Question Number	Scheme	Marks
3.(a)	$300\,000 = 3\times 2^{-k} \Rightarrow 2^{-k} = 100000 \Rightarrow -k = \dfrac{\log 100000}{\log 2}$	M1
	$(k) = -16.61$	A1
		(2)
(b) (i)	Strip width = 1.5	B1
	$\dfrac{1.5}{2}\{4.243 + 0.023 + 2(1.5 + 0.530 + 0.188 + 0.066)\}$ = 6.63	M1, A1
		(3)
(ii)	$\displaystyle\int_{-0.5}^{7} 2^{-x}\,\mathrm{d}x + \int_{-7}^{0.5} 2^{x}\,\mathrm{d}x = \frac{1}{3}\times\text{"6.63"} + \frac{1}{3}\times\text{"6.63"} = 4.42$	M1, A1
		(2)
		(7 marks)

(a)

M1: Correct **use of logs** leading to an expression or value for x or $-x$.

Alternatively applies the correct **use of logs** leading to an expression for k or $-k$

There are lots of variations, examples of which include

- $(\pm k) = \dfrac{\log 100000}{\log 2}$, $(\pm x) = \log_2 \dfrac{1}{100000}$ and $(\pm x) = \dfrac{\ln 100000}{\ln 2}$
- $300\,000 = 3\times 2^{-k} \Rightarrow \log 300000 = \log 3 - k\log 2 \Rightarrow k = \ldots$

Condone a slip on the number of zeros (4 or 6 zeros can still score this method mark)

It cannot be scored if they incorrectly combine the 3 and the 2 and work from $6^{-k} = 300\,000$

A1: AWRT –16.61 following M1. ISW after a correct answer

Note that the answer only is M0, A0. The demand is that the candidates use logs

(b)(i)

B1: Correct strip width. E.g. States or uses $h = 1.5$. Condone it being unprocessed.
E.g. $\frac{7-(-0.5)}{5}$ o.e.

Can be implied by a correct h value within an attempted trapezium rule which does not need to be perfect. A correct application would be
$\frac{1.5}{2}\{4.243+0.023+2(1.5+0.530+0.188+0.066)\}$ or
$0.75\{4.243+0.023+2(1.5+0.530+0.188+0.066)\}$

M1: Correct application of the trapezium rule
$\frac{"h"}{2}\{4.243+0.023+2(1.5+0.530+0.188+0.066)\}$

Condone slips on values but there must be the correct number of them and they must be in the correct place within the formula.

Condone a missing trailing bracket, but hard to decipher bracketing can be awarded this mark only if followed by awrt 6.6. Answers only score M0

A1: awrt 6.63 (Answer in full is 6.6255). ISW after a correct answer

Note that the calculator answer for this integral is 6.087

(b)(ii) Attempts to (b)(ii) must use their answer to (b)(i) but could use an additional attempt at the trapezium rule on $\int_{-7}^{0.5} 2^x \, dx$ with $h = 1.5$ or smaller

M1: Attempts to find $\frac{2}{3}\times"6.63"$ or alternatively $\frac{1}{3}\times"6.63"+\frac{1}{3}\times"6.63"$ following through on their 6.63

Note that $\frac{1}{3}\times"6.63"+2.03 = 4.24$ is M0 as 2.03 is the calculator answer for $\int_{-7}^{0.5} 2^x \, dx$

A1: 4.42. Allow 4.417 or awrt 4.42 if the full answer is used.

Note that the calculator answer for the sum of the two integrals is 4.058...

Question Number	Scheme	Marks
4 (a)	$f(x)=4x^3+13x^2-10x+8$ $x-2\overline{)4x^3+13x^2-10x+8}$ $\quad 4x^2+21x+32$ $4x^3-8x^2$ $21x^2-10x$ $21x^2-42x$ $32x+8$ $32x-64$ 72 Synthetic Division $2 \mid 4 \quad 13 \quad -10 \quad 8$ $\quad\quad 8 \quad 42 \quad 64$ $4 \quad 21 \quad 32 \mid 72$	
(i)	$Q(x)=4x^2+21x+32$	M1, A1
(ii)	$R=72$	M1, A1 **(4)**
(b)(i)	Attempts $f(-4)=4\times-64+13\times16-10\times-4+8$ $=-256+208+40+8=0$ Hence $(x+4)$ is a factor *	M1 A1*
(ii)	$f(x)=4x^3+13x^2-10x+8=(x+4)(4x^2-3x+2)$	M1
	For their $4x^2-3x+2$ attempts "b^2-4ac"$=9-32$, $b^2-4ac'<0$ so $4x^2-3x+2$ has no real roots and $f(x)=0$ has one at $x=-4$	M1 A1* **(5)**
(c)	$(f'(x))=12x^2+26x-10=2(3x-1)(2x+5)$ $-\frac{5}{2}<x<\frac{1}{3}$	M1 dM1, A1 **(3)** **(12 marks)**

(a) (i)

M1: Attempts to divide $f(x)$ by $(x-2)$ and achieves a 3TQ quotient of the form $4x^2+bx+c \quad b\neq 0, c\neq 0$ **AND** a remainder that is a constant. See equivalent form using synthetic division

A1: Achieves a Quotient or $Q(x)=4x^2+21x+32$. It is implied if they write (i) $4x^2+21x+32$

It cannot just be awarded from the expression within the division sum

(a) (ii)