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

M1: Differentiates one term in *y* to a correct form. Award for either $-3y^2 \to \pm ky\dfrac{\mathrm{d}y}{\mathrm{d}x}$ or

$2xy \to \alpha y + \beta x\dfrac{\mathrm{d}y}{\mathrm{d}x}$ Accept equivalents if they differentiate with respect to *y* instead.

dM1: Differentiates both *y* terms to a correct form

Award for **Both** $-3y^2 \to \pm ky\dfrac{\mathrm{d}y}{\mathrm{d}x}$ **and** $2xy \to \alpha y + \beta x\dfrac{\mathrm{d}y}{\mathrm{d}x}$

A1: Fully correct differentiation. (o.e. if with respect to *y*). Allow y' for $\dfrac{\mathrm{d}y}{\mathrm{d}x}$

You may see $24x^2\,\mathrm{d}x - 6y\,\mathrm{d}y + 2y\,\mathrm{d}x + 2x\,\mathrm{d}y = 0$ which is fine.

Note that $\dfrac{\mathrm{d}y}{\mathrm{d}x} = 24x^2 - 6y\dfrac{\mathrm{d}y}{\mathrm{d}x} + 2y + 2x\dfrac{\mathrm{d}y}{\mathrm{d}x} = 0$ is A0 unless the extra $\dfrac{\mathrm{d}y}{\mathrm{d}x} =$ is subsequently omitted

M1: For

- either rearranging to find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ (or $\dfrac{\mathrm{d}x}{\mathrm{d}y}$) in terms of **both** *x* and *y* and then substituting **both** (2, 5)
- or substituting **both** (2, 5) then rearranging to find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ (or $\dfrac{\mathrm{d}x}{\mathrm{d}y}$)

FYI $\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{24x^2 + 2y}{6y - 2x}$ o.e.

It is dependent upon having exactly two terms in $\dfrac{\mathrm{d}y}{\mathrm{d}x}$, one each coming from differentiating the $3y^2$ and the $2xy$.

A1: Correct value for either $\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{53}{13}$ (accept awrt 4.08) or $\dfrac{\mathrm{d}x}{\mathrm{d}y} = \dfrac{13}{53}$ (awrt 0.245)

M1: Correct method for the equation of the normal at (2, 5). E.g. $y - 5 = "-\dfrac{13}{53}"\left(x - 2\right)$

It is dependent upon them having attempted differentiation (may be only one term in $\dfrac{\mathrm{d}y}{\mathrm{d}x}$) and using $x = 2, y = 5$ to find the value of $-\dfrac{\mathrm{d}x}{\mathrm{d}y}$ which must be the negative reciprocal of their $\dfrac{\mathrm{d}y}{\mathrm{d}x}$

If the form $y = mx + c$ is used then the method must proceed as far as *c* = ...

A1: Correct answer or any integer multiple of this. The = 0 must be seen

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