Question	Scheme	Marks
7	$(x+2)$ a factor $\Rightarrow f(-2)=0 \Rightarrow -8A+24+8+B=0$	**M1A1**
	$\int f(x)dx = \frac{A}{4}x^4 + 2x^3 - 2x^2 + Bx$	**M1 A1**
	$\int_3^5 f(x)dx = 176 \Rightarrow \left[\frac{A}{4}x^4 + 2x^3 - 2x^2 + Bx\right]_3^5 = 176$ $\Rightarrow \left(\frac{A}{4}5^4 + 2(5^3) - 2(5^2) + 5B\right) - \left(\frac{A}{4}3^4 + 2(3^3) - 2(3^2) + 3B\right) = 176$	**dM1**
	$\left.\begin{array}{l} 8A - B = 32 \\ 136A + 2B = 12 \end{array}\right\} \Rightarrow A = ..., B = ...$	**dM1**
	$A = \frac{1}{2},\ B = -28$	**A1**
		(7)
		(7 marks)

Notes:

M1: Uses the factor theorem or long division (see below) to find one linear **equation** relating *A* and *B*. The "= 0" must be seen or implied by later work.

A1: Correct equation. Award once a correct equation is seen unsimplified or simplified.

So allow e.g. $A(-2)^3 + 6(-2)^2 - 4(-2) + B = 0$ but not e.g. $A\times -2^3 + 6\times -2^2 - 4\times -2 + B = 0$

unless the indices are processed correctly subsequently to e.g. $-8A + 24 + 8 + B = 0$

The "= 0" must be seen or implied by later work.

M1: Attempts to integrate the given expression, look for at least one power increased by 1.

This can also be evidenced by $B \rightarrow Bx$

A1: Correct integration. Allow unsimplified e.g. $\frac{6x^{2+1}}{2+1}$ for $2x^3$

Condone poor notation e.g. $\int f(x)dx = \int \frac{A}{4}x^4 + 2x^3 - 2x^2 + Bx$ and ignore any "+ *c*"

dM1: Applies limits 5 and 3 either way round and subtracts and equates to 176 to obtain an equation in *A* and *B*. **Depends on <u>previous</u> M.**

Condone poor use of brackets when subtracting e.g. allow

$$\frac{A}{4}5^4 + 2(5^3) - 2(5^2) + 5B - \frac{A}{4}3^4 + 2(3^3) - 2(3^2) + 3B = 176$$

dM1: Solves their two equations in *A* and *B* to find values for both constants.

Depends on <u>all previous</u> M marks <u>but allow this mark if the only error was to attempt f (2) = 0 at the beginning</u>.

A1: Correct values.

Note that some candidates eliminate *A* or *B* by rearranging the first equation and substituting into the integral. This essentially follows the main scheme:

$\mathrm{f}(-2)=0 \Rightarrow -8A+24+8+B=0 \Rightarrow B=8A-32$	**M1A1**
$\int \mathrm{f}(x)\mathrm{d}x = \frac{A}{4}x^4+2x^3-2x^2+8Ax-32x$	**M1A1**
$\Rightarrow \left(\frac{A}{4}5^4+2(5^3)-2(5^2)+40A-160\right)-\left(\frac{A}{4}3^4+2(3^3)-2(3^2)+24A-96\right)=176$	**dM1**
$\Rightarrow A=...,\ \ B=...$	**dM1**
$A=\frac{1}{2},\ B=-28$	**A1**
Long Division for reference: $Ax^2+(6-2A)x+4A-16$ $x+2 \overline{)\ Ax^3+6x^2-4x+B}$ Ax^3+2Ax^2 $(6-2A)x^2-4x+B$ $(6-2A)x^2+(12-4A)x$ $(4A-16)x+B$ $(4A-16)x+8A-32$ $B-8A+32$ Score the first M1 for a complete method to obtain a remainder in terms of A and B that is set = 0 and A1 for a correct equation e.g. $B-8A+32=0$	

Question	Scheme	Marks
8(a)	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)Ax^3+B+\frac{C}{x^3}$	**M1**
	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)4\times256x^3-304-2\times27x^{-3}$ oe e.g. $1024x^3-304-\frac{54}{x^3}$	**A1A1**
		(3)
(b)	$\frac{\mathrm{d}y}{\mathrm{d}x}=0$ at SP $\Rightarrow 1024x^3-304-\frac{54}{x^3}=0\Rightarrow 1024x^6-304x^3-54=0$	**M1**
	$\Rightarrow 512\left(x^3\right)^2-152x^3-27=0\Rightarrow\left(8x^3+1\right)\left(64x^3-27\right)=0\Rightarrow x^3=...$	**dM1**
	$x^3=-\frac{1}{8}$ or $x^3=\frac{27}{64}$ or $x=-\frac{1}{2}$ or $x=\frac{3}{4}$	**A1**
	$y=256\left("-\frac{1}{2}"\right)^4-304\left("-\frac{1}{2}"\right)-35+\frac{27}{\left("-1/2"\right)^2}=...$ or with $x=\frac{3}{4}$	**dM1**
	Coordinates are $\left(-\frac{1}{2},241\right)$ and $\left(\frac{3}{4},-134\right)$	**A1**
		(5)
		(8 marks)

Notes:

(a)

M1: Attempts the derivative, with at least two terms of the correct form (ie $x^n\rightarrow..x^{n-1}$ at least twice).

A1: At least two terms correct, need not be simplified.

A1: Fully correct derivative, need not be simplified. Isw after a correct (unsimplified) answer.

Note that there is no need to see the $"\frac{\mathrm{d}y}{\mathrm{d}x}="$ in (a) just look for the differentiation.

Ignore any spurious "= 0"

(b)

M1: Sets their derivative equal to zero and multiplies through by "x^3" to achieve a polynomial equation. If in doubt at least 2 terms must be multiplied.

Allow equivalent work e.g.

$1024x^3-304-\frac{54}{x^3}=0\Rightarrow\frac{1}{x^3}\left(1024x^6-304x^3-54\right)=0\Rightarrow 1024x^6-304x^3-54=0$

To score this mark, the derivative must have a negative power of x so allow for e.g.

$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)1024x^3-304-54x^{-1}=0\Rightarrow 1024x^4-304x-54=0$

dM1: Solves a 3 term quadratic in x^3 by any valid means (including calculator).

Must come from an attempt at $\frac{\mathrm{d}y}{\mathrm{d}x}=0$ not $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}=0$ or $\int y\,\mathrm{d}x=0$

Condone use of inequalities rather than "=" as long as they solve an equation.