# Question 13 (Total 11 marks)

| Part | Working or answer an examiner might expect to see | Mark | Notes |
|---|---|---|---|
| (a) | The asymptote is found where $2x - q = 0$<br>Hence $q = 2$ | B1 | This mark is given for explaining that the asymptote at $x = 1$ is the solution of $2(1) - q = 0$ |
| | $y = \dfrac{p - 3x}{(2x - 2)(x + 3)}$<br><br>$\dfrac{3}{2} = \dfrac{p - 6}{2 \times 5}$ | M1 | This mark is given for substituting in $(2, \frac{3}{2})$ to form an equation in $p$. |
| | $2p - 12 = 30$<br>$p = 21$ | A1 | This mark is given for solving for $p$. |
| (b) | $\dfrac{p - 3x}{(2x - 2)(x + 3)} = \dfrac{A}{2x - 2} + \dfrac{B}{x + 3}$ | M1 | This mark is given for a method to use partial fractions |
| | $21 - 3x = A(x + 3) + B(2x - 2)$ | M1 | This mark is given for a method to find values for $A$ and $B$ |
| | $= \dfrac{9}{2(2x-2)} - \dfrac{15}{4(x+3)}$<br><br>$= \dfrac{4.5}{2x - 2} - \dfrac{3.75}{x + 3}$ | A1 | This mark is given for a correct simplified expression |
| | $I = \displaystyle\int \dfrac{21 - 3x}{(2x - 2)(x + 3)}\, dx$<br><br>$= m \ln |2x - 2| + n \ln |x + 3|$ | M1 | This mark is given for a method to integrate to find the area of $R$ |
| | $= 2.25 \ln |2x - 2| - 3.75 \ln |x + 3|$ | A1 | This mark is given for a correct expression for the area of $R$ |
| | Area $R$<br>$= [2.25\ \ln|2x - 2| - 3.75 \ln|x + 3|]_5^7$ | M1 | This mark is given for deducing an expression for the area of $R$<br>($y = 0$ when $x = 7$) |
| | $= [2.25 \ln 12 - 3.75 \ln 10] - [2.25 \ln 8 - 3.75 \ln 8]$<br>$= 2.25 \ln 12 - 3.75 \ln 10 + 18 \ln 2$<br>$= 4.5 \ln 2 + 2.25 \ln 3 - 3.75 \ln 2 - 3.75 \ln 5 + 18 \ln 2$ | M1 | This mark is given for a method to find the exact area of $R$ |
| | $= 18.75 \ln 2 + 2.25 \ln 3 - 3.75 \ln 5$ | A1 | This mark is given for a correct value of the area of $R$ with $a = 18.75$, $b = 2.25$ and $c = -3.75$ |