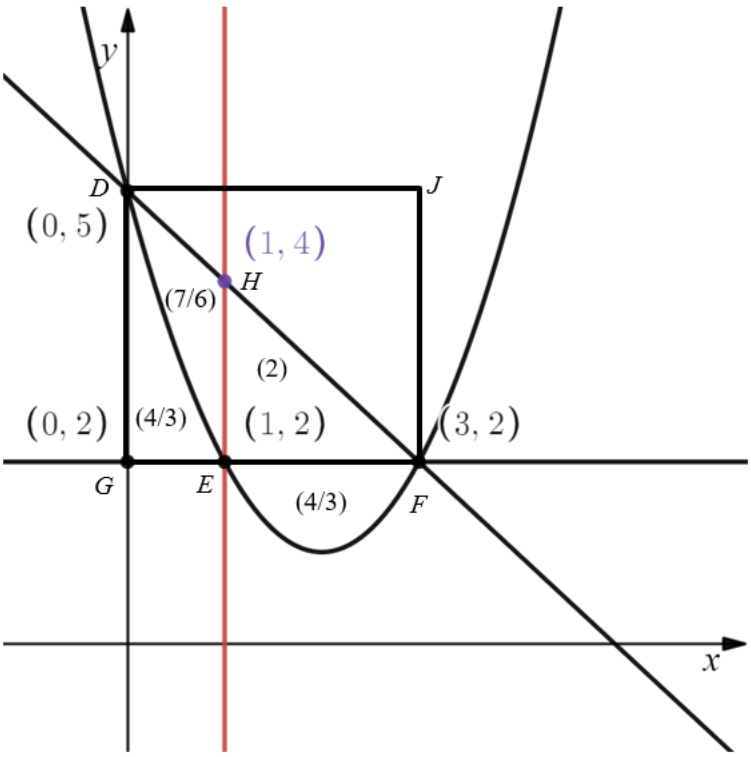
Question Number	Scheme	Marks
9(a)	$(0, 5)$	B1
		(1)
(b)	$x^2-4x+5=2 \Rightarrow x^2-4x+3=0$ $\Rightarrow x=...$	M1
	$x(E)=1,\ x(F)=3$	A1
		(2)
(c)	Area $R_1 = \int_0^1 \left(x^2-4x+5-2\right)\mathrm{d}x = \left[\frac{x^3}{3}-2x^2+3x\right]_0^1 = \frac{1}{3}-2+3-0=\frac{4}{3}$	M1A1
	Area $R_2 = \frac{1}{2}\times 3\times 3-"\frac{4}{3}" = \frac{19}{6}$ or $\int_0^1 \left(5-x-\left(x^2-4x+5\right)\right)\mathrm{d}x+\frac{1}{2}\times 2\times 2 = \left[\frac{3x^2}{2}-\frac{x^3}{3}\right]_0^1+2=\frac{3}{2}-\frac{1}{3}+2=\frac{7}{6}+2=\frac{19}{6}$ or $\frac{1}{2}\times 3\times 3-\int_0^1 \left(x^2-4x+5-2\right)\mathrm{d}x = \frac{9}{2}-\left[\frac{x^3}{3}-2x^2+3x\right]_0^1 = \frac{9}{2}-\left(\left(\frac{1}{3}-2+3\right)-0\right)=\frac{19}{6}$	M1A1
	$\frac{\text{area of } R_1}{\text{area of } R_2} = \frac{\frac{4}{3}}{\frac{19}{6}} = \frac{8}{19}$	A1
		(5)
		Total 8

Diagram for reference:



(a) Mark (a) and (b) together

B1 Correct **coordinates**. Allow to be written as $x = 0,\ y = 5$ (check the diagram as well)
5 on its own is B0

(b)

M1 Sets $C = l$ and solves for x. Expect to see the 3TQ $x^2 - 4x + 3\ (= 0)$ oe (terms do not need to be on the same side) before solving the quadratic by factorising, quadratic formula, completing the square or via a calculator to find a value for x.

A1 Correct values following a **correct method**. Condone $x = 1, 3$ and also allow if the correct y coordinates are also given e.g. $(1,\ 2)$ and $(3,\ 2)$. Condone if E and F are labelled the wrong way round and check the diagram for the coordinates. If there is a contradiction between Figure 3 and the coordinates stated in the main body of the work then the main body of the work takes precedence. isw after the correct x coordinates are found.
Condone e.g. $E = 1, F = 3$
Answers only scores M0A0 (Minimum seen must be $x^2 - 4x + 5 = 2$ or $x^2 - 4x + 3$ oe)

(c) They are many different strategies for finding the area of R_1 and R_2 so check solutions carefully for alternative credit worthy methods

M1 Fully correct strategy for the area of R_1
Attempting the area under curve C – area under the line $y = 2$ between 0 and "1" Score for either

- attempting to integrate $C - l$: $\int_0^1 \left(x^2 - 4x + 5 - 2\right)\mathrm{d}x$ oe
- attempting to integrate C $\int_0^1 \left(x^2 - 4x + 5\right)\mathrm{d}x$ and subtracting the area of the rectangle

Condone slips in their working but expect to see the power raised by one on at least one of their terms and either substituting in the limits 0 and "1" (or subtracting "2" for the area of the rectangle). Must be the limits based on their part (b) answer.
Their integrated expression must be seen with the limits or an attempt to substitute in and subtract either way round – **the method mark cannot be scored directly from using a calculator.** Condone spurious notation.

A1 $\frac{4}{3}$ or exact equivalent correct area of R_1 provided M1 has been scored.

M1 **Fully correct strategy for the area of R_2.**

Note that If R_1 is used to find the area of R_2 then R_1 must have been found from a correct strategy.

There are MANY possible strategies including:

- $GDF - "R_1"$
- $EDH + EHF$
- Finding the equation of the line through DF $y = 5 - x$ and attempting to integrate $DF - C$ between 0 and "3", then finding the area bounded by l and the curve between "1" and "3" and subtracting this from the total
- $DJFG - "R_1" - DJF$

In all cases you need to score for the overall strategy to find R_2 so condone slips in their working and spurious notation but if the method is unclear then the required areas must be correct for their coordinates in (a) and (b). If integration is used on a new area (not R_1) then expect to see the power raised by one on at least one of their

terms and the integrated expression must be seen with the limits or attempting to substitute in and subtracting either way round. Must be the limits based on their part (b) answer.
If there are multiple attempts then score the most complete attempt.

A1 $\frac{19}{6}$ or exact equivalent correct area of R_2 provided M1 has been scored

A1 $\frac{8}{19}$ cao and all previous marks have been scored

Question Number	Scheme	Marks
10	Considers another relevant case for n e.g. $n=3k-1$ or $3k+1$ or $3k+2$ For example $n = 3k + 1$ $\Rightarrow 2n^2+n+1=2(3k+1)^2+(3k+1)+1=18k^2+15k+4$	M1
	$=3(6k^2+5k+1)+1$ which is not divisible by 3	A1
	Considers a third relevant case to complete the 3 cases for n e.g. one of $n=3k-1$ or $3k+1$ or $3k+2$ For example $n = 3k - 1$ $\Rightarrow 2n^2+n+1=2(3k-1)^2+(3k-1)+1=18k^2-9k+2$	dM1
	$=3(6k^2-3k)+2$ which is not divisible by 3 Hence $2n^2+n+1$ is not divisible by 3	A1
		(4)
		Total 4

Condone the use of another letter or even n for the different cases for the first 3 marks.
Do not withhold accuracy marks for any errors which are not part of the main body of the work.
Look at the whole solution and score for a correct case first (which may appear later) so that the first two marks M1A1 can be awarded.

M1 Considers another relevant case for n by attempting to substitute in their expression in k, multiplies out brackets and collects terms. Condone slips.
May attempt eg $3k+4$ or any other multiples of those given which is acceptable.

A1 Completes the process with no errors to show their expression is not divisible by 3. Usually this is by factorising part of the expression, but may identify a particular term which is not divisible by 3.

dM1 Considers a third relevant case which is different to the given case and not an equivalent one to their first relevant case to complete the 3 cases for n by attempting to substitute the final different expression in k, multiplies out brackets and collects terms. Condone slips.

A1 Completes the process with no errors to show their 3rd expression is not divisible by 3 (usually by factorising, but may identify a particular term which is not divisible by 3) and concludes the proof with a statement e.g. hence ($2n^2+n+1$) not divisible by 3. Alternatively, they may write a statement/preamble at the beginning and the proof can be ended with a tick/QED oe
Must have been in terms of k for all cases.

The table below may help when checking for accuracy of quadratics

Case	$2n^2+n+1$	Possible factorisation of expression
$3k-2$	$18k^2-21k+7$	$=3(6k^2-7k+2)+1$
$3k-1$	$18k^2-9k+2$	$=3(6k^2-3k)+2$
$3k+1$	$18k^2+15k+4$	$=3(6k^2+5k+1)+1$
$3k+2$	$18k^2+27k+11$	$=3(6k^2+9k+3)+2$
$3k+4$	$18k^2+51k+37$	$=3(6k^2+17k+12)+1$