Question Number	Scheme	Marks
5 (a)	$y^2 = 2x^2 + 15x + 10y \Rightarrow 2y\frac{dy}{dx} = 4x + 15 + 10\frac{dy}{dx}$	**M1 A1**
	$(2y-10)\frac{dy}{dx} = 4x + 15 \Rightarrow \frac{dy}{dx} = \frac{4x+15}{2y-10}$ oe	**M1, A1**
		(4)
(b)	Deduces that $2y - 10 = 0 \Rightarrow y = 5$	**B1ft**
	Substitutes $y = 5$ into $y^2 = 2x^2 + 15x + 10y \Rightarrow 2x^2 + 15x + 25 = 0$ and solves for x	**M1**
	$(p =) -5, (q =) -\frac{5}{2}$	**A1**
		(3)
		(7 marks)

Question Number	Scheme	Marks
4(i)	$\frac{dV}{dt} = 70\pi$	B1
	$\frac{dV}{dr} = 4\pi r^2$	B1
	$\frac{dV}{dt} = \frac{dV}{dr} \times \frac{dr}{dt} \Rightarrow 70\pi = 4\pi \times 5^2 \times \frac{dr}{dt}$ or e.g. $\frac{dr}{dt} = \frac{dV}{dt} \times \frac{dr}{dV} \Rightarrow \frac{dr}{dt} = 70\pi \times \frac{1}{4\pi \times 5^2}$	M1
	$\left(\frac{dr}{dt}\right) = 0.7\ (\text{cm s}^{-1})$ oe e.g. $\frac{7}{10}$	A1
		(4)
(ii)	$\frac{dh}{dt} = \frac{k}{h^3} \Rightarrow \int h^3\, dh = \int k\, dt \Rightarrow \frac{1}{4}h^4 = kt + c$	M1A1
	$t = 0,\ h = 4 \Rightarrow \frac{1}{4} \times 4^4 = 0 + c \Rightarrow c = 64$	M1
	$t = 5,\ h = 6 \Rightarrow \frac{1}{4} \times 6^4 = k \times 5 + 64 \Rightarrow k = (52)$	dM1
	$h = 10 \Rightarrow \frac{1}{4}(10)^4 = 52T + 64 \Rightarrow T = \ldots$	dddM1
	46.8 (hours) or exact e.g. $\frac{609}{13}, \frac{9744}{208}$	A1
		(6)
		(10 marks)

Question Number	Scheme	Marks
5 (a)	$\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{\mathrm{d}y/\mathrm{d}t}{\mathrm{d}x/\mathrm{d}t}=\frac{16\sec^2 t\tan t}{2\sec^2 t}=8\tan t$	M1 A1
	At $x=3, \tan t=-1 \Rightarrow$ Gradient $=-8$	dM1 A1
		(4)
(b)	Attempts to use $1+\tan^2 t=\sec^2 t \Rightarrow 1+\frac{(x-5)^2}{4}=\frac{y}{8}$	M1 A1
	$y=2(x-5)^2+8$	A1
		(3)
(c)	8„ f„ 32	M1 A1
		(2)
		(9 marks)

Question Number	Scheme	Marks
6(a)	$4y^2+3x=6y\mathrm{e}^{-2x}$	
	$4y^2+3x \to 8y\frac{\mathrm{d}y}{\mathrm{d}x}+3$	B1
	$6y\mathrm{e}^{-2x} \to -12y\mathrm{e}^{-2x}+6\mathrm{e}^{-2x}\frac{\mathrm{d}y}{\mathrm{d}x}$	M1 A1
	$8y\frac{\mathrm{d}y}{\mathrm{d}x}+3=-12y\mathrm{e}^{-2x}+6\mathrm{e}^{-2x}\frac{\mathrm{d}y}{\mathrm{d}x} \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x}=\frac{12y\mathrm{e}^{-2x}+3}{6\mathrm{e}^{-2x}-8y}$ oe	M1 A1
		(5)
(b)	Sets $x=0$ in $4y^2+3x=6y\mathrm{e}^{-2x} \Rightarrow y=\frac{3}{2}$ oe	B1
	Substitutes $\left(0,\frac{3}{2}\right)$ in their $\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{12y\mathrm{e}^{-2x}+3}{6\mathrm{e}^{-2x}-8y}=\left(\frac{7}{-2}\right)$	M1
	$m_N=-1\div"\frac{7}{-2}" \Rightarrow y="\frac{2}{7}"x+"\frac{3}{2}"$	dM1
	$y=\frac{2}{7}x+\frac{3}{2}$ oe e.g. $y=\frac{6}{21}x+\frac{3}{2}$	A1
		(4)
		(9 marks)

Question Number	Scheme	Marks
1	Attempt at chain rule $\quad y^2 \to ...y\frac{\mathrm{d}y}{\mathrm{d}x}$	M1
	Attempt at product rule $\quad 3x^2y \to ...x^2\frac{\mathrm{d}y}{\mathrm{d}x}+...xy$	M1
	Correct differentiation $2-8y\frac{\mathrm{d}y}{\mathrm{d}x}+6xy+3x^2\frac{\mathrm{d}y}{\mathrm{d}x}=8x$	A1
	Substitutes $x=3, y=2 \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x}=-\frac{14}{11}$	M1, A1
	Correct method for normal at $(3,2) \Rightarrow y-2=\frac{11}{14}(x-3)$	dM1
	$11x-14y-5=0$	A1
		(7)
		(7 marks)

Question Number	Scheme	Marks
2(a)	$\dfrac{dV}{dx}=3x^2$	M1 (B1 on EPEN)
	$\dfrac{dx}{dt}=\dfrac{dx}{dV}\times\dfrac{dV}{dt}=\dfrac{5}{3x^2}$	**dM1A1**
		(3)
	Alternative 1	
	$V=x^3\Rightarrow x=V^{\frac{1}{3}}\Rightarrow\dfrac{dx}{dV}=\dfrac{1}{3}V^{-\frac{2}{3}}$	M1 (B1 on EPEN)
	$\dfrac{dx}{dt}=\dfrac{dx}{dV}\times\dfrac{dV}{dt}=\dfrac{5}{3V^{\frac{2}{3}}}=\dfrac{5}{3x^2}$	**dM1A1**
	Alternative 2	
	$\dfrac{dV}{dt}=5\Rightarrow V=5t+c$	M1 (B1 on EPEN)
	$V=x^3\Rightarrow x^3=5t+c\Rightarrow 3x^2\dfrac{dx}{dt}=5$ or $V=x^3\Rightarrow x^3=5t+c\Rightarrow 3x^2=5\dfrac{dt}{dx}$	**dM1**
	$\dfrac{dx}{dt}=\dfrac{5}{3x^2}$	A1
(b)	$\dfrac{dx}{dt}=\dfrac{5}{3\times 4^2}=\dfrac{5}{48}$	M1A1
		(2)
		(5 marks)
	Note this is now being marked as M1dM1A1 not B1M1A1	

Question Number	Scheme	Marks
9 (a)	States or uses $V=\pi\times 4^2\times h\Rightarrow\dfrac{dV}{dh}=16\pi$	B1
	States or uses $\dfrac{dV}{dt}=0.6\pi-0.15\pi h$	B1
	Attempts to use $\dfrac{dV}{dt}=\dfrac{dV}{dh}\times\dfrac{dh}{dt}\Rightarrow 0.6\pi-0.15\pi h=16\pi\times\dfrac{dh}{dt}$	M1
	$\dfrac{dh}{dt}=\dfrac{12-3h}{320}$ *	A1*
		(4)
(b)	$\dfrac{dh}{dt}=\dfrac{12-3h}{320}\Rightarrow\displaystyle\int\frac{dh}{12-3h}=\int\frac{1}{320}\,dt$	
	$-\dfrac{1}{3}\ln(12-3h)=\dfrac{1}{320}t+c$	M1 A1
	Uses $t=0,\ h=0.5$ $\quad -\dfrac{1}{3}\ln\left(\dfrac{21}{2}\right)=c\Rightarrow-\dfrac{1}{3}\ln(12-3h)=\dfrac{1}{320}t-\dfrac{1}{3}\ln\left(\dfrac{21}{2}\right)$	M1 A1
	Substitutes $h=3.5$ $\quad -\dfrac{1}{3}\ln\left(\dfrac{3}{2}\right)=\dfrac{1}{320}t-\dfrac{1}{3}\ln\left(\dfrac{21}{2}\right)\Rightarrow t=\ldots$	dM1
	208 minutes cso	A1
		(6)
		(10 marks)

Question Number	Scheme	Marks
1(a)	$2y^2-3y=7+13 \Rightarrow 2y^2-3y-20=0 \Rightarrow y=...$	M1
	$y=-\frac{5}{2}$ and $y=4$	A1
		(2)
(b)	$2y^2 \to 4y\frac{dy}{dx}$	B1
	$-6xy \to \pm...x\frac{dy}{dx}\pm...y$	M1
	$4y\frac{dy}{dx}-6x\frac{dy}{dx}-6y=14e^{2x-1}$	A1
	$4(4)\frac{dy}{dx}-6\left(\frac{1}{2}\right)\frac{dy}{dx}-6(4)=14e^{2\left(\frac{1}{2}\right)-1} \Rightarrow \frac{dy}{dx}=...$	M1
	$y-"4"="\frac{38}{13}"\left(x-\frac{1}{2}\right)$	M1
	$38x-13y+33=0$	A1
		(6)
		(8 marks)

Question Number	Scheme	Marks
4 (a)	Attempt at chain rule $y^2 \to ...y\frac{dy}{dx}$	M1
	Attempt at product rule $2xy \to \alpha x\frac{dy}{dx}+\beta y$	M1
	Correct differentiation $8x+2y\frac{dy}{dx}-2y-2x\frac{dy}{dx}=24$ oe	A1
	Collects terms in $(2y-2x)\frac{dy}{dx} = 24-8x+2y$	M1
	$\left(\frac{dy}{dx}=\right)\frac{12-4x+y}{y-x}$ oe	A1
		(5)
(b)	Sets $\frac{12-4x+y}{y-x}=2 \Rightarrow y=12-2x$ or $x=6-\frac{1}{2}y$	M1
	Substitute $y=12-2x$ or $x=6-\frac{1}{2}y$ into $4x^2+y^2-2xy=24x$	dM1
	$x^2-8x+12=0$ oe or $y^2-8y=0$	A1
	Solves $x=6, y=0$ or $x=2, y=8$	ddM1
	Chooses $a(x)=2, b(y)=8$ or states $(2,8)$ only	A1
		(5)
		(10 marks)

Question	Scheme	Marks
3(a)	$y^2x+3y=4x^2+k$	
	$y^2x \to ...\times y\dfrac{dy}{dx}(+...)$ or $3y \to 3\dfrac{dy}{dx}$	**M1**
	$y^2x \to 2xy\dfrac{dy}{dx}+y^2$	**A1**
	$...+3y=4x^2+k \to ...+3\dfrac{dy}{dx}=8x$	**A1**
	$2xy\dfrac{dy}{dx}+y^2+3\dfrac{dy}{dx}=8x \Rightarrow \dfrac{dy}{dx}=...$	**dM1**
	$\dfrac{dy}{dx}=\dfrac{8x-y^2}{2xy+3}$ oe	**A1**
		(5)
(b)	$\dfrac{dy}{dx}=0 \Rightarrow 8x-4=0 \Rightarrow x=...$	**M1**
	$p=\dfrac{1}{2}$	**A1**
	$k=2^2\times\dfrac{1}{2}+3\times2-4\times\dfrac{1}{4}=...$	**M1**
	$k=7$	**A1**
		(4)

Question Number	Scheme	Marks
2(a)	States or uses $S=6x^2$ **or** $\dfrac{dS}{dt}=4$	B1
	States or uses $S=6x^2$ **and** $\dfrac{dS}{dt}=4$	B1
	Attempts to use $\dfrac{dS}{dt}=\dfrac{dS}{dx}\times\dfrac{dx}{dt} \Rightarrow 4=12x\times\dfrac{dx}{dt} \Rightarrow \dfrac{dx}{dt}=...$	M1
	$\Rightarrow \dfrac{dx}{dt}=\dfrac{1}{3x}$ oe	A1
		(4)
(b)	States or uses $\dfrac{dV}{dx}=3x^2$	B1
	Attempts to use $\dfrac{dV}{dt}=\dfrac{dV}{dx}\times\dfrac{dx}{dt} \Rightarrow \dfrac{dV}{dt}=3x^2\times\dfrac{1}{3x}=x$	M1
	$\Rightarrow \dfrac{dV}{dt}=V^{\frac{1}{3}}$	A1
		(3)

Question Number	Scheme	Marks
5 (a)	$\underline{\underline{2y\frac{dy}{dx}}}=\underline{e^{-2x}\frac{dy}{dx}-2ye^{-2x}}-3$	B1 M1 A1
	$\left(e^{-2x}-2y\right)\frac{dy}{dx}=2ye^{-2x}+3\Rightarrow\frac{dy}{dx}=\frac{2ye^{-2x}+3}{e^{-2x}-2y}$ *	A1*
		(4)
(b)	Puts $x=0$ into the equation of the curve $\Rightarrow y=y^2\Rightarrow y=1$	B1
	Attempts tangent at $(0,0)$ **or** $(0,1)$ $\quad y=3x$ **or** $y=-5x+1$	M1 A1
	Solves $y=3x$ with $y=-5x+1\Rightarrow R=\left(\frac{1}{8},\frac{3}{8}\right)$	dM1 A1
		(5)
		(9 marks)

Question Number	Scheme	Marks
8(a)	A and B are where $y = 0$ so $t^3 - 9t = 0 \Rightarrow t(t^2 - 9) = 0 \Rightarrow t = 3 \quad (0 \text{ and } -3)$ Substitutes $t = 3$ in $x = 3^2 + 2 \times 3 = 15$ $B\,(15, 0)$ $A = (3, 0)$	M1 A1* B1 **(3)**
8(a) ALT	Uses answer $x = 15$: $t^2 + 2t = 15 \Rightarrow t = 3$ (-5) Substitutes $t = 3$ in $y = t^3 - 9t = 27 - 27 = 0$ ✓ $B\,(15, 0)$ $A = (3, 0)$	M1 A1* B1 **(3)**
(b)	$\frac{dy}{dx} = \frac{dy/dt}{dx/dt} = \frac{3t^2 - 9}{2t + 2}$ Substitutes $t = 3$ into $\frac{dy}{dx} = \frac{3t^2 - 9}{2t + 2} \Rightarrow \frac{dy}{dx} = \frac{9}{4}$ Uses their $\frac{9}{4}$ with $(15, 0)$ to produce tangent equation $9x - 4y - 135 = 0$	M1 A1 dM1 A1 **(4)**
(c)	Substitutes $x = t^2 + 2t,\ y = t^3 - 9t,$ into their $9x - 4y - 135 = 0$ $\Rightarrow 9(t^2 + 2t) - 4(t^3 - 9t) - 135 = 0$ $\Rightarrow 4t^3 - 9t^2 - 54t + 135 = 0$ $\Rightarrow (t^2 - 6t + 9)(4t + 15) = 0$ $t = -\frac{15}{4}$ Coordinates of X are $\left(\frac{105}{16}, -\frac{1215}{64}\right)$	M1 dM1 A1 dM1A1 **(5)** **(12 marks)**

Question Number	Scheme	Marks
2(a)	$x=2\Rightarrow 4-8y+y^2=13\Rightarrow\left(y^2-8y-9=0\Rightarrow\right)y=...$	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
	$\frac{dy}{dx}(2y-4x)=4y-2^x\ln 2\Rightarrow\frac{dy}{dx}=...$	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 $\frac{dy}{dx}=\frac{\ln 2e^{x\ln 2}-4y}{4x-2y}$	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
	$y=0\Rightarrow 0-"9"="\frac{36-4\ln 2}{10}"(x-2)\Rightarrow x=...$	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
3	$8x^3-3y^2+2xy=9$	
	Either $3y^2\rightarrow ky\frac{dy}{dx}$ **or** $2xy\rightarrow\alpha y+\beta x\frac{dy}{dx}$	**M1**
	Both $3y^2\rightarrow ky\frac{dy}{dx}$ **and** $2xy\rightarrow\alpha y+\beta x\frac{dy}{dx}$	**dM1**
	$8x^3-3y^2+2xy=9\rightarrow 24x^2-6y\frac{dy}{dx}+2y+2x\frac{dy}{dx}=0$	**A1**
	$(2,5): 96-30\frac{dy}{dx}+10+4\frac{dy}{dx}=0\Rightarrow\frac{dy}{dx}=...\left(=\frac{53}{13}\right)$	**M1**
	$\frac{dy}{dx}=\frac{53}{13}$ or $\frac{dx}{dy}=\frac{13}{53}$ o.e.	**A1**
	Normal: $y-5="-\frac{13}{53}"\left(x-2\right)$	**M1**
	$13x+53y-291=0$	**A1**
		(7)
		(7 marks)

Question Number	Scheme	Marks
3	$8y\dfrac{dy}{dx} = xe^{-y^2} \rightarrow \int 8ye^{y^2}\,dy = \int x\,dx$	B1
	$4e^{y^2} = \dfrac{x^2}{2}\ (+c)$	M1A1
	$4 = \dfrac{5^2}{2} + c \Rightarrow c = \ldots$	**dM1**
	$y^2 = \ln\left(\dfrac{x^2 - 17}{8}\right)$	A1
		(5 marks)

B1: Separates the variables correctly with some indication of integration

Question Number	Scheme	Marks
2(a)	$2^x \rightarrow 2^x \ln 2$	B1
	$y^2 \rightarrow \ldots y\dfrac{dy}{dx}$	M1
	$4x^2y \rightarrow \ldots x^2\dfrac{dy}{dx} + \ldots xy$	M1
	$3 + 10y\dfrac{dy}{dx} + 4x^2\dfrac{dy}{dx} + 8xy = 10 \times 2^x \ln 2$	A1
	$\left(10y + 4x^2\right)\dfrac{dy}{dx} = 10 \times 2^x \ln 2 - 3 - 8xy \Rightarrow \dfrac{dy}{dx} = \ldots$	M1
	$\dfrac{dy}{dx} = \dfrac{10 \times 2^x \ln 2 - 3 - 8xy}{10y + 4x^2}$	A1
		(6)

2(b)	At $x = 0$ $5y^2 = 45 \Rightarrow y = 3$ $x = 0, y = 3 \Rightarrow \dfrac{dy}{dx} = \dfrac{10 \times 2^0 \ln 2 - 3 - 8 \times 0 \times 3}{10 \times 3 + 4 \times 0^2} = \dfrac{10\ln 2 - 3}{30}$	M1 A1
		(2)

Question	Scheme	Marks
7(a)	$\frac{dx}{dt}=\cos t+6\cos t\sin t \quad \frac{dy}{dt}=3\cos t-2\sin t$	B1B1
	$\frac{dy}{dx}=\frac{dy}{dt}\times\frac{dt}{dx}=\frac{3\cos t-2\sin t}{\cos t+6\cos t\sin t}=\frac{3\cos\pi-2\sin\pi}{\cos\pi+6\cos\pi\sin\pi}=3$ *	M1A1*
		(4)
(b)	When $t=\pi,\ x=-3,\ y=-2$	B1
	$y-"-2"=3(x-"-3")$	M1
	$y=3x+7$	A1
		(3)
(c)	$y=3x+7\Rightarrow 3\sin t+2\cos t=3\left(\sin t-3\cos^2 t\right)+7$ or $y=3\left(x+3\cos^2 t\right)+2\cos t\Rightarrow 3x+7=3x+9\cos^2 t+2\cos t$	M1
	$\Rightarrow 9\cos^2 t+2\cos t-7=0$ *	A1*
		(2)
(d)	$\cos t=\frac{7}{9}$	B1
	$y=3\times\frac{\sqrt{32}}{9}+2\times\frac{7}{9}=\frac{4\sqrt{2}}{3}+\frac{14}{9}$	M1A1
		(3)
		(12 marks)

Question	Scheme	Marks
3	$8x^3-3y^2+2xy=9$	
	Either $3y^2\to ky\frac{dy}{dx}$ **or** $2xy\to\alpha y+\beta x\frac{dy}{dx}$	**M1**
	Both $3y^2\to ky\frac{dy}{dx}$ **and** $2xy\to\alpha y+\beta x\frac{dy}{dx}$	**dM1**
	$8x^3-3y^2+2xy=9\to 24x^2-6y\frac{dy}{dx}+2y+2x\frac{dy}{dx}=0$	**A1**
	$(2,5):96-30\frac{dy}{dx}+10+4\frac{dy}{dx}=0\Rightarrow\frac{dy}{dx}=...\left(=\frac{53}{13}\right)$	**M1**
	$\frac{dy}{dx}=\frac{53}{13}$ or $\frac{dx}{dy}=\frac{13}{53}$ o.e.	**A1**
	Normal: $y-5="-\frac{13}{53}"\left(x-2\right)$	**M1**
	$13x+53y-291=0$	**A1**
		(7)
		(7 marks)

Question Number	Scheme	Marks
5 (a)	$y^2 = 2x^2 + 15x + 10y \Rightarrow 2y\frac{dy}{dx} = 4x + 15 + 10\frac{dy}{dx}$	**M1 A1**
	$(2y-10)\frac{dy}{dx} = 4x + 15 \Rightarrow \frac{dy}{dx} = \frac{4x+15}{2y-10}$ oe	**M1, A1**
		(4)
(b)	Deduces that $2y - 10 = 0 \Rightarrow y = 5$	**B1ft**
	Substitutes $y = 5$ into $y^2 = 2x^2 + 15x + 10y \Rightarrow 2x^2 + 15x + 25 = 0$ and solves for x	**M1**
	$(p=) -5, (q=) -\frac{5}{2}$	**A1**
		(3)
		(7 marks)

Question Number	Scheme	Marks
9(a)(i)	$\frac{dy}{dx} = \frac{dy/dt}{dx/dt} = \frac{3\sin^2 t\cos t}{-4\sin 2t}$	M1A1
	$\frac{3\sin^2 t\cos t}{-4\sin 2t} = \frac{3\sin^2 t\cos t}{-8\sin t\cos t} = -\frac{3}{8}\sin t$ or e.g. $\frac{3\sin^2 t\cos t}{-4\sin 2t} = \frac{\frac{3}{2}\sin 2t\sin t}{-4\sin 2t} = -\frac{3}{8}\sin t$	A1
(ii)	$t = \frac{\pi}{6} \quad \Rightarrow \quad x = 1, \quad y = \frac{1}{8}$	B1
	$m = -\frac{3}{8}\sin\left(\frac{\pi}{6}\right) = -\frac{3}{16} \Rightarrow y - \frac{1}{8} = -\frac{3}{16}(x-1)$	M1
	$3x + 16y - 5 = 0$ *	A1*
		(6)
(b)	$3(2\cos 2t) + 16(\sin^3 t) - 5 = 0$	M1
	$6(1 - 2\sin^2 t) + 16\sin^3 t - 5 = 0$	dM1
	$16\sin^3 t - 12\sin^2 t + 1 = 0$	A1
	$(2\sin t - 1)^2(4\sin t + 1) = 0 \Rightarrow \sin t = -\frac{1}{4}$	ddM1
	$\sin t = -\frac{1}{4} \Rightarrow x = 2\cos 2t = ..$ **and** $y = \sin^3 t = ...$	dddM1
	$Q\left(\frac{7}{4}, -\frac{1}{64}\right)$	A1
		(6)
		(12 marks)

Question Number	Scheme	Marks
1(a)	$2y^2-3y=7+13\Rightarrow 2y^2-3y-20=0\Rightarrow y=...$	M1
	$y=-\frac{5}{2}$ and $y=4$	A1
		(2)
(b)	$2y^2\to 4y\frac{dy}{dx}$	B1
	$-6xy\to \pm...x\frac{dy}{dx}\pm...y$	M1
	$4y\frac{dy}{dx}-6x\frac{dy}{dx}-6y=14e^{2x-1}$	A1
	$4(4)\frac{dy}{dx}-6\left(\frac{1}{2}\right)\frac{dy}{dx}-6(4)=14e^{2\left(\frac{1}{2}\right)-1}\Rightarrow\frac{dy}{dx}=...$	M1
	$y-"4"="\frac{38}{13}"\left(x-\frac{1}{2}\right)$	M1
	$38x-13y+33=0$	A1
		(6)
		(8 marks)

Question Number	Scheme	Marks
2	$\frac{dV}{dt}=\pm k$	B1
	$V=\frac{4}{3}\pi r^3\to\frac{dV}{dr}=4\pi r^2$	B1
	$\pm k=\lambda r^2\times\frac{dr}{dt}$	M1
	$\frac{dr}{dt}=\frac{\pm k}{4\pi r^2}\Rightarrow\frac{dr}{dt}\propto\frac{1}{r^2}$ ✓ *	A1*
		(4 marks)

Question Number	Scheme	Marks
8(a)	A and B are where $y = 0$ so $t^3 - 9t = 0 \Rightarrow t(t^2 - 9) = 0 \Rightarrow t = 3 \quad (0 \text{ and } -3)$ Substitutes $t = 3$ in $x = 3^2 + 2 \times 3 = 15$ $B(15, 0)$ $A = (3,0)$	M1 A1* B1 **(3)**
8(a) ALT	Uses answer $x = 15$: $t^2 + 2t = 15 \Rightarrow t = 3$ (-5) Substitutes $t = 3$ in $y = t^3 - 9t = 27 - 27 = 0$ ✓ $B(15, 0)$ $A = (3,0)$	M1 A1* B1 **(3)**
(b)	$\dfrac{dy}{dx} = \dfrac{dy/dt}{dx/dt} = \dfrac{3t^2 - 9}{2t + 2}$ Substitutes $t = 3$ into $\dfrac{dy}{dx} = \dfrac{3t^2 - 9}{2t + 2} \Rightarrow \dfrac{dy}{dx} = \dfrac{9}{4}$ Uses their $\dfrac{9}{4}$ with $(15,0)$ to produce tangent equation $9x - 4y - 135 = 0$	M1 A1 dM1 A1 **(4)**
(c)	Substitutes $x = t^2 + 2t,\ y = t^3 - 9t,$ into their $9x - 4y - 135 = 0$ $\Rightarrow 9(t^2 + 2t) - 4(t^3 - 9t) - 135 = 0$ $\Rightarrow 4t^3 - 9t^2 - 54t + 135 = 0$ $\Rightarrow (t^2 - 6t + 9)(4t + 15) = 0$ $t = -\dfrac{15}{4}$ Coordinates of X are $\left(\dfrac{105}{16}, -\dfrac{1215}{64}\right)$	M1 dM1 A1 dM1A1 **(5)** **(12 marks)**

Question Number	Scheme	Marks
5(a)	$y^3 - x^2 + 4x^2y = k$	
	$y^3 \to 3y^2\dfrac{dy}{dx}$	M1
	$4x^2y \to 8xy + 4x^2\dfrac{dy}{dx}$	M1
	$y^3 - x^2 + 4x^2y = k \Rightarrow 3y^2\dfrac{dy}{dx} - 2x + 8xy + 4x^2\dfrac{dy}{dx} = 0$	A1
	$\Rightarrow \left(3y^2 + 4x^2\right)\dfrac{dy}{dx} = 2x - 8xy$	M1
	$\Rightarrow \dfrac{dy}{dx} = \dfrac{2x - 8xy}{3y^2 + 4x^2}$	A1
		(5)
(b)	$\dfrac{dy}{dx} = -1$ at P	M1
	Uses $\dfrac{dy}{dx} = \pm 1$ and $y = x$ to set up and solve equation in x, y or 'p' $\Rightarrow -1 = \dfrac{2p - 8p^2}{3p^2 + 4p^2} \Rightarrow p = 2$	M1 A1
	e.g. $k = "2"^3 - "2"^2 + 4 \times "2"^3$	**dd**M1
	$k = 36$	A1
		(5)
		(10 marks)

Question Number	Scheme	Marks
4 (a)	Attempt at chain rule $y^2 \to ...y\frac{dy}{dx}$	M1
	Attempt at product rule $2xy \to \alpha x\frac{dy}{dx} + \beta y$	M1
	Correct differentiation $8x + 2y\frac{dy}{dx} - 2y - 2x\frac{dy}{dx} = 24$ oe	A1
	Collects terms in $(2y-2x)\frac{dy}{dx} = 24 - 8x + 2y$	M1
	$\left(\frac{dy}{dx} = \right) \frac{12 - 4x + y}{y - x}$ oe	A1
		(5)
(b)	Sets $\frac{12-4x+y}{y-x} = 2 \Rightarrow y = 12 - 2x$ or $x = 6 - \frac{1}{2}y$	M1
	Substitute $y = 12 - 2x$ or $x = 6 - \frac{1}{2}y$ into $4x^2 + y^2 - 2xy = 24x$	dM1
	$x^2 - 8x + 12 = 0$ oe or $y^2 - 8y = 0$	A1
	Solves $x = 6, y = 0$ or $x = 2, y = 8$	ddM1
	Chooses $a(x) = 2, b(y) = 8$ or states $(2, 8)$ only	A1
		(5)
		(10 marks)

Question Number	Scheme	Marks
3 (a)	Attempts a correct identity $3x^3+8x^2-3x-6 \equiv (Ax+B)x(x+3)+C(x+3)+Dx$ o.e.	M1
	Correct method for two constants e.g. $x=0, x=-3 \Rightarrow C=..., D=...$	dM1
	Two correct constants e.g. $C=-2$ and $D=2$	A1
	Correct method to find all four constants (e.g. by comparing coefficients)	ddM1
	$A=3, B=-1, C=-2, D=2$	A1
		(5)
(b)	$g(x)=3x-1-\frac{2}{x}+\frac{2}{x+3}$	
	$\Rightarrow g'(x)=3+\frac{2}{x^2}-\frac{2}{(x+3)^2}$	M1 A1ft
		(2)
(c)	Explains that (if $x>0$) $\frac{2}{x^2}>\frac{2}{(x+3)^2}$ so $\frac{2}{x^2}-\frac{2}{(x+3)^2}>0$ and $\Rightarrow g'(x)>3$	B1
		(1)
		(8 marks)
3 (a) ALT	Via division	
	Attempts to divide $3x^3+8x^2-3x-6$ by x^2+3x forming a linear quotient	M1
	Correct method for two constants implied by quotient of $3x+...$	dM1
	Correct quotient $3x-1$	A1
	Correct method to find all four constants (e.g. uses PF on $\frac{rem}{x(x+3)}$)	ddM1
	$A=3, B=-1, C=-2, D=2$	A1
		(5)

Question Number	Scheme	Marks
4 (a)	Attempt at chain rule $y^2 \to \ldots y\frac{dy}{dx}$	M1
	Attempt at product rule $2xy \to \alpha x\frac{dy}{dx} + \beta y$	M1
	Correct differentiation $8x + 2y\frac{dy}{dx} - 2y - 2x\frac{dy}{dx} = 24$ oe	A1
	Collects terms in $(2y-2x)\frac{dy}{dx} = 24 - 8x + 2y$	M1
	$\left(\frac{dy}{dx} = \right) \frac{12-4x+y}{y-x}$ oe	A1
		(5)
(b)	Sets $\frac{12-4x+y}{y-x} = 2 \Rightarrow y = 12-2x$ or $x = 6 - \frac{1}{2}y$	M1
	Substitute $y = 12-2x$ or $x = 6-\frac{1}{2}y$ into $4x^2 + y^2 - 2xy = 24x$	dM1
	$x^2 - 8x + 12 = 0$ oe or $y^2 - 8y = 0$	A1
	Solves $x = 6, y = 0$ or $x = 2, y = 8$	ddM1
	Chooses $a(x) = 2, b(y) = 8$ or states $(2, 8)$ only	A1
		(5)
		(10 marks)

Question	Scheme	Marks
1	E.g $xy^2 \to (\ldots+)2xy\frac{dy}{dx}$ or $x^2y \to (\ldots+)x^2\frac{dy}{dx}$ but see notes.	**M1**
	$xy^2 \to y^2 + kxy\frac{dy}{dx}$ or $x^2y \to kxy + x^2\frac{dy}{dx}$	**dM1**
	$y^2 + 2xy\frac{dy}{dx} = 2xy + x^2\frac{dy}{dx}$ oe	**A1**
	$(x^2-2xy)\frac{dy}{dx} = y^2 - 2xy \Rightarrow \frac{dy}{dx} = \frac{y^2-2xy}{x^2-2xy} \Rightarrow \left.\frac{dy}{dx}\right\|_P = \frac{3^2-12}{2^2-12} = \ldots$ or $3^2 + 2\times2\times3\left.\frac{dy}{dx}\right\|_P = 2\times2\times3 + 2^2\left.\frac{dy}{dx}\right\|_P \Rightarrow \left.\frac{dy}{dx}\right\|_P = \frac{9-12}{4-12} = \ldots$	**M1**
	Tangent is $y - 3 = "\frac{3}{8}"(x-2)$	**dM1**
	$\Rightarrow 3x - 8y + 18 = 0$	**A1**
		(6)
		(6 marks)

Question	Scheme	Marks
3(a)	$\frac{dA}{dt} = -0.5$	B1
	$A = \pi x^2 \Rightarrow \frac{dA}{dx} = 2\pi x$	B1
	$\frac{dx}{dt} = \frac{dA}{dt} \div \frac{dA}{dx} = \frac{"-0.5"}{"2\pi x"} \quad \left(= \frac{-1}{4\pi x}\right)$	M1
	$\frac{dx}{dt} = -0.011368...$	A1cso
		(4)
(b)	$V = \pi x^2 (3x) = 3\pi x^3$	B1
	$\frac{dV}{dx} = 9\pi x^2$	B1ft
	$\frac{dV}{dt} = \frac{dV}{dx} \times \frac{dx}{dt} = 9\pi x^2 \times "-\frac{1}{4\pi x}" \quad (= -2.25x)$	M1
	$\left(\frac{dV}{dt} =\right) -9 \Rightarrow$ (Rate of decrease $=$) $9 \; \left(\text{mm}^3 \text{ s}^{-1}\right)$	A1
		(4)
		(8 marks)

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

Question Number	Scheme	Marks
6 (a)	$y = x^{\sin x} \Rightarrow \ln y = \sin x \ln x$	B1
	Differentiates $\frac{1}{y}\frac{dy}{dx} = \frac{\sin x}{x} + \ln x \cos x$	M1 M1 A1
	$\frac{dy}{dx} = \frac{y \sin x}{x} + y \ln x \cos x$ oe	A1
		(5)
(b)	Puts $\frac{dy}{dx} = 0 \Rightarrow \frac{\sin x}{x} + \ln x \cos x = 0$	M1
	$\frac{\sin x}{\cos x} + x \ln x = 0 \Rightarrow \tan x + x \ln x = 0$*	A1*
		(2)
		(7 marks)

Question Number	Scheme	Marks
2(a)	$\frac{dV}{dx} = 3x^2$	M1 (B1 on EPEN)
	$\frac{dx}{dt} = \frac{dx}{dV} \times \frac{dV}{dt} = \frac{5}{3x^2}$	**d**M1A1
		(3)
	Alternative 1	
	$V = x^3 \Rightarrow x = V^{\frac{1}{3}} \Rightarrow \frac{dx}{dV} = \frac{1}{3}V^{-\frac{2}{3}}$	M1 (B1 on EPEN)
	$\frac{dx}{dt} = \frac{dx}{dV} \times \frac{dV}{dt} = \frac{5}{3V^{\frac{2}{3}}} = \frac{5}{3x^2}$	**d**M1A1
	Alternative 2	
	$\frac{dV}{dt} = 5 \Rightarrow V = 5t + c$	M1 (B1 on EPEN)
	$V = x^3 \Rightarrow x^3 = 5t + c \Rightarrow 3x^2 \frac{dx}{dt} = 5$ or $V = x^3 \Rightarrow x^3 = 5t + c \Rightarrow 3x^2 = 5\frac{dt}{dx}$	**d**M1
	$\frac{dx}{dt} = \frac{5}{3x^2}$	A1
(b)	$\frac{dx}{dt} = \frac{5}{3 \times 4^2} = \frac{5}{48}$	M1A1
		(2)
		(5 marks)

Note this is now being marked as M1dM1A1 not B1M1A1

Question Number	Scheme	Marks
6 (a)	For correct parameter $t=\dfrac{\pi}{4}$ or x coordinate at P $x=4$	B1
	$\dfrac{dy}{dx}=\dfrac{dy/dt}{dx/dt}=\dfrac{-4\sin 2t}{3\sec^2 t}$	M1 A1
	Equation of tangent $y-0=-\dfrac{2}{3}(x-4)\Rightarrow y=-\dfrac{2}{3}x+\dfrac{8}{3}$	dM1 A1
		(5)
(b)	$k=1-\sqrt{3}$	B1
		(1)
(c)	-1,, f ,, 2	M1 A1
		(2) **(8 marks)**

Question Number	Scheme	Marks
5.	One of $\dfrac{dA}{dt}=\dfrac{\pi}{20}$, $\dfrac{dA}{dx}=2\pi x$, $\dfrac{dV}{dx}=18\pi x^2$	B1
	Two of $\dfrac{dA}{dt}=\dfrac{\pi}{20}$, $\dfrac{dA}{dx}=2\pi x$, $\dfrac{dV}{dx}=18\pi x^2$	B1
	All three of $\dfrac{dA}{dt}=\dfrac{\pi}{20}$, $\dfrac{dA}{dx}=2\pi x$, $\dfrac{dV}{dx}=18\pi x^2$	B1
Main	Full attempt to find $\dfrac{dV}{dt}$ E.g. $\dfrac{dV}{dt}=\dfrac{dV}{dx}\times\dfrac{dx}{dA}\times\dfrac{dA}{dt}=18\pi x^2\times\dfrac{1}{2\pi x}\times\dfrac{\pi}{20}$	M1
	Finds $\dfrac{dV}{dt}$ at $x=2\Rightarrow$ $\dfrac{dV}{dt}=18\pi 2^2\times\dfrac{1}{80}=\dfrac{9}{10}\pi$	dM1 A1
		(6 marks)
	Note that the M1 may be found in two steps: E.g.I Finds $\dfrac{dx}{dt}$ from $\dfrac{dA}{dt}=\dfrac{dA}{dx}\times\dfrac{dx}{dt}$ followed by $\dfrac{dV}{dt}=\dfrac{dV}{dx}\times\dfrac{dx}{dt}$ E.g II Finds $\dfrac{dV}{dA}$ from $\dfrac{dV}{dx}=\dfrac{dV}{dA}\times\dfrac{dA}{dx}$ followed by $\dfrac{dV}{dt}=\dfrac{dV}{dA}\times\dfrac{dA}{dt}$	
Alt	$\dfrac{dA}{dt}=\dfrac{\pi}{20}$	B1
	$V=6\pi x^3, A=\pi x^2\Rightarrow V=6\pi\left(\dfrac{A}{\pi}\right)^{\frac{3}{2}}$ $\dfrac{dV}{dA}=9\left(\dfrac{A}{\pi}\right)^{\frac{1}{2}}$	B1, B1
	$\dfrac{dV}{dt}=\dfrac{dV}{dA}\times\dfrac{dA}{dt}\Rightarrow\dfrac{dV}{dt}=9\left(\dfrac{A}{\pi}\right)^{\frac{1}{2}}\times\dfrac{\pi}{20}$	M1
	$x=2\Rightarrow A=4\pi$ $\Rightarrow\left.\dfrac{dV}{dt}\right\|_{A=4\pi}=\dfrac{9}{10}\pi$	dM1A1
		(6 marks)

Question Number	Scheme	Marks
5(a)	$y^3 - x^2 + 4x^2y = k$	
	$y^3 \to 3y^2\frac{dy}{dx}$	M1
	$4x^2y \to 8xy + 4x^2\frac{dy}{dx}$	M1
	$y^3 - x^2 + 4x^2y = k \Rightarrow 3y^2\frac{dy}{dx} - 2x + 8xy + 4x^2\frac{dy}{dx} = 0$	A1
	$\Rightarrow \left(3y^2 + 4x^2\right)\frac{dy}{dx} = 2x - 8xy$	M1
	$\Rightarrow \frac{dy}{dx} = \frac{2x - 8xy}{3y^2 + 4x^2}$	A1
		(5)
(b)	$\frac{dy}{dx} = -1$ at P	M1
	Uses $\frac{dy}{dx} = \pm 1$ and $y = x$ to set up and solve equation in x, y or 'p' $\Rightarrow -1 = \frac{2p - 8p^2}{3p^2 + 4p^2} \Rightarrow p = 2$	M1 A1
	e.g. $k = "2"^3 - "2"^2 + 4 \times "2"^3$	**dd**M1
	$k = 36$	A1
		(5)
		(10 marks)

Question Number	Scheme	Marks
5(a)	e.g. $\frac{r}{h} = \frac{12}{30} \Rightarrow r = \frac{12}{30}h \Rightarrow V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi\left(\frac{2}{5}h\right)^2 h$	M1
	$V = \frac{4\pi h^3}{75}$ *	A1*
		(2)
(b)	$V = \frac{4\pi h^3}{75} \Rightarrow \frac{dV}{dh} = \frac{12\pi h^2}{75}\left(= \frac{4\pi h^2}{25}\right)$	B1
	$V = 1.5 \times 60 \times 2\pi$ $180\pi = \frac{4\pi h^3}{75} \Rightarrow h^3 = 3375 \Rightarrow h = \ldots(15)$	M1
	$\frac{dh}{dt} = \frac{dh}{dV}\frac{dV}{dt} = \frac{75}{12\pi \times 15^2} \times 2\pi = \ldots$	M1
	$\frac{1}{18}$ (cm s^{-1})	A1
		(4)
		Total 6

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

Question Number	Scheme	Marks
4 (a)	Attempt at chain rule $y^2 \rightarrow ...y\frac{dy}{dx}$	M1
	Attempt at product rule $2xy \rightarrow \alpha x\frac{dy}{dx}+\beta y$	M1
	Correct differentiation $8x+2y\frac{dy}{dx}-2y-2x\frac{dy}{dx}=24$ oe	A1
	Collects terms in $(2y-2x)\frac{dy}{dx} = 24-8x+2y$	M1
	$\left(\frac{dy}{dx}=\right)\frac{12-4x+y}{y-x}$ oe	A1
		(5)
(b)	Sets $\frac{12-4x+y}{y-x}=2 \Rightarrow y=12-2x$ or $x=6-\frac{1}{2}y$	M1
	Substitute $y=12-2x$ or $x=6-\frac{1}{2}y$ into $4x^2+y^2-2xy=24x$	dM1
	$x^2-8x+12=0$ oe or $y^2-8y=0$	A1
	Solves $x=6, y=0$ or $x=2, y=8$	ddM1
	Chooses $a(x)=2, b(y)=8$ or states $(2,8)$ only	A1
		(5) (10 marks)

Question Number	Scheme	Marks
4(a)	A and B are where $t^3-4t=0 \Rightarrow t(t^2-4)=0 \Rightarrow t=2$ or -2	M1
	Substitutes $t=2, x=2\times4-6\times2=-4$ Hence $A=(-4,0)$	A1
	When $t=-2, x=2\times4-6\times-2=20, (y=0)$ Hence $B=(20,0)$ *	B1*
		(3)
(b)	$\dfrac{dy}{dx}=\dfrac{dy/dt}{dx/dt}=\dfrac{3t^2-4}{4t-6}$	M1A1
	Sub $t=-2$ into $\dfrac{dy}{dx}=\dfrac{3t^2-4}{4t-6}\Rightarrow \text{gradient}=\left(-\dfrac{4}{7}\right)$	M1
	Uses their $\left(-\dfrac{4}{7}\right)$ and $(20,0)$ to produce eqn of tangent $\Rightarrow 7y+4x-80=0$ *	M1 A1*
		(5)
(c)	Substitutes $x=2t^2-6t, y=t^3-4t,$ into $7y+4x-80=0$	
	$\Rightarrow 7\left(t^3-4t\right)+4\left(2t^2-6t\right)-80=0$	M1
	$\Rightarrow 7t^3+8t^2-52t-80=0$	A1
	$\Rightarrow (t+2)^2(7t-20)=0$	
	$t=\text{"}\dfrac{20}{7}\text{"}\Rightarrow x=....$	dM1
	$x=-\dfrac{40}{49}$	A1
		(4)
		(12 marks)

Question	**Scheme**	**Marks**
4(a)	$A=\dfrac{1}{2}5^2\left(\theta-\sin\theta\right)\Rightarrow\dfrac{dA}{d\theta}=\dfrac{25}{2}\left(1\pm\cos\theta\right)$	**M1**
	$\dfrac{dA}{d\theta}=\dfrac{25}{2}\left(1-\cos\theta\right)$	**A1**
		(2)
(b)	$\dfrac{d\theta}{dt}=0.1$	**B1**
	$\dfrac{dA}{dt}=\dfrac{dA}{d\theta}\times\dfrac{d\theta}{dt}$ (oe)	**B1**
	$\dfrac{dA}{dt}=\dfrac{25}{2}\left(1-\cos\dfrac{\pi}{3}\right)\times0.1$	**M1**
	$=\dfrac{5}{8}$ (cm^2 per second)	**A1**
		(4)
		(6 marks)

Question	Scheme	Marks
4(a)	$A=\frac{1}{2}5^2\left(\theta-\sin\theta\right) \Rightarrow \frac{dA}{d\theta}=\frac{25}{2}\left(1\pm\cos\theta\right)$	M1
	$\frac{dA}{d\theta}=\frac{25}{2}\left(1-\cos\theta\right)$	A1
		(2)
(b)	$\frac{d\theta}{dt}=0.1$	B1
	$\frac{dA}{dt}=\frac{dA}{d\theta}\times\frac{d\theta}{dt}$ (oe)	B1
	$\frac{dA}{dt}=\frac{25}{2}\left(1-\cos\frac{\pi}{3}\right)\times 0.1$	M1
	$=\frac{5}{8}$ (cm^2 per second)	A1
		(4)
		(6 marks)

Question Number	Scheme	Marks
9 (a)	$\frac{dy}{dt}=\frac{-1}{(t+1)^2}$, $\frac{dx}{dt}=\frac{2}{2t+5}$ $\Rightarrow\left(\frac{dy}{dx}=\right)-\frac{2t+5}{2(t+1)^2}$	M1A1
	Sets $-\frac{2t+5}{2(t+1)^2}=-4\Rightarrow 8t^2+14t+3=0$	M1A1
	$\Rightarrow(4t+1)(2t+3)=0\Rightarrow t=-\frac{1}{4}\Rightarrow(y=)\ \frac{4}{3}$	dM1A1
		(6)
(b) (i)	$a=2, b=5$	B1
	Area = $\int y\frac{dx}{dt}\,dt=\int_2^5\frac{1}{t+1}\times\frac{2}{2t+5}\,dt=\int_2^5\frac{2}{(t+1)(2t+5)}\,dt$	M1A1
(ii)	$\frac{2}{(t+1)(2t+5)}\equiv\frac{A}{(t+1)}+\frac{B}{(2t+5)}\Rightarrow A=\ldots, B=\ldots$	M1
	$=\frac{2/3}{(t+1)}-\frac{4/3}{(2t+5)}$	A1
	$\int\frac{2/3}{(t+1)}-\frac{4/3}{(2t+5)}\,dt=\frac{2}{3}\ln\lvert t+1\rvert-\frac{2}{3}\ln\lvert 2t+5\rvert$	M1A1ft
	$\int_2^5\frac{2}{(t+1)(2t+5)}\,dt=\left(\frac{2}{3}\ln 6-\frac{2}{3}\ln 15\right)-\left(\frac{2}{3}\ln 3-\frac{2}{3}\ln 9\right)$ $=\frac{2}{3}\ln\left(\frac{6}{5}\right)=\frac{1}{3}\ln\left(\frac{36}{25}\right)$	dM1A1
		(9) **(15 marks)**

Question	Scheme	Marks
4(a)	$16x^3-9kx^2y+8y^3=875$	
	$(8)y^3\rightarrow(8\times)3y^2\dfrac{dy}{dx}$	B1
	$-9kx^2y\rightarrow ...kxy\pm ...-9kx^2\dfrac{dy}{dx}$	M1
	$48x^2-18kxy-9kx^2\dfrac{dy}{dx}+24y^2\dfrac{dy}{dx}=0\Rightarrow\dfrac{dy}{dx}(24y^2-9kx^2)=18kxy-48x^2\Rightarrow\dfrac{dy}{dx}=...$	M1
	$\dfrac{dy}{dx}=\dfrac{6kxy-16x^2}{8y^2-3kx^2}$ *	A1*
		(4)
(b)	$\dfrac{dy}{dx}=0, x=\dfrac{5}{2}\Rightarrow\dfrac{6k\left(\frac{5}{2}\right)y-16\left(\frac{5}{2}\right)^2}{8y^2-3k\left(\frac{5}{2}\right)^2}=0$ or $x=\dfrac{5}{2}\Rightarrow16\left(\dfrac{5}{2}\right)^3-9k\left(\dfrac{5}{2}\right)^2y+8y^3=875$	M1
	$15ky-100=0$ or $250-\dfrac{225}{4}ky+8y^3=875$	A1
	E.g. $16\left(\dfrac{5}{2}\right)^3-9k\left(\dfrac{5}{2}\right)^2\left(\dfrac{20}{3k}\right)+8\left(\dfrac{20}{3k}\right)^3=875\Rightarrow k^3=...\left(=\dfrac{64}{27}\right)\Rightarrow k=...$	M1
	$k=\dfrac{4}{3}$	A1
		(4)
		(8 marks)

Question Number	Scheme	Marks
3 (a)	Attempts to find $\dfrac{\frac{1}{3}\times20^2\times24}{160}=20$ seconds	M1 A1
		(2)
(b)	Attempts $\dfrac{dV}{dh}=h^2+\dfrac{8}{3}h$	M1
	Attempts to use $\dfrac{dV}{dt}=\dfrac{dV}{dh}\times\dfrac{dh}{dt}\Rightarrow160=\left(h^2+\dfrac{8}{3}h\right)\times\dfrac{dh}{dt}$	M1 A1
	Substitutes $h=5\Rightarrow160=\left(5^2+\dfrac{40}{3}\right)\times\dfrac{dh}{dt}\Rightarrow\dfrac{dh}{dt}=\dfrac{96}{23}$ (4.2) cm s $^{-1}$	dM1 A1
		(5)
		(7 marks)

Question Number	Scheme	Marks
5(a)	e.g. $\frac{r}{h}=\frac{12}{30}\Rightarrow r=\frac{12}{30}h\Rightarrow V=\frac{1}{3}\pi r^2h=\frac{1}{3}\pi\left(\frac{2}{5}h\right)^2h$	M1
	$V=\frac{4\pi h^3}{75}$ *	A1*
		(2)
(b)	$V=\frac{4\pi h^3}{75}\Rightarrow\frac{dV}{dh}=\frac{12\pi h^2}{75}\left(=\frac{4\pi h^2}{25}\right)$	B1
	$V=1.5\times60\times2\pi$ $180\pi=\frac{4\pi h^3}{75}\Rightarrow h^3=3375\Rightarrow h=...(15)$	M1
	$\frac{dh}{dt}=\frac{dh}{dV}\frac{dV}{dt}=\frac{75}{12\pi\times15^2}\times2\pi=...$	M1
	$\frac{1}{18}$ (cm s^{-1})	A1
		(4)
		Total 6

Question Number	Scheme	Notes	Marks
3(a)	$3y^2-11x^2+11xy=20y-36x+28$ $\Rightarrow \underline{6y\frac{dy}{dx}}-22x+\underline{\underline{11x\frac{dy}{dx}+11y}}=20\frac{dy}{dx}-36$ M1: $y^2\to Ay\frac{dy}{dx}$ M1: $11xy\to px\frac{dy}{dx}+qy$ A1: All correct		M1M1A1
	$(6y+11x-20)\frac{dy}{dx}=22x-11y-36\Rightarrow\frac{dy}{dx}=...$ Collects terms in $\frac{dy}{dx}$ (must be 3 and from the appropriate terms) and makes $\frac{dy}{dx}$ the subject		M1
	$\frac{dy}{dx}=\frac{22x-11y-36}{6y+11x-20}$	Correct expression or correct equivalent	A1
			(5)
(b)	$x=4\Rightarrow3y^2-176+44y=20y-144+28$	Substitutes $x=4$ into C to obtain a 3TQ in y	M1
	$3y^2+24y-60=0\Rightarrow y=...$	Solves for y	M1
	$y=-10\ (,2)$	Correct value	A1
	$(4,-10)\to\frac{dy}{dx}=\frac{88+110-36}{-60+44-20}$	Substitutes $x=4$ and their negative y into their $\frac{dy}{dx}$	M1
	$\frac{dy}{dx}=-\frac{9}{2}$	Correct value	A1
			(5)
			Total 10

Question Number	Scheme	Marks
5.	One of $\frac{dA}{dt}=\frac{\pi}{20}$, $\frac{dA}{dx}=2\pi x$, $\frac{dV}{dx}=18\pi x^2$	B1
	Two of $\frac{dA}{dt}=\frac{\pi}{20}$, $\frac{dA}{dx}=2\pi x$, $\frac{dV}{dx}=18\pi x^2$	B1
Main	All three of $\frac{dA}{dt}=\frac{\pi}{20}$, $\frac{dA}{dx}=2\pi x$, $\frac{dV}{dx}=18\pi x^2$	B1
	Full attempt to find $\frac{dV}{dt}$ E.g. $\frac{dV}{dt}=\frac{dV}{dx}\times\frac{dx}{dA}\times\frac{dA}{dt}=18\pi x^2\times\frac{1}{2\pi x}\times\frac{\pi}{20}$	M1
	Finds $\frac{dV}{dt}$ at $x=2\Rightarrow$ $\frac{dV}{dt}=18\pi 2^2\times\frac{1}{80}=\frac{9}{10}\pi$	dM1 A1
		(6 marks)
	Note that the M1 may be found in two steps: E.g.I Finds $\frac{dx}{dt}$ from $\frac{dA}{dt}=\frac{dA}{dx}\times\frac{dx}{dt}$ followed by $\frac{dV}{dt}=\frac{dV}{dx}\times\frac{dx}{dt}$ E.g II Finds $\frac{dV}{dA}$ from $\frac{dV}{dx}=\frac{dV}{dA}\times\frac{dA}{dx}$ followed by $\frac{dV}{dt}=\frac{dV}{dA}\times\frac{dA}{dt}$	
Alt	$\frac{dA}{dt}=\frac{\pi}{20}$	B1
	$V=6\pi x^3, A=\pi x^2\Rightarrow V=6\pi\left(\frac{A}{\pi}\right)^{\frac{3}{2}}$ $\frac{dV}{dA}=9\left(\frac{A}{\pi}\right)^{\frac{1}{2}}$	B1, B1
	$\frac{dV}{dt}=\frac{dV}{dA}\times\frac{dA}{dt}\Rightarrow\frac{dV}{dt}=9\left(\frac{A}{\pi}\right)^{\frac{1}{2}}\times\frac{\pi}{20}$	M1
	$x=2\Rightarrow A=4\pi$ $\quad\Rightarrow\left.\frac{dV}{dt}\right\|_{A=4\pi}=\frac{9}{10}\pi$	dM1A1
		(6 marks)

Question Number	Scheme	Marks
5(a)	e.g. $\frac{r}{h}=\frac{12}{30}\Rightarrow r=\frac{12}{30}h\Rightarrow V=\frac{1}{3}\pi r^2h=\frac{1}{3}\pi\left(\frac{2}{5}h\right)^2h$	M1
	$V=\frac{4\pi h^3}{75}$*	A1*
		(2)
(b)	$V=\frac{4\pi h^3}{75}\Rightarrow\frac{dV}{dh}=\frac{12\pi h^2}{75}\left(=\frac{4\pi h^2}{25}\right)$	B1
	$V=1.5\times 60\times 2\pi$ $180\pi=\frac{4\pi h^3}{75}\Rightarrow h^3=3375\Rightarrow h=...(15)$	M1
	$\frac{dh}{dt}=\frac{dh}{dV}\frac{dV}{dt}=\frac{75}{12\pi\times 15^2}\times 2\pi=...$	M1
	$\frac{1}{18}$ (cm s^{-1})	A1
		(4)
		Total 6

Question Number	Scheme	Marks
2	$\frac{dV}{dt} = \pm k$	B1
	$V = \frac{4}{3}\pi r^3 \to \frac{dV}{dr} = 4\pi r^2$	B1
	$\pm k = \lambda r^2 \times \frac{dr}{dt}$	M1
	$\frac{dr}{dt} = \frac{\pm k}{4\pi r^2} \Rightarrow \frac{dr}{dt} \propto \frac{1}{r^2}$ ✓ *	A1*
		(4 marks)

Question Number	Scheme	Marks
2(a)	States or uses $S = 6x^2$ **or** $\frac{dS}{dt} = 4$	B1
	States or uses $S = 6x^2$ **and** $\frac{dS}{dt} = 4$	B1
	Attempts to use $\frac{dS}{dt} = \frac{dS}{dx} \times \frac{dx}{dt} \Rightarrow 4 = 12x \times \frac{dx}{dt} \Rightarrow \frac{dx}{dt} = ...$	M1
	$\Rightarrow \frac{dx}{dt} = \frac{1}{3x}$ oe	A1
		(4)
(b)	States or uses $\frac{dV}{dx} = 3x^2$	B1
	Attempts to use $\frac{dV}{dt} = \frac{dV}{dx} \times \frac{dx}{dt} \Rightarrow \frac{dV}{dt} = 3x^2 \times \frac{1}{3x} = x$	M1
	$\Rightarrow \frac{dV}{dt} = V^{\frac{1}{3}}$	A1
		(3)

Question Number	Scheme	Marks
3	Differentiates wrt x $\quad 3^x \ln 3 + 6\underline{\underline{\frac{dy}{dx}}} = \underline{\frac{3}{2}y^2 + 3xy\frac{dy}{dx}}$	B1 $\underline{\underline{\text{B1}}}$, $\underline{\text{M1}}$, A1
	Substitutes (2, 3) **AND** rearranges to get $\frac{dy}{dx}$ or vice versa $\Rightarrow 9\ln 3 + 6\frac{dy}{dx} = \frac{27}{2} + 18\frac{dy}{dx} \Rightarrow \frac{dy}{dx} = \frac{9\ln 3 - \frac{27}{2}}{12} = \frac{6\ln 3 - 9}{8} = \frac{-9 + \ln 729}{8}$	M1 A1, A1
		(7) **(7 marks)**

Question Number	Scheme	Marks
2(a)	$2^x \to 2^x \ln 2$	B1
	$y^2 \to \ldots y\dfrac{dy}{dx}$	M1
	$4x^2y \to \ldots x^2\dfrac{dy}{dx} + \ldots xy$	M1
	$3 + 10y\dfrac{dy}{dx} + 4x^2\dfrac{dy}{dx} + 8xy = 10 \times 2^x \ln 2$	A1
	$\left(10y + 4x^2\right)\dfrac{dy}{dx} = 10 \times 2^x \ln 2 - 3 - 8xy \Rightarrow \dfrac{dy}{dx} = \ldots$	M1
	$\dfrac{dy}{dx} = \dfrac{10 \times 2^x \ln 2 - 3 - 8xy}{10y + 4x^2}$	A1
		(6)

2(b)	At $x = 0$ $5y^2 = 45 \Rightarrow y = 3$ $x = 0, y = 3 \Rightarrow \dfrac{dy}{dx} = \dfrac{10 \times 2^0 \ln 2 - 3 - 8 \times 0 \times 3}{10 \times 3 + 4 \times 0^2} = \dfrac{10\ln 2 - 3}{30}$	M1 A1
		(2)

Question Number	Scheme	Marks
9 (a)	$\frac{dy}{dt}=\frac{-1}{(t+1)^2}$, $\frac{dx}{dt}=\frac{2}{2t+5}$ $\Rightarrow\left(\frac{dy}{dx}=\right)-\frac{2t+5}{2(t+1)^2}$	M1A1
	Sets $-\frac{2t+5}{2(t+1)^2}=-4\Rightarrow 8t^2+14t+3=0$	M1A1
	$\Rightarrow(4t+1)(2t+3)=0\Rightarrow t=-\frac{1}{4}\Rightarrow(y=)\ \frac{4}{3}$	dM1A1
		(6)
(b) (i)	$a=2, b=5$	B1
	Area = $\int y\frac{dx}{dt}\,dt=\int_2^5\frac{1}{t+1}\times\frac{2}{2t+5}\,dt=\int_2^5\frac{2}{(t+1)(2t+5)}\,dt$	M1A1
(ii)	$\frac{2}{(t+1)(2t+5)}\equiv\frac{A}{(t+1)}+\frac{B}{(2t+5)}\Rightarrow A=\ldots, B=\ldots$	M1
	$=\frac{2/3}{(t+1)}-\frac{4/3}{(2t+5)}$	A1
	$\int\frac{2/3}{(t+1)}-\frac{4/3}{(2t+5)}\,dt=\frac{2}{3}\ln\lvert t+1\rvert-\frac{2}{3}\ln\lvert 2t+5\rvert$	M1A1ft
	$\int_2^5\frac{2}{(t+1)(2t+5)}\,dt=\left(\frac{2}{3}\ln 6-\frac{2}{3}\ln 15\right)-\left(\frac{2}{3}\ln 3-\frac{2}{3}\ln 9\right)$	
	$=\frac{2}{3}\ln\left(\frac{6}{5}\right)=\frac{1}{3}\ln\left(\frac{36}{25}\right)$	dM1A1
		(9)
		(15 marks)

Question	Scheme	Marks
9(a)	$\frac{\mathrm{d}}{\mathrm{d}y}(1+2\ln y)^{-2}=\alpha(1+2\ln y)^{-3}\times\frac{\beta}{y}=\frac{K}{y(1+2\ln y)^3}$	M1
	$=\frac{-4}{y(1+2\ln y)^3}$ oe	A1
		(2)
(b)	$3\operatorname{cosec}(2x)\frac{\mathrm{d}y}{\mathrm{d}x}=y(1+2\ln y)^3$ $\Rightarrow\int ...\mathrm{d}y=\int k\sin(2x)\,\mathrm{d}x$ **or** $\int\frac{k}{y(1+2\ln y)^3}\mathrm{d}y=\int ...\mathrm{d}x$ **and** $\Rightarrow\int ...\mathrm{d}y=\int k\sin(2x)\,\mathrm{d}x\Rightarrow ...=A\cos 2x$ oe **or** $\Rightarrow\int\frac{k}{y(1+2\ln y)^3}\mathrm{d}y=\int ...\mathrm{d}x\Rightarrow\frac{A}{(1+2\ln y)^2}=...$	M1
	$\Rightarrow\int\frac{A}{y(1+2\ln y)^3}\mathrm{d}y=\int B\sin(2x)\,\mathrm{d}x\Rightarrow\frac{C}{(1+2\ln y)^2}=D\cos 2x$ oe	M1
	One side integrated **correctly** $\int\frac{3}{y(1+2\ln y)^3}\mathrm{d}y=-\frac{3}{4(1+2\ln y)^2},\int\frac{1}{y(1+2\ln y)^3}\mathrm{d}y=-\frac{1}{4(1+2\ln y)^2}$ or $\int\frac{1}{3}\sin(2x)\,\mathrm{d}x=-\frac{1}{6}\cos(2x)$ oe, $\int\sin(2x)\,\mathrm{d}x=-\frac{1}{2}\cos(2x)$ oe	A1
	$-\frac{3}{4(1+2\ln y)^2}=-\frac{1}{2}\cos(2x)(+c)$ or $-\frac{1}{4(1+2\ln y)^2}=-\frac{1}{6}\cos(2x)(+c)$	A1
		(4)
(c)	$y=1,x=\frac{\pi}{6}\Rightarrow-\frac{3}{4(1+2\ln 1)}=-\frac{1}{2}\cos\left(\frac{\pi}{3}\right)+c\Rightarrow c=...$	M1
	$-\frac{3}{4(1+2\ln y)^2}=-\frac{1}{2}\cos(2x)-\frac{1}{2}$ or $-\frac{1}{4(1+2\ln y)^2}=-\frac{1}{6}\cos(2x)-\frac{1}{6}$	A1
	$-\frac{3}{4(1+2\ln y)^2}=-\frac{1}{2}\cos(2x)-\frac{1}{2}\Rightarrow\frac{3}{4(1+2\ln y)^2}=\frac{1}{2}+\frac{1}{2}\cos(2x)=\cos^2 x$	M1
	$\Rightarrow(1+2\ln y)^2=\frac{3}{4}\sec^2 x\Rightarrow\ln y=\frac{1}{2}\left(\frac{\sqrt{3}}{2}\sec x-1\right)$ **Depends on both previous method marks.**	ddM1
	$\Rightarrow y=\mathrm{e}^{\frac{\sqrt{3}}{4}\sec x-\frac{1}{2}}$	A1
		(5)

Question	Scheme	Marks
4(a)	Area of one face $=\frac{1}{2}x\times x\times\sin 60°=\frac{1}{2}x^2\frac{\sqrt{3}}{2}$ oe	M1
	So surface area of icosahedron is $20\times\frac{\sqrt{3}}{4}x^2=5\sqrt{3}x^2$ *	A1*
		(2)
(b)	$\frac{dA}{dx}=10\sqrt{3}x$ and $\frac{dV}{dx}=\frac{15}{12}\left(3+\sqrt{5}\right)x^2$	M1
	$\frac{dV}{dA}=\frac{dV}{dx}\times\frac{dx}{dA}=\frac{dV}{dx}\div\frac{dA}{dx}=...$ (oe)	M1
	$=\frac{15\left(3+\sqrt{5}\right)x^2}{12\times10\sqrt{3}x}=\frac{\left(3+\sqrt{5}\right)x}{8\sqrt{3}}$ *	A1*
		(3)
(c)	$\frac{dA}{dt}=0.025$	B1
	$\frac{dV}{dt}=\frac{dV}{dA}\times\frac{dA}{dt}=\frac{\left(3+\sqrt{5}\right)x}{8\sqrt{3}}\times0.025=...$ When $x=2$, $\frac{dV}{dt}=\frac{2\left(3+\sqrt{5}\right)}{8\sqrt{3}}\times0.025=...$	M1
	awrt 0.019 $(\text{cm}^3\text{s}^{-1})$	A1
		(3)
		(8 marks)

Question	Scheme	Marks
3(a)	$y^2x+3y=4x^2+k$	
	$y^2x\to...\times y\frac{dy}{dx}(+...)$ or $3y\to3\frac{dy}{dx}$	M1
	$y^2x\to2xy\frac{dy}{dx}+y^2$	A1
	$...+3y=4x^2+k\to...+3\frac{dy}{dx}=8x$	A1
	$2xy\frac{dy}{dx}+y^2+3\frac{dy}{dx}=8x\Rightarrow\frac{dy}{dx}=...$	dM1
	$\frac{dy}{dx}=\frac{8x-y^2}{2xy+3}$ oe	A1
		(5)
(b)	$\frac{dy}{dx}=0\Rightarrow8x-4=0\Rightarrow x=...$	M1
	$p=\frac{1}{2}$	A1
	$k=2^2\times\frac{1}{2}+3\times2-4\times\frac{1}{4}=...$	M1
	$k=7$	A1
		(4)

Question Number	Scheme	Marks
4(i)	$\frac{dV}{dt}=70\pi$	B1
	$\frac{dV}{dr}=4\pi r^2$	B1
	$\frac{dV}{dt}=\frac{dV}{dr}\times\frac{dr}{dt}\Rightarrow 70\pi=4\pi\times5^2\times\frac{dr}{dt}$ or e.g. $\frac{dr}{dt}=\frac{dV}{dt}\times\frac{dr}{dV}\Rightarrow\frac{dr}{dt}=70\pi\times\frac{1}{4\pi\times5^2}$	M1
	$\left(\frac{dr}{dt}\right)=0.7\,(\text{cm s}^{-1})$ oe e.g. $\frac{7}{10}$	A1
		(4)
(ii)	$\frac{dh}{dt}=\frac{k}{h^3}\Rightarrow\int h^3\,dh=\int k\,dt\Rightarrow\frac{1}{4}h^4=kt+c$	M1A1
	$t=0,\ h=4\Rightarrow\ \frac{1}{4}\times4^4=0+c\Rightarrow c=64$	M1
	$t=5,\ h=6\Rightarrow\frac{1}{4}\times6^4=k\times5+64\Rightarrow k=(52)$	dM1
	$h=10\Rightarrow\frac{1}{4}(10)^4=52T+64\Rightarrow T=\ldots$	dddM1
	46.8 (hours) or exact e.g. $\frac{609}{13},\ \frac{9744}{208}$	A1
		(6)
		(10 marks)

Question Number	Scheme	Marks
9(a)(i)	$\frac{dy}{dx}=\frac{dy/dt}{dx/dt}=\frac{3\sin^2 t\cos t}{-4\sin 2t}$	M1A1
	$\frac{3\sin^2 t\cos t}{-4\sin 2t}=\frac{3\sin^2 t\cos t}{-8\sin t\cos t}=-\frac{3}{8}\sin t$ or e.g. $\frac{3\sin^2 t\cos t}{-4\sin 2t}=\frac{\frac{3}{2}\sin 2t\sin t}{-4\sin 2t}=-\frac{3}{8}\sin t$	A1
(ii)	$t=\frac{\pi}{6} \Rightarrow x=1,\ y=\frac{1}{8}$	B1
	$m=-\frac{3}{8}\sin\left(\frac{\pi}{6}\right)=-\frac{3}{16} \Rightarrow y-\frac{1}{8}=-\frac{3}{16}(x-1)$	M1
	$3x+16y-5=0$ *	A1*
		(6)
(b)	$3(2\cos 2t)+16(\sin^3 t)-5=0$	M1
	$6(1-2\sin^2 t)+16\sin^3 t-5=0$	dM1
	$16\sin^3 t-12\sin^2 t+1=0$	A1
	$(2\sin t-1)^2(4\sin t+1)=0 \Rightarrow \sin t=-\frac{1}{4}$	ddM1
	$\sin t=-\frac{1}{4} \Rightarrow x=2\cos 2t=..$ **and** $y=\sin^3 t=...$	dddM1
	$Q\left(\frac{7}{4},-\frac{1}{64}\right)$	A1
		(6)
		(12 marks)

Question Number	Scheme	Marks
3	$8y\frac{dy}{dx}=xe^{-y^2} \rightarrow \int 8ye^{y^2}\,dy=\int x\,dx$	B1
	$4e^{y^2}=\frac{x^2}{2}\ (+c)$	M1A1
	$4=\frac{5^2}{2}+c \Rightarrow c=...$	**dM1**
	$y^2=\ln\left(\frac{x^2-17}{8}\right)$	A1
		(5 marks)

B1: Separates the variables correctly with some indication of integration

Question Number	Scheme	Marks
11 (a)	$(x+y)^3+10y^2=108x$	
	Differentiates $10y^2$ to $20y\dfrac{dy}{dx}$	B1
	Differentiates $(x+y)^3$ to $3(x+y)^2\left(1+\dfrac{dy}{dx}\right)$	M1
	$3(x+y)^2\left(1+\dfrac{dy}{dx}\right)+20y\dfrac{dy}{dx}=108$	A1
	$3(x+y)^2\dfrac{dy}{dx}+20y\dfrac{dy}{dx}=108-3(x+y)^2$	dM1
	$\dfrac{dy}{dx}=\dfrac{108-3(x+y)^2}{20y+3(x+y)^2}$ *	A1*
		(5)
(b)	Deduces that P and Q are where $108-3(x+y)^2=0\Rightarrow(x+y)^2=36$	M1
	Attempts to substitute $(x+y)=\pm6$ into $(x+y)^3+10y^2=108x$ to form an equation in y (or x)	dM1
	Solves $216+10y^2=108(6-y)$ and finds the negative root	ddM1
	Awrt 13900 metres	A1
		(4)
		(9 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)	$2^x\to 2^x\ln 2$	B1
	$-4xy\to-4x\dfrac{dy}{dx}-4y$ **OR** $y^2\to 2y\dfrac{dy}{dx}$	M1
	$2^x\ln 2-4x\dfrac{dy}{dx}-4y+2y\dfrac{dy}{dx}=0$	A1
	$\dfrac{dy}{dx}(2y-4x)=4y-2^x\ln 2\Rightarrow\dfrac{dy}{dx}=\ldots$	M1
	$\dfrac{dy}{dx}=\dfrac{4y-2^x\ln 2}{2y-4x}$ or $\dfrac{dy}{dx}=\dfrac{2^x\ln 2-4y}{4x-2y}$ or $\dfrac{dy}{dx}=\dfrac{\ln 2e^{x\ln 2}-4y}{4x-2y}$	A1
		(5)
(c)	$(2,\,9)\to\dfrac{dy}{dx}=\dfrac{4(9)-2^2\ln 2}{2(9)-4(2)}$ $\Rightarrow y-\text{"}9\text{"}=\text{"}\dfrac{36-4\ln 2}{10}\text{"}(x-2)$	M1
	$y=0\Rightarrow 0-\text{"}9\text{"}=\text{"}\dfrac{36-4\ln 2}{10}\text{"}(x-2)\Rightarrow x=\ldots$	dM1
	$x=\dfrac{4\ln 2+9}{2\ln 2-18}$ o.e. e.g. $x=\dfrac{-8\ln 2-18}{-4\ln 2+36}$	A1
		(3)
		Total 10

Question Number	Scheme	Marks
3	Differentiates wrt x $\quad 3^x \ln 3 + \underline{\underline{6\frac{dy}{dx}}} = \underline{\frac{3}{2}y^2 + 3xy\frac{dy}{dx}}$	B1 $\underline{\underline{\text{B1}}}$, $\underline{\text{M1}}$, A1
	Substitutes (2, 3) **AND** rearranges to get $\frac{dy}{dx}$ or vice versa $\Rightarrow 9\ln 3 + 6\frac{dy}{dx} = \frac{27}{2} + 18\frac{dy}{dx} \Rightarrow \frac{dy}{dx} = \frac{9\ln 3 - \frac{27}{2}}{12} = \frac{6\ln 3 - 9}{8} = \frac{-9 + \ln 729}{8}$	M1 A1, A1
		(7)
		(7 marks)