Question Number	Scheme	Marks
3(i)	$\int x^2 e^{2x}\,dx = \frac{1}{2}x^2 e^{2x} - \int x\,e^{2x}\,dx$	M1
	$= \frac{1}{2}x^2 e^{2x} - \left\{\frac{1}{2}xe^{2x} - \int \frac{e^{2x}}{2}\,dx\right\}$	M1
	$= \frac{1}{2}x^2 e^{2x} - \frac{1}{2}xe^{2x} + \frac{e^{2x}}{4}$	A1
	$\int_0^4 x^2 e^{2x}\,dx = \left[\frac{1}{2}x^2 e^{2x} - \frac{1}{2}xe^{2x} + \frac{e^{2x}}{4}\right]_0^4 = 8e^8 - 2e^8 + \frac{e^8}{4} - \frac{1}{4}$	M1
	$= \frac{25e^8}{4} - \frac{1}{4}$	A1
		(5)

(ii)	**1.** $u = 2x-1 \Rightarrow \frac{du}{dx} = 2$ or e.g. $du = 2dx$ **OR** **2.** $u = (2x-1)^2 \Rightarrow \frac{du}{dx} = 4(2x-1)$ or e.g. $du = 4(2x-1)dx$ **OR** **3.** $u = 2x \Rightarrow \frac{du}{dx} = 2$ or e.g. $du = 2dx$	B1
	1. $u = 2x-1 \Rightarrow \int \frac{4x}{(2x-1)^2}\,dx = \int \frac{2u+2}{u^2} \times \frac{1}{2}\,du$ **OR** **2.** $u = (2x-1)^2 \Rightarrow \int \frac{4x}{(2x-1)^2}\,dx = \int \frac{2\sqrt{u}+2}{u} \times \frac{1}{4\sqrt{u}}\,du$ **OR** **3.** $u = 2x \Rightarrow \int \frac{4x}{(2x-1)^2}\,dx = \int \frac{2u}{(u-1)^2} \times \frac{1}{2}\,du$	M1 A1

	1. $\int \left(\frac{1}{u}+\frac{1}{u^2}\right)\mathrm{d}u = \ln u - \frac{1}{u}$ **OR** **2.** $\frac{1}{2}\int \left(\frac{1}{u}+\frac{1}{u^{\frac{3}{2}}}\right)\mathrm{d}u = \frac{1}{2}\ln u - \frac{1}{\sqrt{u}}$ **OR 3.** $\int \frac{u}{(u-1)^2}\,\mathrm{d}u = -u(u-1)^{-1} + \int \frac{1}{u-1}\mathrm{d}u = -u(u-1)^{-1} + \ln(u-1)$	**dM1 A1**
	1. Uses limits $u=5$ to $u=20$: $\left(\ln 20 - \frac{1}{20}\right) - \left(\ln 5 - \frac{1}{5}\right)$ **OR** **2.** Uses limits $u=25$ to $u=400$: $\left(\frac{1}{2}\ln 400 - \frac{1}{20}\right) - \left(\frac{1}{2}\ln 25 - \frac{1}{5}\right)$ **OR** **3.** Uses limits $u=6$ to $u=21$: $\left(\ln 20 - \frac{21}{20}\right) - \left(\ln 5 - \frac{6}{5}\right)$	**M1**
	$= \frac{3}{20} + \ln 4$	**A1**
		(7)
		(12 marks)

Question	Scheme	Marks
4(a)	$16x^3 - 9kx^2y + 8y^3 = 875$	
	$(8)y^3 \to (8\times)3y^2\frac{\mathrm{d}y}{\mathrm{d}x}$	B1
	$-9kx^2y \to \ldots kxy \pm \ldots - 9kx^2\frac{\mathrm{d}y}{\mathrm{d}x}$	M1
	$48x^2 - 18kxy - 9kx^2\frac{\mathrm{d}y}{\mathrm{d}x} + 24y^2\frac{\mathrm{d}y}{\mathrm{d}x} = 0 \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x}(24y^2 - 9kx^2) = 18kxy - 48x^2 \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x} = \ldots$	M1
	$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{6kxy - 16x^2}{8y^2 - 3kx^2}$ *	A1*
		(4)
(b)	$\frac{\mathrm{d}y}{\mathrm{d}x} = 0, x = \frac{5}{2} \Rightarrow \frac{6k\left(\frac{5}{2}\right)y - 16\left(\frac{5}{2}\right)^2}{8y^2 - 3k\left(\frac{5}{2}\right)^2} = 0$ or $x = \frac{5}{2} \Rightarrow 16\left(\frac{5}{2}\right)^3 - 9k\left(\frac{5}{2}\right)^2 y + 8y^3 = 875$	M1
	$15ky - 100 = 0$ or $250 - \frac{225}{4}ky + 8y^3 = 875$	A1
	E.g. $16\left(\frac{5}{2}\right)^3 - 9k\left(\frac{5}{2}\right)^2\left(\frac{20}{3k}\right) + 8\left(\frac{20}{3k}\right)^3 = 875 \Rightarrow k^3 = \ldots \left(= \frac{64}{27}\right) \Rightarrow k = \ldots$	M1
	$k = \frac{4}{3}$	A1
		(4)
		(8 marks)

Question	Scheme	Marks
1	$\int x\cos 3x\,dx = \frac{1}{3}x\sin 3x - \frac{1}{3}\int \sin 3x\,dx$	M1
	$= \frac{1}{3}x\sin 3x + \frac{1}{9}\cos 3x$	dM1 A1
	$\int_0^{\frac{\pi}{6}} x\cos 3x\,dx = \left[\frac{1}{3}x\sin 3x + \frac{1}{9}\cos 3x\right]_0^{\frac{\pi}{6}} = \frac{1}{3}\frac{\pi}{6}\sin\frac{\pi}{2} + \frac{1}{9}\cos\frac{\pi}{2} - \left(0 + \frac{1}{9}\right)$	M1
	$= \frac{\pi}{18} - \frac{1}{9}$	A1
		(5)
		(5 marks)

Question Number	Scheme	Marks
2(a)	$x = 2 \Rightarrow 4 - 8y + y^2 = 13 \Rightarrow (y^2 - 8y - 9 = 0 \Rightarrow) y = \ldots$	M1
	$y = 9$	A1
		(2)
(b)	$2^x \rightarrow 2^x \ln 2$	B1
	$-4xy \rightarrow -4x\frac{dy}{dx} - 4y$ **OR** $y^2 \rightarrow 2y\frac{dy}{dx}$	M1
	$2^x \ln 2 - 4x\frac{dy}{dx} - 4y + 2y\frac{dy}{dx} = 0$	A1
	$\frac{dy}{dx}(2y - 4x) = 4y - 2^x \ln 2 \Rightarrow \frac{dy}{dx} = \ldots$	M1
	$\frac{dy}{dx} = \frac{4y - 2^x \ln 2}{2y - 4x}$ or $\frac{dy}{dx} = \frac{2^x \ln 2 - 4y}{4x - 2y}$ or $\frac{dy}{dx} = \frac{\ln 2 e^{x\ln 2} - 4y}{4x - 2y}$	A1
		(5)
(c)	$(2, 9) \rightarrow \frac{dy}{dx} = \frac{4(9) - 2^2\ln 2}{2(9) - 4(2)}$ $\Rightarrow y - "9" = "\frac{36 - 4\ln 2}{10}"(x - 2)$	M1
	$y = 0 \Rightarrow 0 - "9" = "\frac{36 - 4\ln 2}{10}"(x - 2) \Rightarrow x = \ldots$	dM1
	$x = \frac{4\ln 2 + 9}{2\ln 2 - 18}$ o.e. e.g. $x = \frac{-8\ln 2 - 18}{-4\ln 2 + 36}$.	A1
		(3)
		Total 10

Question	Scheme	Marks
2(a)	$\frac{3x+4}{(x-2)(2x+1)^2}=\frac{A}{x-2}+\frac{B}{2x+1}+\frac{C}{(2x+1)^2}$	
	$3x+4=A(2x+1)^2+B(x-2)(2x+1)+C(x-2)$ E.g. $x=2\rightarrow 10=A\times 25\Rightarrow A=...$ or $x=-\frac{1}{2}\rightarrow\frac{5}{2}=C\times-\frac{5}{2}\Rightarrow C=...$ or $x^2:0=4A+2B, x:3=4A-3B+C, x^0:4=A-2B-2C\rightarrow A=...$	M1
	One of $A=\frac{2}{5}, B=-\frac{4}{5}, C=-1$	A1
	$\Rightarrow A=..., B=...$ and $C=...$	M1
	$\frac{3x+4}{(x-2)(2x+1)^2}=\frac{2}{5(x-2)}-\frac{4}{5(2x+1)}-\frac{1}{(2x+1)^2}$ or $A=\frac{2}{5}, B=-\frac{4}{5}, C=-1$	A1
		(4)
(b)	$\int\frac{p}{x-2}\,dx=\alpha\ln(x-2)$ or $\int\frac{q}{2x+1}\,dx=\beta\ln(2x+1)$ Alt: $\int\frac{8x+9}{(2x+1)^2}\,dx=\int\frac{8x+4}{(2x+1)^2}+\frac{5}{(2x+1)^2}\,dx=\gamma\ln(2x+1)^2+...$	M1
	$\int\frac{k}{(2x+1)^2}\,dx=\frac{K}{2x+1}$	M1
	$\int_7^{12}\frac{3x+4}{(x-2)(2x+1)^2}\,dx=\left[\text{"}\frac{2}{5}\text{"}\ln(x-2)-\text{"}\frac{4}{5}\text{"}\times\frac{1}{2}\ln(2x+1)+\frac{\text{"1"}}{4x+2}\right]_7^{12}$	A1ft
	$=\left(\frac{2}{5}\ln(10)-\frac{2}{5}\ln(25)+\frac{1}{50}\right)-\left(\frac{2}{5}\ln(5)-\frac{2}{5}\ln(15)+\frac{1}{30}\right)=...$	DM1
	$=\frac{2}{5}\ln\frac{10}{25}+\frac{1}{50}-\frac{2}{5}\ln\frac{5}{15}-\frac{1}{30}=\frac{2}{5}\ln\frac{10\times15}{25\times5}+...$	M1
	$\frac{2}{5}\ln\frac{6}{5}-\frac{1}{75}$ (oe)	A1
		(6)
		(10 marks)

Question	Scheme	Marks
4(a)	$(l=)\sqrt{25+r^2}$	B1
		(1)
(b)	$\left(S=\pi r^2+\right)\pi r\sqrt{25+r^2} \Rightarrow \left(\frac{\mathrm{d}S}{\mathrm{d}r}=2\pi r+\right)\underline{\pi\sqrt{25+r^2}+\pi r.\frac{1}{2}\left(25+r^2\right)^{-\frac{1}{2}}.2r}$ Or $\left(S=\pi r^2+\right)\pi\sqrt{25r^2+r^4} \rightarrow \left(\frac{\mathrm{d}S}{\mathrm{d}r}=2\pi r+\right)\underline{\pi.\frac{1}{2}\left(25r^2+r^4\right)^{-\frac{1}{2}}\times\left(50r+4r^3\right)}$	M1 A1
	$\left(S=\pi\left(l^2-25\right)\right)+\pi l\sqrt{l^2-25} \Rightarrow \left(\frac{\mathrm{d}S}{\mathrm{d}l}=2\pi l+\right)\underline{\pi\sqrt{l^2-25}+\pi l.\frac{1}{2}\left(l^2-25\right)^{-\frac{1}{2}}.2l}$	(M1 A1)
	$\frac{\mathrm{d}S}{\mathrm{d}t}=\frac{\mathrm{d}S}{\mathrm{d}r}\times\frac{\mathrm{d}r}{\mathrm{d}t}=..\times 3$	M1
	$=81.5\left(\mathrm{cm}^2/\mathrm{min}\right)$	A1
		(4)
		(5 marks)