| Question Number | Scheme | Marks |
|---|---|---|
| **10. (a)** | Correct equations $\frac{1}{2}r^2\theta = 6, \quad 2r + r\theta = 10$ | B1 B1 |
| | Eliminates $r = \frac{10}{2+\theta} \Rightarrow \frac{1}{2}\left(\frac{10}{2+\theta}\right)^2 \theta = 6$ | M1 |
| | $\Rightarrow 50\theta = 6\left(4 + 4\theta + \theta^2\right) \Rightarrow 3\theta^2 - 13\theta + 12 = 0$ * | A1* |
| | | (4) |
| **(b)** | $(3\theta - 4)(\theta - 3) = 0 \Rightarrow \theta = \frac{4}{3}, 3$ | B1 |
| | $\theta = \frac{4}{3}, r = 3 \qquad \theta = 3, r = 2$ | M1 A1 |
| | | (3) |
| | | (7 marks) |

(a)

B1 One correct equation $\frac{1}{2}r^2\theta = 6$ or $2r + r\theta = 10$ (may use $\varphi$ instead of $\theta$ which is fine)

B1 Two correct equations $\frac{1}{2}r^2\theta = 6$ and $2r + r\theta = 10$ ($r + r + r\theta = 10$ is acceptable)

Note you may see one of both of these equations in (b) which you can award the marks retrospectively. They may be implied from later work:

Eg. $r^2 = \frac{12}{\theta} \Rightarrow 2\sqrt{\frac{12}{\theta}} + \sqrt{\frac{12}{\theta}}\theta = 10$ implies B1B1

M1 Scored for eliminating $r$ and reaching an equation in $\theta$ only. The initial equations must be of a similar form to the area of the sector and the perimeter but possibly with errors (look for $...r^2\theta = 6$ and $2r + ...r\theta = 10$). Condone errors when rearranging but their subsequent substitution must be correct for their rearrangement. Eg. $10 = r\theta + 2r \Rightarrow \frac{10}{\theta} = 3r$

A1* Reaches the given answer with no errors. There must be at least one intermediate line of manipulation following the elimination stage and $(\theta + 2)^2$ must be multiplied out correctly before achieving the final answer to score full marks.

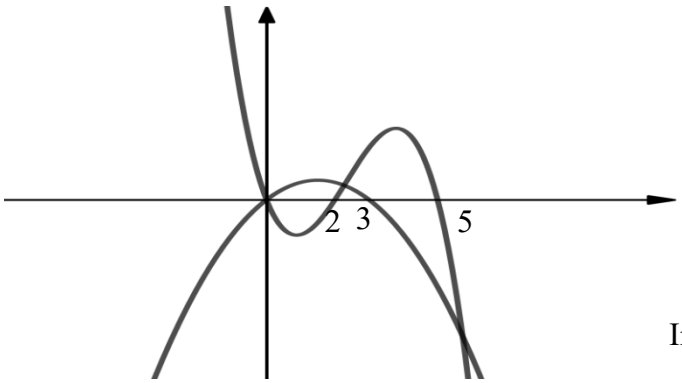
(b)

B1 $\theta = \frac{4}{3}, 3$ (They may just appear from a calculator)

M1 Substitutes one of their values of $\theta$ into one of the previous equations of the allowable form and proceeds as far as $r =\ldots$

A1 Both results $\theta = \frac{4}{3}, r = 3$ $\theta = 3, r = 2$

Values must be exact. Withold the final mark if they do not rule out $r = -3 / r = -2$ from using the area of a sector equation and withhold the final mark if the corresponding values of $r$ are incorrectly paired to the other values of $\theta$ ($\theta = \frac{4}{3}, r = 2$ and $\theta = 3, r = 3$)

| Question Number | Scheme | Marks |
|---|---|---|
| **11. (a)** | <br>$\cap$ shaped quadratic<br>Intercepts at $O$ and $3$<br>-ve cubic<br>Intercepts at $O$, $2$ and $5$ | B1<br>B1<br>B1<br>B1<br>(4) |
| **(b)** | Sets $x(x-2)(5-x)=x(3-x)$<br>$3x-x^2=-x^3+7x^2-10x \Rightarrow \pm(x^3-8x^2+13x)$ $(=0)$ OR<br>$\pm x\{(x-2)(5-x)-(3-x)\}$ $(=0)$<br>Proceeds to $x(x^2-8x+13)=0$ * | M1<br>dM1<br>A1*<br>(3) |
| **(c)** | Solves $x^2-8x+13=0 \Rightarrow x=4\pm\sqrt{3}$<br>Substitutes $x="4-\sqrt{3}"$ into $y=x(3-x)$ oe<br>$y=(4-\sqrt{3})(-1+\sqrt{3})=-4+4\sqrt{3}+\sqrt{3}-3=\ldots$<br>$y=-7+5\sqrt{3}$ | M1 A1<br>M1<br>M1<br>A1<br>(5)<br>(12 marks) |

(a) **For both parts they must have a graph**

(i)

B1 $\cap$ shaped quadratic appearing anywhere on the graph. This is for the general shape so do not be concerned with any parts which appear linear.

B1 A quadratic which crosses the $x$-axis at $O$ and $3$. Accept a mark of 3 on the $x$-axis. The origin does not need to be labelled as a point of intersection.