Question Number	Scheme	Marks
10a	$\dfrac{(x-k)^2}{\sqrt{x}} = \dfrac{x^2-2kx+k^2}{x^{\frac{1}{2}}} = \dfrac{x^2}{x^{\frac{1}{2}}} - \dfrac{2kx}{x^{\frac{1}{2}}} + \dfrac{k^2}{x^{\frac{1}{2}}} = x^{\frac{3}{2}} - 2kx^{\frac{1}{2}} + k^2x^{-\frac{1}{2}}$	M1
	$\int_1^{16} x^{\frac{3}{2}} - 2kx^{\frac{1}{2}} + k^2x^{-\frac{1}{2}}\,\mathrm{d}x = \left[\dfrac{2}{5}x^{\frac{5}{2}} - \dfrac{4}{3}kx^{\frac{3}{2}} + 2k^2x^{\frac{1}{2}}\right]_1^{16}$	M1A1
	$\dfrac{2}{5}(16)^{\frac{5}{2}} - \dfrac{4}{3}k(16)^{\frac{3}{2}} + 2k^2(16)^{\frac{1}{2}} - \dfrac{2}{5} + \dfrac{4}{3}k - 2k^2 = 6k^2 - 84k + \dfrac{2046}{5}$	dM1A1
		(5)
b	$9 = \dfrac{(1-k)^2}{\sqrt{1}} \Rightarrow 9 = (1-k)^2$	M1
	$k = 4$ only *	A1*
		(2)
c	$q = 36$	B1
	$\dfrac{1}{2}(9+"36")\times 15 - \left("6"(4)^2 - "84"(4) + \dfrac{2046}{5}\right) = \dfrac{1683}{10}$	M1A1
		(3)
		(10 marks)

(a)

M1 Attempts to multiply out the numerator and split the fraction into separate terms. Score for one term with a correct index (which must be processed). Any attempts via substitution e.g. setting $u = \sqrt{x}$ send to review. Condone poor attempts at multiplying out the brackets such that $(x-k)^2 \Rightarrow x^2 \pm k^2$

M1 Attempts to raise the power (which must be a fraction or decimal) by one on one of their terms. (The index does not need to be processed).

A1 $\dfrac{2}{5}x^{\frac{5}{2}} - \dfrac{4}{3}kx^{\frac{3}{2}} + 2k^2x^{\frac{1}{2}}$ or unsimplified equivalent. Indices must be processed. Ignore any spurious notation around the expression. May be with or without $+c$

dM1 Substitutes in 16 and 1 for *x* and subtracts either way round. The values embedded are sufficient and condone invisible brackets. It is dependent on the previous method mark.

A1 $6k^2 - 84k + \dfrac{2046}{5}$ o.e. e.g. $6k^2 - 84k + 409.2$ isw after a correct answer is seen, but withhold this mark if there is spurious notation such as $\int$ or $\mathrm{d}x$ at either the start or end of the answer.

(b)

M1 Substitutes the coordinates of *A* into the equation for *C* or, alternatively, substitutes in the coordinates of *A* and $k = 4$ into the equation for *C*.

A1* Solves either:

- $9 = (1-k)^2 \Rightarrow k = ...$
- $k^2 - 2k - 8 = 0$ with terms collected to a 3TQ via any allowable method including via a calculator.

With either method they must proceed to $k = 4$ only with no errors seen, including invisible brackets. If -2 is found it must be rejected or 4 clearly selected. If they use $k = 4$ in their solution, then there must be a minimal conclusion.

(c)

B1 $q = 36$ seen (may be in (b) or on the diagram) or implied for example by a correct area of a triangle or trapezium.

M1 Attempts to find the area of *R* using their *q* and **their answer to part (a)**. Condone arithmetical slips and do not be concerned with poor notation for this mark. Must proceed to find a value for the area but condone subtracting areas the wrong way round which may result in a negative area.

Possible methods include:

e.g. Line – curve: $\int_1^{16} \frac{9}{5}x + \frac{36}{5}\mathrm{d}x$ – part (a) with $k = 4$

e.g. Area of trapezium ($= 337.5$) – part (a) with $k = 4$

Note: the correct values if the trapezium is split into a rectangle and a triangle are 135 and 202.5, respectively.

For evidence of use of part (a), look for $k = 4$ to be substituted into their part (a) answer, or may be implied by a correct value for their $6k^2 - 84k + \frac{2046}{5}$ with $k = 4$

Condone $\int_1^{16} \frac{(x-k)^2}{\sqrt{x}}\mathrm{d}x = 169.2$ provided their part (a) is correct

A1 $\frac{1683}{10}$ oe (ignore units) Condone spurious notation.

Withhold this mark if their method results in a negative area but they just omit the negative sign. They would need to indicate area is positive for e.g. $A = ... - .... = -\frac{1683}{10}$ so $A = \frac{1683}{10}$

Question Number	Scheme	Marks
11a	$u_2 = b - 3a$ $u_3 = b - a(b-3a) \quad \left(= b - ab + 3a^2\right)$	B1 B1
		(2)
b	$3 + b - 3a + b - a(b-3a) = 153$ oe $3 + (a+9) - 3a + (a+9) - a((a+9) - 3a) = 153 \Rightarrow 2a^2 - 10a - 132 = 0$ $\Rightarrow a^2 - 5a - 66 = 0$ *	M1 dM1A1*
		(3)
c	$a = -6$ $b = 9 - 6 = 3 \Rightarrow u_2 = 3 - 3(-6) = 21$ or $u_2 = 9 - 2a = 9 - 2\times -6 = 21$	B1 M1A1
		(3)
		(8 marks)

(a) **Check next to the question. If there is a contradiction between the answer next to the question and the answer in the main body of the work then the answer in the main body of the work takes precedence.**

B1 $\left(u_2 =\right) b - 3a$ oe

B1 $\left(u_3 =\right) b - a(b-3a)$ oe isw

(b)

M1 Attempts to add 3, their u_2 and their u_3 and sets equal to 153. Condone slips in their copying of their expressions for u_2 and u_3. Invisible brackets may be implied by further work.

May be in terms of *a* or *b* only if they substitute in $b = a + 9$ at the same time.

e.g. $3 + a + 9 - 3a + a + 9 - a(a + 9 - 3a) = 153$

dM1 Attempts to substitute $b = a + 9$ into their equation and then attempts to collect terms to achieve a 3TQ in *a* (condone the omission of = 0). The three terms do not all need to be on the same side of the equation. It is dependent on them having a u_3 term which would lead to an a^2 term. Do not be too concerned by the mechanics of their rearrangement for this mark. It is dependent on the previous method mark.

A1* Achieves the given answer with no arithmetical errors seen. Condone recovery of missing brackets, provided the recovery is before the final answer. Must see at least one intermediate stage of working following an equation in *a* only, before proceeding to the given quadratic equation.

(c)

B1 $a = -6$ seen or used in (c). Ignore the positive root for this mark.

M1 Attempts to substitute their negative root into $b = a + 9$ to find a value for *b* and then uses these in their expression for u_2 to find a value for u_2

Alternatively, attempts to substitute both their negative root and $b = a + 9$ into their expression for u_2 and proceeds to find a value for u_2

Ignore working relating to where they repeat the calculations to find u_2 using their positive root

May be implied by their answer (you may need to check this)

Note: For candidates who have two roots of the same sign then this mark can be awarded for using their smaller value (i.e. most negative/least positive) and proceeding to find a value for u_2

A1 21 only cao (if two answers are reached they must select 21 or reject the other answer)

Correct answer on its own scores full marks.