Question Number	Scheme	Marks
5	$4y^2 \rightarrow 8y\dfrac{dy}{dx}$	M1
	$e^{xy} \rightarrow \left(y + x\dfrac{dy}{dx}\right)e^{xy}$ or e.g. $e^{xy} \rightarrow ye^{xy} + x\dfrac{dy}{dx}e^{xy}$	M1
	$2 + 8y\dfrac{dy}{dx} = 3\left(y + x\dfrac{dy}{dx}\right)e^{xy}$	A1
	$2 = 3\times\dfrac{9}{2}\times\dfrac{dy}{dx} \Rightarrow \dfrac{dy}{dx} = \dfrac{4}{27}$	M1
	$y = \dfrac{4}{27}\left(x - \dfrac{9}{2}\right) \Rightarrow 4x - 27y - 18 = 0$	**d**M1A1
		(6)
		(6 marks)

M1: Differentiates $4y^2$ to obtain $...y\dfrac{dy}{dx}$

M1: Differentiates $3e^{xy}$ to obtain $...\left(y + x\dfrac{dy}{dx}\right)e^{xy}$ or equivalent.

Do not condone missing brackets unless they are implied by subsequent work.

A1: Fully correct differentiation $2 + 8y\dfrac{dy}{dx} = 3\left(y + x\dfrac{dy}{dx}\right)e^{xy}$ or equivalent.

Condone e.g. $\dfrac{dy}{dx} = 2 + 8y\dfrac{dy}{dx} = 3\left(y + x\dfrac{dy}{dx}\right)e^{xy}$ where the "$\dfrac{dy}{dx} =$" is their intention to differentiate.

M1: Substitutes $x = \dfrac{9}{2}$ and $y = 0$ and proceeds to find a value for $\dfrac{dy}{dx}$.

If no substitution is seen then their value must be correct for their $\dfrac{dy}{dx}$.

Must be a constant but may be in terms of e or may be a decimal.

Note that they may attempt to make $\dfrac{dy}{dx}$ the subject first e.g. $\dfrac{dy}{dx} = \dfrac{3ye^{xy} - 2}{8y - 3xe^{xy}}$

You do not need to be concerned with the details of the rearrangement.

It is dependent on having **exactly two** $\dfrac{dy}{dx}$ terms so if they had e.g.

$\dfrac{dy}{dx} = 2 + 8y\dfrac{dy}{dx} = 3\left(y + x\dfrac{dy}{dx}\right)e^{xy}$ and use all 3 $\dfrac{dy}{dx}$ terms, this scores M0

dM1: Uses their gradient at $\left(\dfrac{9}{2}, 0\right)$ with $x = \dfrac{9}{2}$ and $y = 0$ with the values correctly placed, in a correct straight line method for the tangent at P. Their gradient must be non-zero and must exist so do not allow methods leading to e.g. $\dfrac{\alpha}{0}$ where α is then used for the gradient.

If they use $y = mx + c$, they must reach as far as a value for c.

It is dependent on the previous method mark.

A1: **cso** $4x - 27y - 18 = 0$ or any integer multiple of this equation.

Note that incorrect differentiation can lead to the correct gradient and the correct answer so this mark must follow **correct work and all previous marks must be awarded.**

Question Number	Scheme	Marks
6(a)	$\frac{dy}{dx} = 6\cos t \times \frac{1}{-8\sin t} = k\frac{\cos t}{\sin t}$	M1
	$\frac{dy}{dx} = -\frac{3}{4}\cot\left(\frac{\pi}{3}\right) = -\frac{\sqrt{3}}{4}$	**d**M1A1
		(3)

Mark (a) and (b) together.

(a)

M1: Attempts to differentiate both parametric equations to obtain $\frac{dx}{dt} = ...\sin t$ and $\frac{dy}{dt} = ...\cos t$ and attempts $\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx}$ or equivalent e.g. $\frac{dy}{dx} = \frac{dy}{dt} \div \frac{dx}{dt}$

Note that this may be done numerically e.g.

$$\frac{dx}{dt} = -8\sin t = -4\sqrt{3},\ \frac{dy}{dt} = 6\cos t = 3 \Rightarrow \frac{dy}{dx} = 3 \times \frac{1}{-4\sqrt{3}}$$

dM1: Substitutes in $t = \frac{\pi}{3}$ and proceeds to find a value for $\frac{dy}{dx}$ which may be implied.

Depends on the previous mark.

A1: $-\frac{\sqrt{3}}{4}$ **from fully correct work** or any exact equivalent e.g. $-\frac{3}{4\sqrt{3}}$.

Isw once a correct answer is seen.

(b)	$\left(6,\ 3\sqrt{3}-3\right)$	B1B1
	$-\frac{\sqrt{3}}{4}\rightarrow\frac{4}{\sqrt{3}}$	B1ft
	$y-3\sqrt{3}+3=\frac{4}{\sqrt{3}}(x-6)$ or $y=\frac{4}{\sqrt{3}}x+c\Rightarrow -3\sqrt{3}+3=\frac{4}{\sqrt{3}}\times 6+c\Rightarrow c=\left(-3-5\sqrt{3}\right)$	M1
	When $y=0$ $-3\sqrt{3}+3=\frac{4}{\sqrt{3}}(x-6)\Rightarrow x=...$	**d**M1
	$\left(\frac{15+3\sqrt{3}}{4},\ 0\right)$	A1
		(6)

(b)

B1: One of $x=6,\ y=3\sqrt{3}-3$

B1: For both coordinates correct for P: $x=6,\ y=3\sqrt{3}-3$ or e.g. $\left(6,\ 3\sqrt{3}-3\right)$

Note that the above B marks may be implied and may be seen embedded in their attempt at the equation of normal and can be scored if seen anywhere in their solution.

B1ft: Gradient of the normal to C at P is $\frac{4}{\sqrt{3}}$ oe e.g. $\frac{4\sqrt{3}}{3}$ (follow through from (a)) and can be scored anywhere in their solution.

M1: Attempts the equation of the normal with values correctly placed using

- their coordinates for P which have come from substituting $t=\frac{\pi}{3}$ into the parametric equations
- a changed gradient from that found in (a)

If using $y = mx + c$ they must proceed to find a value for c.
If candidates use P in terms of t e.g. $x=8\cos t+2$ and $y=6\sin t-3$ in their normal equation then this mark will only score at the point they substitute $t=\frac{\pi}{3}$

The first 2 B marks may also be implied if the x and y coordinates can clearly be implied or seen as $x = 6$ and/or $y=3\sqrt{3}-3$ you may need to check.

dM1: Substitutes $y=0$ into their equation of the normal and proceeds to find a value for x.
It is dependent on the previous method mark.
Note that attempts to solve $6\sin t-3=0$ score M0

A1: Correct coordinates or correct value of x $\left(\frac{15+3\sqrt{3}}{4},\ 0\right)$ or $x=\frac{15+3\sqrt{3}}{4}$ o.e. e.g.

$x=\frac{9+15\sqrt{3}}{4\sqrt{3}},\ \frac{9\sqrt{3}+45}{12},\ \frac{3}{4}\left(5+\sqrt{3}\right)$ and isw once a correct answer is seen.

Allow unsimplified e.g. $x=\left(5\sqrt{3}+3\right)\div\frac{4\sqrt{3}}{3}$

(c)	$x = 8\cos t + 2 \Rightarrow \cos t = \frac{x-2}{8} \quad y = 6\sin t - 3 \Rightarrow \sin t = \frac{y+3}{6}$	M1
	$\frac{(x-2)^2}{64} + \frac{(y+3)^2}{36} = 1$	A1
		(2)
		(11 marks)

(c)

M1: Attempts to rearrange either of the parametric equations to obtain $\cos t$ or $\cos^2 t$ in terms of x or $\sin t$ or $\sin^2 t$ in terms of y which may be implied by their working.
You can condone slips as long as the intention is clear e.g.

$$x = 8\cos t + 2 \Rightarrow x^2 = 8\cos^2 t + 4 \Rightarrow \cos^2 t = \frac{x^2 - 4}{8}$$

Also condone an attempt to obtain $\cos t$ or $\cos^2 t$ in terms of x or $\sin t$ or $\sin^2 t$ in terms of y if they have errors in trig identities but the intention is clear e.g. $\sin^2 t = 1 - \frac{x-2}{8}$

A1: $\frac{(x-2)^2}{64} + \frac{(y+3)^2}{36} = 1$ o.e. e.g. $y = 6\sqrt{1 - \left(\frac{x-2}{8}\right)^2} - 3$ or e.g. $y = \pm 6\sqrt{1 - \left(\frac{x-2}{8}\right)^2} - 3$

There will be many different alternatives. Once a correct equation is seen, award the A mark and apply isw.