)(x-3)}$ $=\frac{7x\cancel{(x+4)}}{\cancel{(x+4)}(x-3)}=\frac{7x}{(x-3)}$ *	A1*
		(3)

(b)	$f(x)=\frac{7x}{(x-3)} \Rightarrow f'(x)=\frac{(x-3)\times7-7x\times1}{(x-3)^2}$	M1
	$f(x)=\frac{7x}{(x-3)} \Rightarrow f'(x)=-\frac{21}{(x-3)^2}$	A1
		(2)
(b) ALT	$f(x)=\frac{7x}{(x-3)}=7+\frac{21}{x-3} \Rightarrow f'(x)=-\frac{21}{(x-3)^2}$	M1A1
		Total 5

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

Question Number	Scheme	Marks
9(a)	$y=\sqrt{3+4\mathrm{e}^{x^2}}=\left(3+4\mathrm{e}^{x^2}\right)^{\frac{1}{2}}\Rightarrow\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{1}{2}\left(3+4\mathrm{e}^{x^2}\right)^{-\frac{1}{2}}\times 8x\mathrm{e}^{x^2}$	M1
	$=4x\mathrm{e}^{x^2}\left(3+4\mathrm{e}^{x^2}\right)^{-\frac{1}{2}}$	A1
		(2)
(b)	$\dfrac{\left(3+4\mathrm{e}^{x^2}\right)^{\frac{1}{2}}}{x}=4x\mathrm{e}^{x^2}\left(3+4\mathrm{e}^{x^2}\right)^{-\frac{1}{2}}$	M1
	$\dfrac{\left(3+4\mathrm{e}^{x^2}\right)}{x}=4x\mathrm{e}^{x^2}$	dM1
	$4x^2\mathrm{e}^{x^2}-4\mathrm{e}^{x^2}-3=0$ *	A1*
		(3)
(c)	$\mathrm{f}(x)=4x^2\mathrm{e}^{x^2}-4\mathrm{e}^{x^2}-3\Rightarrow\mathrm{f}(1)=-3$ AND $\mathrm{f}(2)=652\cdot\ldots$	M1
	Change of sign and $\mathrm{f}(x)$ is continuous hence root in (1, 2)	A1
		(2)
(d)	$4x^2\mathrm{e}^{x^2}-4\mathrm{e}^{x^2}-3=0\Rightarrow x^2=\dfrac{4\mathrm{e}^{x^2}+3}{4\mathrm{e}^{x^2}}=\dfrac{4+3\mathrm{e}^{-x^2}}{4}\Rightarrow x=\dfrac{1}{2}\sqrt{4+3\mathrm{e}^{-x^2}}$ *	B1*
		(1)
(e)(i)	$x_1=1\Rightarrow x_2=\dfrac{1}{2}\sqrt{4+3\mathrm{e}^{-1}}$	M1
	$x_3=1.0997$	A1
(ii)	$\alpha=1.1051$	A1
		(3)
		Total 11

Question Number	Scheme	Marks
9. (a)	$\frac{1}{4}$	B1
		(1)
(b)	$f'(x) = \frac{3}{\sqrt{x}}\ln(4x) + 6\sqrt{x} \times \frac{1}{x}$	M1 A1
	Sets $\frac{3}{\sqrt{x}}\ln(4x) + 6\sqrt{x} \times \frac{1}{x} = 0 \Rightarrow \ln(4x) = -2$	dM1
	$Q\left(\frac{1}{4e^2}, -\frac{6}{e}\right)$	A1 A1
		(5)
(c)	Attempts $-2 \times y$ co-ordinate of Q	M1
	Range $g(x) \leqslant \frac{12}{e}$	A1ft
		(2)
		(8 marks)

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

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

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

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 $2(4\times 8-7)^{-\frac{1}{2}}\left(=\frac{2}{5}\right)$	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)

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)