Question Number	Scheme	Marks
3	$\int_1^4 3x+\frac{16}{x^2}-8\,\mathrm{d}x=\frac{3}{2}x^2-\frac{16}{x}-8x \quad (+c)$ e.g. Area $=\frac{3}{2}(5+11)-\left[\frac{3}{2}x^2-\frac{16}{x}-8x\right]_1^4=24-\left(-12+\frac{45}{2}\right)=\frac{27}{2}$	M1, A1, A1 dM1, A1 **(5)** **(5 marks)**

M1: Attempts to integrate the curve and achieves at least one term with the correct index i.e. $x\to x^2$, $x^{-2}\to x^{-1}$ or $-8\to\pm 8x$ (indices do not need to be processed for this mark e.g. $x\to x^{1+1}$)

A1: Two correct terms from $\frac{3}{2}x^2-\frac{16}{x}-8x$, may be unsimplified but indices must be processed.
Allow equivalent forms.

A1: $\frac{3}{2}x^2-\frac{16}{x}-8x$, may be unsimplified. Allow the presence of the constant of integration.
Do not be concerned with spurious notation or any limits.

dM1: Full method including correct area (value or expression) of trapezium. The expression with correct limits substituted in or partially evaluated as evidence is sufficient for this mark and condone subtracting either way round. They cannot just proceed to the final answer without additional evidence of using the limits. Note area of trapezium = 24, area under curve = 10.5.
Condone slips in evaluating some of the terms provided the intention is clear.

A1: 13.5 o.e following all previous marks scored. Note if they use the limits the wrong way round resulting in a negative value for the integral then we must see that calculated correctly before they state the area is 13.5

Alternative: line – curve

$$\int_1^4 (13-2x)-\left(3x+\frac{16}{x^2}-8\right)\mathrm{d}x=\int_1^4\left(-5x-\frac{16}{x^2}+21\right)\mathrm{d}x=\left[-\frac{5x^2}{2}+\frac{16}{x}+21x\right]_1^4=48-\frac{69}{2}=\frac{27}{2}$$

Note: They may not fully simplify/collect terms in this method so score according to the main scheme for the first 3 marks.

M1: Attempts to integrate and achieves at least one term with the correct index . i.e. $x\to x^2$, $x^{-2}\to x^{-1}$ or $"21"\to"\pm 21"x$ (allow slips in their collecting terms). Indices do not need to be processed for this mark.

A1: Two correct terms from $-\frac{5x^2}{2}+\frac{16}{x}+21x$, which may be unsimplified but indices must be processed.
Allow equivalent forms including terms which have not been collected.

A1: Correct integration, may be unsimplified. Allow the presence of the constant of integration.
Allow equivalent forms including terms which have not been collected.
Do not be concerned with spurious notation or any limits.

dM1: Full method (condoning an incorrect equation for the line). Scored for

e.g. $\int_1^4 (13-2x)-\left(3x+\frac{16}{x^2}-8\right)\mathrm{d}x=\left[\left(13x-x^2\right)-\left(\frac{3}{2}x^2-\frac{16}{x}-8x\right)\right]_1^4=\ldots$

The expression with correct limits substituted in or partially evaluated is sufficient for this mark and condone subtracting either way round.

Condone slips in finding the straight line, evaluating some terms or collecting terms incorrectly provided the intention is clear.

A1: 13.5 o.e following all previous marks scored. Note if they use the limits the wrong way round resulting in a negative value then we must see that calculated correctly before they state the area is 13.5

There will be variations of these two methods but should mark similarly. Send to review if you are unsure.

Note for those who attempt curve-line

$$\int_1^4\left(3x+\frac{16}{x^2}-8\right)-(13-2x)-\mathrm{d}x=\int_1^4\left(5x+\frac{16}{x^2}-21\right)\mathrm{d}x=\left[\frac{5x^2}{2}-\frac{16}{x}-21x\right]_1^4=-48+\frac{69}{2}=-\frac{27}{2}$$

Allow to score M1A1A1dM1A0 but accept the final A1 to be scored if they subsequently state the area is $\frac{27}{2}$

(i.e. they cannot just write $\frac{27}{2}$ as the answer to this integral)

Question Number	Scheme	Marks
4(a)	$\mathrm{f}(x)=ax^3+bx^2+5x-3$ Sets $\mathrm{f}(-3)=0\rightarrow\ a\times(-3)^3+b\times(-3)^2+5\times(-3)-3=0$ $\Rightarrow -27a+9b=18\Rightarrow\ b=3a+2$ *	M1 A1* **(2)**
(b)	Sets $\mathrm{f}\left(\frac{1}{2}\right)=\frac{7}{4}\rightarrow\ a\times\left(\frac{1}{2}\right)^3+b\times\left(\frac{1}{2}\right)^2+5\times\left(\frac{1}{2}\right)-3=\frac{7}{4}$ $a+2b=18$ Solves $b=3a+2$ with their $a+2b=18\Rightarrow a=...,b=...$ $a=2,b=8$	M1 A1 M1 A1 **(4)**
(c)	e.g. $\dfrac{2x^3+8x^2+5x-3}{x-2}=\left(...x^2+...x+...\right)+\text{Remainder}$ (Quotient =) $2x^2+12x+29$ Remainder = 55	M1 A1 B1 **(3)** **(9 marks)**

(a)

M1: Sets $\mathrm{f}(-3)=0$ and proceeds to an equation in *a* and *b* Condone sign slips.
Score when you see embedded values within the equation or two correct simplified terms on the lhs of the equation. The = 0 may be implied by further work which is not the given answer.

A1*: Completes proof with no errors including brackets and at least one intermediate stage of working such as $-27a+9b=18$ **and** = 0 **must be seen** somewhere in their solution.

Alt I

M1: Attempts to divide by $x+3$ and sets their remainder in *a* and *b* = 0. May be seen in a variety of forms such as the grid or box method. Condone slips provided they are attempting to divide by $x+3$ and set their remainder in *a* and *b* equal to 0. The = 0 may be implied by further work which is not the given answer.

$$\begin{array}{r} ax^2+(b-3a)x+5-3(b-3a) \\ x+3\overline{)\ ax^3\quad +bx^2\quad +5x\quad -3} \\ ax^3\quad +3ax^2 \\ (b-3a)x^2\quad +5x \\ (b-3a)x^2\quad +3(b-3a)x \\ \left(5-3(b-3a)\right)x\quad -3 \\ \left(5-3(b-3a)\right)x+15-9(b-3a) \end{array} \qquad \Rightarrow -3-(15-9(b-3a))=0$$

A1*: Completes proof with no errors seen and an intermediate stage of working such as $-18+9(b-3a)=0\Rightarrow b=3a+2$ * (= 0 **must be seen** somewhere in their solution)