Question	Scheme	Marks	AOs
5(a)	$2(3)^3-9(3)^2+5(3)+k=0\Rightarrow k=...$	**M1**	1.1b
	$54-81+15+k=0\Rightarrow k=12*$ or $-12+k=0\Rightarrow k=12*$	**A1***	1.1b
		(2)	
	(a) Alternative by verification:		
	$2(3)^3-9(3)^2+5(3)+12=0$	**M1**	1.1b
	$54-81+15+12=0$ Hence k = 12 *	**A1***	1.1b
		(2)	
(b)	$\int(2x^3-9x^2+5x+12)\,dx ...x^4\pm...x^3\pm...x^2\pm...x\pm...$	**M1**	3.1a
	$\frac{1}{2}(3)^4-3(3)^3+\frac{5}{2}(3)^2+12(3)+c=-10\Rightarrow c=...$	**dM1**	1.1b
	$(0,-28)$	**A1**	2.2a
		(3)	
			(5 marks)

Notes

(a) **Mark (a) and (b) together**

M1: Substitutes x = 3 completely into the given derivative, sets = 0 and solves for k.

e.g., $2(3)^3-9(3)^2+5(3)+k=0\Rightarrow k=...$

May be implied by e.g. $54-81+15+k=0\Rightarrow k=...$ with at least 2 correctly evaluated powers.

A1*: Obtains k = 12 with no errors seen and sufficient working shown. As a minimum you would need to see e.g., $2(3)^3-9(3)^2+5(3)+k=0\Rightarrow-12+k=0\Rightarrow k=12$ **or** $54-81+15+k=0\Rightarrow k=12$ **or** $2\times27-9\times9+5(3)+k=0\Rightarrow k=12$

But $2(3)^3-9(3)^2+5(3)+k=0\Rightarrow k=12$ scores M1A0 for lack of working

Note that some are just writing the expression for $\frac{dy}{dx}$, then write "sub in x = 3" but don't actually show 3 substituted in and then go on to write $-12+k=0$ leading to $k=12$ scores M0A0*.

Alternative:

M1: Substitutes x = 3 and k = 12 into the given derivative and attempts to evaluate

A1*: Correct work to obtain an answer of 0 with a (minimal) conclusion e.g., tick, hence proven etc.

As a minimum you would need to see e.g., $2(3)^3-9(3)^2+5(3)+12=54-81+15+12=0$ ✓

(b)

M1: Attempts to integrate. Evidence can be taken for integrating to obtain at least 2 from:

$2x^3\to...x^4$ or $-9x^2\to...x^3$ or $5x\to...x^2$ or $12\to...x$ where … are constants

dM1: Substitutes x = 3 into their integrated expression that includes a constant of integration, sets this equal to ±10 and proceeds to find their constant. **Depends on the previous mark.**

If the substitution is not shown this mark may be implied by their value for c or by their equation e.g., $18+c=\pm10$

A1: $(0,-28)$ Condone -28 or y = -28 but not just c = –28. There must be no other values or points.

Condone $(-28,\ 0)$ following y = -28

<u>Beware of circular arguments which avoid doing part (a) e.g.</u>

Integration is used on the given derivative to give y in terms of x, k and c

(3, –10) is substituted to give 3k + c = 8

Part (b) is then done first using k = 12 to find c = –28

This is then substituted into $3k + c = 8$ to give $k = 12$
This scores (a) M0A0 (b) M1dM1A1 (if –28 is identified as the intercept)

Alternative for part (a) using algebraic division:

$$
\begin{array}{r}
2x^2 - 3x \quad - 4 \\
x-3 \overline{\big) 2x^3 - 9x^2 + 5x + k} \\
\underline{2x^3 - 6x^2 \qquad\qquad} \\
-3x^2 + 5x \qquad \\
\underline{-3x^2 + 9x \qquad} \\
-4x + k \\
\underline{-4x + 12} \\
k - 12 \text{ (or 0)}
\end{array}
$$

leading to $k - 12 = 0$ and then $k = 12$.

M1: Attempts to divide the given cubic by $(x - 3)$ and proceeds as far as a remainder set = 0. Requires at least $2x^2 \pm 3x$.

A1*: Obtains $k = 12$ with no errors seen and sufficient working. Their algebraic division needs to be correct but allow them to have either $k - 12$ or 0 as their "remainder". If their remainder is given in their working as 0 they may proceed directly to $k = 12$.