Question Number	Scheme	Marks
3.	$\frac{dy}{dx}=\frac{4(x+3)^2-2(4x+1)(x+3)}{(x+3)^4}$	M1 A1
	Solves their $4(x+3)^2-2(4x+1)(x+3)=0$ $\Rightarrow (x+3)(10-4x)=0 \Rightarrow x=...$	M1
	Critical value of $\frac{5}{2}$; Critical value of -3	A1; B1
	C increasing when $\frac{dy}{dx}>0 \Rightarrow -3<x<\frac{5}{2}$	A1
		(6 marks)

Note this appears as M1A1M1A1M1A1 on epen but is being marked as M1A1M1A1B1A1

M1: Attempts the quotient rule and achieves

$$\frac{dy}{dx}=\frac{a(x+3)^2-b(4x+1)(x+3)}{(x+3)^4} \quad a,b>0 \quad \text{condoning slips}$$

They may attempt to multiply out the $(x+3)^2$ first which is fine as long as they reach a quadratic

Product rule may be attempted, look for $\frac{dy}{dx}=A(x+3)^{-2}-B(4x+1)(x+3)^{-3}$, $A,B>0$

Note: Only the numerator is required for this problem, and this mark can be awarded if a student attempts just $u'v-uv'=0$. If the denominator is considered it must be treated correctly.

A1: For a correct (unsimplified) $\frac{dy}{dx}$ or $u'v-uv'$ (if this is all that is considered). By the Product rule

$\frac{dy}{dx}=4(x+3)^{-2}-2(4x+1)(x+3)^{-3}$

M1: Solves their numerator/their $\frac{dy}{dx}$ = 0 (or with any inequality, and the "=0" may be implied) to obtain at least one critical value from a non-calculator method. If the numerator is expanded to a quadratic a method of solution must be shown (e.g. factorisation or completing the square or formula seen applied) They may be working with equalities or inequalities for this mark. Note this means students who cancel the $(x+3)$ and lose the second critical value can still score M1.

A1: Critical value of $\frac{5}{2}$ (allow equivalent fractions) found provided the previous M has been scored.

B1: Finds or identifies -3 as the other critical value (no need for method shown).

A1: Depends on first M. For $-3<x<\frac{5}{2}$ or $-3<x\leqslant\frac{5}{2}$ or equivalent set notation, e.g. $x\in\left(-3,\frac{5}{2}\right]$ Condone $-3\leqslant x\leqslant\frac{5}{2}$ or $-3\leqslant x<\frac{5}{2}$. Must be simplified fraction. Allow split inequalities $-3<x$ and $x<\frac{5}{2}$, condoning "or" or a comma between but if set notation used it must be intersection not union.

Note: If the denominator of $\frac{dy}{dx}$ is incorrectly treated but the numerator is correct, a correct answer may be achieved. In such cases award SC M0 A0 M1 A1 B1 A1 if the subsequent marks are earned.

Note: answers relying on calculator technology where roots appear from an unsimplified derivative can score maximum M1A1M0A0B1A1

Question Number	Scheme	Marks
4 (a)	$\dfrac{4x^3+2x^2+3x+8}{x^2+4} \equiv Ax+B+\dfrac{Cx+D}{x^2+4}$	
(i)	Any correct value of $A=4,\ B=2$ or $C=-13$	B1
	Full method to find values for A, B and C E.g. $4x^3+2x^2+3x+8 \equiv (Ax+B)(x^2+4)+Cx+D$ Or $x^2+0x+4\overline{)4x^3+2x^2+3x+8}$ $\begin{array}{l}4x+2\\ \\ \hline -13x\end{array}$	M1
	$A=4,\ B=2$ and $C=-13$	A1
(ii)	E.g. Using $4x^3+2x^2+3x+8 \equiv (Ax+B)(x^2+4)+Cx+D$ For example $x^2 \Rightarrow B=2 \qquad x=0 \Rightarrow 4\times 2+D=8 \qquad D=0$ *	B1*
		(4)
(b)	$\int\left(Ax+B+\dfrac{Cx}{x^2+4}\right)\mathrm{d}x=\dfrac{Ax^2}{2}+Bx,+\dfrac{1}{2}C\ln\left(k\left(x^2+4\right)\right)$ k any constant	B1 ft, M1 A1ft
	$\displaystyle\int_1^4 \frac{4x^3+2x^2+3x-8}{x^2+4}\,\mathrm{d}x=\left[2x^2+2x-\frac{13}{2}\ln\left(k\left(x^2+4\right)\right)\right]_1^4$	
	$=\left(32+8-\dfrac{13}{2}\ln 20\right)-\left(2+2-\dfrac{13}{2}\ln 5\right)=36+\dfrac{13}{2}\ln\dfrac{1}{4}=36-13\ln 2$	dM1 A1
		(5)
		(9 marks)

(a)(i) Note – mark part (a) as a whole.

B1: Any correct value of A, B or C. Must be correctly identified to its letter by label or position in the identity, not just a value.

M1: A full method to find values for A, B and C.

If they attempt $4x^3+2x^2+3x+8 \equiv (Ax+B)(x^2+4)+Cx+D$ the expression must be correct.

If they attempt by division then they must proceed to a linear quotient and a linear remainder. Alternative notations of long division may be seen. Correct values for A, B and C will imply the method mark.

A1: Correct A, B, C or correct expression.

Note: attempts at long division but mixing up the constants to give $-13x+\dfrac{4x+2}{x^2+4}$ can score the method mark only.