Question	Scheme	Marks
4(a)	$\left(2+\frac{x}{8}\right)^{13} = 8192 + ...$	B1
	$+\underline{\binom{13}{1}}2^{12}\left(\frac{x}{8}\right)^{1} + \underline{\binom{13}{2}}2^{11}\left(\frac{x}{8}\right)^{2} + \underline{\binom{13}{3}}2^{10}\left(\frac{x}{8}\right)^{3} + ...$	M1
	$\left(2+\frac{x}{8}\right)^{13} = (8192) + 6656x + 2496x^2 + 572x^3 + ...$	A1A1
		(4)
(b)	$\frac{x}{8} = 0.0125 \Rightarrow x = 0.1$	B1
	$2.0125^{13} \approx 8192 + 665.6 + 24.96 + 0.572$	M1
	$= 8883.132$ cao	A1
		(3)
(c)	As all the terms in the expansion are positive, the truncated series will give an underestimate of the actual value.	B1
		(1)
		(8 marks)

Notes:

(a)

B1: For the correct constant term of 8192 in their expression. Do not accept 2^{13}

M1: Correct binomial coefficients linked with correct powers of x at least twice in the x, x^2 and x^3 terms in their expansion. Accept alternative notation, such as ${}^{13}C_1$ or just 13 etc, for the coefficients. (The power 1 need not be seen.) The powers of 2 and the 8's may be missing or incorrect.

A1: Any two of the final three terms correct. (See also note below.)

A1: All three of the final terms correct.

Note: Students may attempt to take out a common factor of 2^{13} first. In such cases the **B** mark is for correct constant term in their final expansion, **M** follows as above, correct coefficients linked to correct powers of x. The first **A** can be awarded as above or SC $8192\left(1+\frac{13}{16}x+\frac{39}{128}x^2+\frac{143}{2048}x^3\right)$ (oe), final **A** as scheme

(b)

B1: Identifies $x = 0.1$ needs to be substituted into the expression.

M1: Substitutes their $x = 0.1$ into their answer to (a)

A1: Correct answer only, must be to 3 dp.

(c)

B1: States or implies underestimate with correct explanation of why the answer found is an underestimate. Must refer to terms in the expansion being positive or equivalent wording. Do not accept just "as adding more terms" without reference to the terms being non-negative.

If all that is done is a comparison with the true value, then B0.

Question	Scheme	Marks
5(a)	$h = \frac{1}{4}$	B1
	$A \approx \left(\frac{1}{2}\times\frac{1}{4}\right)\left\{5.453+5+2\left(7.764+...+7.626\right)\right\}$	M1
	$A \approx \left(\frac{1}{2}\times\frac{1}{4}\right)\left\{5.453+5+2\left(7.764+9.375+9.964+9.367+7.626\right)\right\}$	A1
	= awrt 12.33	A1
		(4)
(b)	$\int x^{\frac{3}{2}} - 3x + 9\,\mathrm{d}x = kx^{\frac{5}{2}} - lx^2 + mx$ (at least two powers correct)	M1
	$\int x^{\frac{3}{2}} - 3x + 9\,\mathrm{d}x = \frac{2}{5}x^{\frac{5}{2}} - \frac{3}{2}x^2 + 9x\,(+c)$	A1A1
		(3)
(c)	$\left[\frac{2}{5}x^{\frac{5}{2}} - \frac{3}{2}x^2 + 9x\right]_{\frac{5}{2}}^{4} = \left(\frac{2}{5}\times 4^{\frac{5}{2}} - \frac{3}{2}\times 4^2 + 9\times 4\right) - \left(\frac{2}{5}\left(\frac{5}{2}\right)^{\frac{5}{2}} - \frac{3}{2}\left(\frac{5}{2}\right)^2 + 9\left(\frac{5}{2}\right)\right) = ...$ $\left(= 24.8 - 17.077... = 7.722...\right)$	M1
	Area R = "12.33" – "7.722" = …	M1
	= awrt 4.6	A1
		(3)
		(10 marks)

Notes:

(a)

B1: For using $h = 0.25$ or equivalent. Score for sight of $h = 0.25$ or $\frac{1}{2}\times\frac{1}{4}$ or just $\frac{1}{8}$ outside the brackets.

M1: Correct bracket structure for the trapezium rule. Look for "$h/2$"(first + last y values + 2(attempt at sum of remaining values)). If one value is missing, allow the M as a slip, but M0 if 1st or last value repeated. Must be y values used. Incorrect/invisible external bracketing may be recovered by implication.

A1: Correct bracket "$h/2$"{…} with all 7 y values used, though allow a minor miscopy of a term if it is clear the correct value is meant. May be implied by the correct answer.

A1: awrt 12.33

(b)

M1: Attempts to integrate. Power to increase by 1 in at least two terms.

A1: Any two terms correct.

A1: Fully correct. No need for constant of integration. Need not be simplified.

(c)

M1: Applies limits of 2.5 and 4 to their answer to (b) to get the area under C_2. Limits may be either way around for this mark. May be implied by awrt 7.72 and allow if scored from a calculator.