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)

Alt II

M1: Substitutes in $b=3a+2$, sets $\text{f}(-3)=0\rightarrow$ equation in *a* or *b* only Condone sign slips.

Score when you see embedded values within the equation or two correct terms on the lhs of the equation.

A1*: Completes proof and achieves $0=0$ concluding that $b=3a+2$

(b) Note they may have substituted in $b=3a+2$ early so the equation will be in *a* only or *b* only

M1: Sets $\text{f}\left(\frac{1}{2}\right)=\frac{7}{4}$ o.e. and proceeds to an equation in *a* and *b*.

Condone slips provided they set their remainder in *a* and *b* equal to $\frac{7}{4}$ o.e. (e.g. $\text{f}\left(\frac{1}{2}\right)-\frac{7}{4}=0$)

May use algebraic division or e.g. grid method.

$$2x-1\overline{)\,ax^3+bx^2+5x-3}\qquad \frac{a}{2}x^2+\frac{1}{2}\left(b+\frac{a}{2}\right)x+\frac{5}{2}+\frac{1}{4}\left(b+\frac{a}{2}\right)$$

$$ax^3-\frac{a}{2}x^2$$

$$\left(b+\frac{a}{2}\right)x^2+5x \qquad \Rightarrow -3-\left(-\frac{5}{2}-\frac{1}{4}\left(b+\frac{a}{2}\right)\right)=\frac{7}{4}$$

$$\left(b+\frac{a}{2}\right)x^2-\frac{1}{2}\left(b+\frac{a}{2}\right)x$$

$$\left(5+\frac{1}{2}\left(b+\frac{a}{2}\right)\right)x-3$$

$$\left(5+\frac{1}{2}\left(b+\frac{a}{2}\right)\right)x-\frac{5}{2}-\frac{1}{4}\left(b+\frac{a}{2}\right)$$

A1: $a+2b=18$ or other simplified equivalent including $\frac{1}{8}a+\frac{1}{4}b=\frac{9}{4}$ which may only be in *a* or only in *b*.

e.g. $7a=14$

M1: Solves $b=3a+2$ with their $a+2b=18\Rightarrow a=...,b=...$

You do not need to be concerned with the mechanics of the rearrangement. Award as long as values appear for both *a* and *b* (both non zero) (which may be found using a calculator)

A1: $a=2,b=8$

(c) In EPEN this is M1A1A1 but we are marking this M1A1B1

M1: Attempts to divide the cubic with their values for *a* and *b* by $(x-2)$ and proceeds to a quadratic quotient $ax^2+...x+...$. where *a* is the value found in (b). It is not a requirement to proceed to a value for *R* for this mark, but their method must allow for it to be found. If *R* is stated as 0 then M0. Condone slips.

If they attempt $2x^3+8x^2+5x-3=(x-2)\left(ax^2+bx+c\right)+R\Rightarrow a=..,b=...,c=...,\left(R=...\right)$

A1: Quotient $=2x^2+12x+29$ which can be extracted from their working e.g. on the top line of their algebraic division or $(x-2)\left(2x^2+12x+29\right)+R$ isw

B1: Remainder = 55 which can be extracted from their working. isw

May also be written in the expression $(x-2)\left(2x^2+12x+29\right)+55$

Question Number	Scheme	Marks
5(a)	Identifies $h = 1.5$	B1
	Area = $\frac{1.5}{2}\{12 + 0.023 + 2(4.243 + 1.5 + 0.530 + 0.188 + 0.066)\}$	M1
	$= 18.8$	A1
		(3)
(b) (i)	$\int_{-2}^{7} 3\left(\frac{1}{2}\right)^{x+2} \mathrm{d}x = \frac{1}{4}\int_{-2}^{7} 3\left(\frac{1}{2}\right)^{x} \mathrm{d}x = \frac{1}{4} \times "18.8" = 4.7$	B1ft
(ii)	$\int_{-2}^{7} \left(2^{-x} + 2x\right) \mathrm{d}x = \frac{1}{3} \times "18.8" + \left[x^2\right]_{-2}^{7} = 51.3$	M1, A1ft
		(3)
		(6 marks)

(a) Note that awrt 18.8 with no working is 0 marks

B1: Identifies $h = 1.5$ or may be implied by e.g. 0.75 oe outside of the bracket in the expression for the area

M1: Correct method of finding the area. Requires $\frac{1}{2} \times$ *their* $h \times$ correct bracket structure but condone the omission of a trailing bracket. Allow $h = 1$ if stated but if only an expression is seen then it must be correct. Allow equivalent expressions e.g. they may add together individual trapezia.
Condone invisible brackets to be implied by further work or awrt 18.8 but do not allow just awrt 18.8 with no working seen to score this mark. Condone slips on the digits of the heights, e.g 4.234 for 4.243

A1: 18.8 or better (18.80775) following M1. i.e. if they have carried out the calculation and their 18.8 does not come from 18.0775 (allow truncating or rounding) then A0. Isw
Note that the calculator answer is 17.2785...

(b) Note in part (b) they may have rounded their value in part (a) as their final answer (e.g. 18.8) but then used an earlier unrounded value in part (b). They must give an answer in part (b) that is at least 1dp for the B1ft in (i) and/or A1ft (ii) to be awarded. You will need to check their follow through answers if (a) is incorrect.

Do not accept solutions in (b) which involve re-doing the table of values and attempting the trapezium rule again.

(b)(i) Note if they have awrt 17.3 in (a) then this mark cannot be scored unless we see $\frac{1}{4} \times$ awrt 17.3

B1ft: Calculates $\frac{1}{4} \times "18.8" = "4.7"$

Note that the calculator answer is 4.3196...

(b)(ii) Note if they have awrt 17.3 in (a) then A1ft can be scored following M1.

M1: Recognises that $\int_{-2}^{7} \left(2^{-x}\right) \mathrm{d}x = \frac{1}{3} \times \int_{-2}^{7} 3\left(\frac{1}{2}\right)^{x} \mathrm{d}x$ AND integrates $2x$ to x^2. We must see the x^2 or allow to be implied by limits substituted in and subtracting e.g. $7^2 - (-2)^2$ (or $7^2 - 2^2$ or $49 - 4$) but not just 45

A1ft: 51.3 or ft on their answer to part (a) by adding 45 to $\frac{1}{3} \times "18.8"$. Allow fractions e.g. $\frac{769}{15}$

Note that the calculator answer is 50.7595...