Question Number	Scheme	Marks
5 (a)	$y = x^3 + 2x + 3 \Rightarrow \dfrac{\mathrm{d}y}{\mathrm{d}x} = 3x^2 + 2$ Gradient at $x = 2$ is $3 \times 2^2 + 2 = 14$	M1, A1 **(2)**
(b)	$y_Q = (2+h)^3 + 2(2+h) + 3 = 15 + 14h + 6h^2 + h^3$ Gradient PQ = $\dfrac{y_Q - y_P}{x_Q - x_P} = \dfrac{(15+14h+6h^2+h^3)-15}{2+h-2} = \dfrac{h^3+6h^2+14h}{h} = h^2 + 6h + 14$	M1, A1 dM1, A1 **(4)**
(c)	States as $h \to 0$ gradient of PQ tends to gradient of tangent	B1 **(1)** **(7 marks)**

(a) Note that no algebraic differentiation seen scores M0A0

M1: Attempts to substitute $x = 2$ into $\dfrac{\mathrm{d}y}{\mathrm{d}x} = ax^2 + b$. It can only be implied by 14 provided a correct derivative is seen.

A1: 14 provided M1 is scored. Minimum acceptable e.g. $3x^2 + 2 = 14$ Do not isw if e.g. they change 14 to $-\dfrac{1}{14}$

(b)

M1: Attempts to substitute $2 + h$ into $x^3 + 2x + 3$ and expand so that all brackets have been removed. Condone slips in expanding and any miscopying slips provided the intention is clear.

A1: $15 + 14h + 6h^2 + h^3$ but allow if the terms are not collected. May be implied by further work.

dM1: Dependent on the previous method mark.

Scored for attempting $\dfrac{y_Q - y_P}{x_Q - x_P} = \dfrac{('15+14h+6h^2+h^3')-15}{2+h-2}$ oe i.e. they must be subtracting the correct way round consistently for both the numerator and denominator.

The expression is sufficient and condone invisible brackets provided the intention is clear. May be implied by further work i.e. if all terms are divided by h already.

A1: $h^2 + 6h + 14$

Alt (b) Simultaneous equations

M1: Attempts the straight line equation $(2+h)^3+2(2+h)+3=(2+h)m+c$ and expands at least the left hand side so that all of the brackets have been removed. Condone slips in expanding and any miscopying slips provided the intention is clear.

A1: $15+14h+6h^2+h^3\left(=(2+h)m+c\right)$ (may be implied)

dM1: Attempts to solve simultaneously with the equation $15=2m+c$ and proceeds to find an expression for m

Look for $15+14h+6h^2+h^3=2m+hm+c \Rightarrow 15+14h+6h^2+h^3-2m-hm=15-2m$

$\Rightarrow 14h+6h^2+h^3=hm \Rightarrow m=...$

A1: $h^2+6h+14$

(c)

B1: States as $h\to 0$ oe (e.g. as h tends to 0) gradient of PQ tends to gradient of tangent oe

May say e.g. "as h tends to 0 the gradients will be the same".

Condone any sort of reference of tending towards 0 e.g. close to / near to / approaching / almost etc

Do not allow this mark for a reference of h being equal to 0 but condone use of equal/same for the relationship between the answers to part (a) and part (b) instead of referring to the gradient of PQ tending towards the gradient of the tangent at P.

May use other notation or words for gradient which is acceptable.

Question Number	Scheme	Marks
6(a)	$\sin BOA = \frac{7.3}{9} \Rightarrow BOA = 0.946$	M1, A1 **(2)**
(b)	Attempts e.g. $\frac{1}{2}\times 9^2 \times (\pi + '0.946') = ...$ OR e.g. $\frac{1}{2}\times 7.3 \times \sqrt{9^2 - 7.3^2}$	M1
	Attempts e.g. $\frac{1}{2}\times 9^2 \times (\pi + '0.946') - \frac{1}{2}\times 7.3 \times \sqrt{9^2 - 7.3^2} = ...$	dM1
	$= 146$ (cm^2)	A1 **(3)**
(c)	Attempts e.g. $9 \times (\pi + '0.946') = ...$ OR $9 + 7.3 + \sqrt{9^2 - 7.3^2}$	M1
	Attempts e.g. $9 \times (\pi + '0.946') + 9 + 7.3 + \sqrt{9^2 - 7.3^2} = ...$	dM1
	$= 58.4$ (cm)	A1 **(3)**
		(8 marks)

Work must be seen or used in the correct part to score

(a)

M1: A correct method to find the size of angle *BOA*. This mark can be scored for a correct equation which does not need to be rearranged. e.g. $\sin BOA = \frac{7.3}{9}$ or $\frac{9}{\sin\left(\frac{\pi}{2}\right)} = \frac{7.3}{\sin BOA}$ scores M1 Allow to work in degrees for this mark i.e. may see $\sin 90°$ instead.

Alternatively uses e.g. Pythagoras' theorem with the lengths in the correct places (but condone slips in rearranging) and forms a different correct equation using another trigonometric identity

A1: awrt 0.946

Note in (b) and (c) they may attempt to find areas or lengths and subtract from the area of the circle / the circumference of the circle.

(b)

M1: Attempts to find the area of sector *DOBCD* **OR** the area of triangle *OAB*

For sector *DOBCD* look for e.g. $\frac{1}{2}\times 9^2 \times (\pi + "0.946") = ...$ May be implied by awrt 166

May split the sector into sections e.g. a semi-circle and a smaller sector. They need to combine these together correctly for this mark. If just a value is stated you may need to check this on your calculator.

For area of triangle *OAB* look for e.g. $\frac{1}{2}\times 7.3 \times \sqrt{9^2 - 7.3^2}$, $\frac{1}{2}\times 7.3 \times 9 \times \sin\left(\frac{\pi}{2} - "0.946"\right)$ May be implied by awrt 19.2

dM1: Attempts both areas **AND** subtracts the correct way round. It is dependent on the previous method mark. If just a value is stated you may need to check this on your calculator.

Note there are a variety of different approaches to finding these areas so the overall method should be correct but allow for slips in processing.