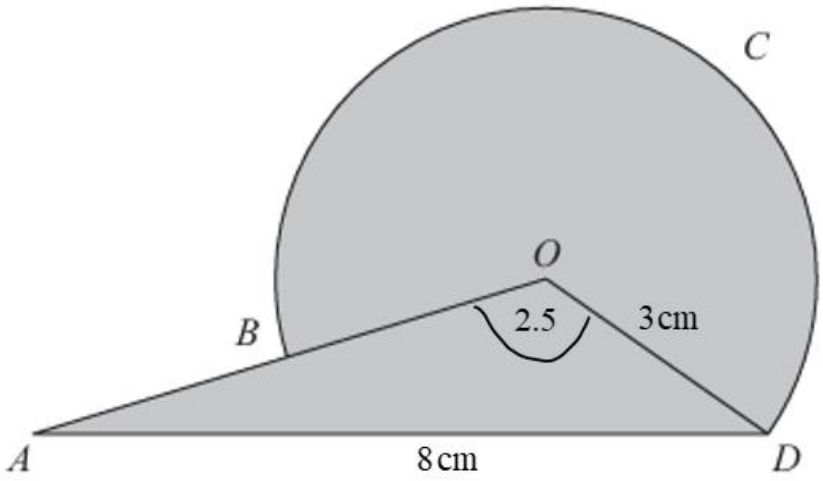
| Question Number | Scheme | Marks |
|---|---|---|
| **5 (a)** | $\frac{\sin(OAD)}{3}=\frac{\sin 2.5}{8}\Rightarrow \sin(OAD)=0.2244...$ | M1 |
| | (Angle $(ODA)$) $=\pi-2.5-\arcsin(0.2244...)=\pi-2.5-0.226355...=0.415$ * | dM1, A1* |
| | | **(3)** |
| **(b)** | Attempts either $\frac{1}{2}\times 3^2\times(2\pi-2.5)=(17.02)$ or $\frac{1}{2}\times 3\times 8\times\sin 0.415=(4.838...)$ | M1 |
| | Complete attempt at area $=\frac{1}{2}\times 3^2\times(2\pi-2.5)+\frac{1}{2}\times 3\times 8\times\sin 0.415$ | dM1 |
| | $=$ awrt 21.9 cm$^2$ | A1 |
| | | **(3)** |
| **(c)** | Attempts either $3(2\pi-2.5)=(11.349..)$ or $AO^2=3^2+8^2-2\times 3\times 8\cos(0.415)=(29.07.)$ | M1 |
| | Complete attempt at perimeter $=3(2\pi-2.5)+8+\sqrt{3^2+8^2-2\times 3\times 8\cos(0.415)}-3=11.35+8+5.39-3$ | dM1 |
| | $=$ awrt 21.7 cm | A1 |
| | | **(3)** |
| | | **(9 marks)** |




**Be aware that it is possible that the whole question could be done in degrees with 2.5 radians converted to** $143.23°$**,** $143.24°$ **or better. Provided this accuracy is used full marks are possible, but the final conversion from** $23.79°$ **to 0.415 must be shown. If less accuracy is used, e.g** $143.2°$ **or** $143°$ **only the method marks are available in part (a), BUT full marks are possible in parts (b) and (c)**

**FYI. Angle *AOD* =** $143.23°$ **or** $143.24°$**, Angle *OAD* =** $12.96°$ **or** $12.97°$ **Angle *ODA* =** $23.79°$ **or** $23.80°$

(a) **This is a given answer and it is important that a full method is shown.**

**Candidates will NOT gain credit in part (a) when starting with or using angle *ODA* = 0.415**

M1: Attempts to use the sine rule with the angles and lengths in the correct position.

Allow $OAD=\theta$ or any other variable. Condone slips in the labelling of the angle.

The calculation must lead at least as far as $\sin OAD=...$

E.g. $\frac{3}{\sin x}=\frac{8}{\sin 2.5}\Rightarrow \sin x=(0.2244...)$ OR $x=\arcsin(0.2244...)=(0.22635...)$

dM1: Full attempt at finding angle *ODA*. It is dependent upon the previous M1

Look for example, sight of $\pi - 2.5 - \arcsin("0.2244..")$ OR $3.14 - 2.5 - "0.226"$

A1*: Uses sufficient accuracy to achieve the given answer of 0.415 or the more accurate awrt 0.4152
Intermediate working must show or imply that the necessary accuracy has been achieved.
If a candidate achieves the correct answer of 0.4152… or better this is sufficient evidence
Additionally, a candidate could give intermediate answers to 4dp or better (rounded or truncated).
E.g. $\pi - 2.5 - \arcsin(0.2244)$ , $\pi - 2.5 - 0.2263$, $\pi - 2.5 - 0.2264$ .
If a decimal approximation of $\pi$ is used it must be 3.142 or better
Note that the calculation $\pi - 2.5 - 0.226 = 0.415$ is M1, dM1, A0

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Alt (a) using the cosine rule

M1: Uses the cosine rule to find *OA*.
Look for a correctly set up quadratic equation with an allowable attempt to solve
E.g $8^2 = 3^2 + y^2 - 2\times 3\times y\cos(2.5) \Rightarrow y^2 - 6y\cos 2.5 - 55 = 0 \Rightarrow y = 5.3924..$

dM1: Uses the sine rule with the sides and angles in the correct places. Dependent upon previous M.
$$\frac{\sin x}{"5.394"} = \frac{\sin 2.5}{8} \Rightarrow \sin x = (0.4034.....)$$

A1*: Achieves awrt 0.415 following accuracy to 4dp throughout

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(b) **Note that we are told that angle *ODA* = 0.415 radians so if used in (b) and (c) it must be correct or a more accurate value**

M1: Attempts either

- the area of the sector $\frac{1}{2}\times 3^2\times(2\pi - 2.5) = (17.02)$ or decimal equivalent with accuracy to at least $\frac{1}{2}\times 3^2\times(6.28 - 2.5)$
- or the area of the triangle E.g. $\frac{1}{2}\times 3\times 8\times\sin 0.415 = (4.838...)$ (other alternatives exist)

dM1: Complete attempt at area = $\frac{1}{2}\times 3^2\times(2\pi - 2.5) + \frac{1}{2}\times 3\times 8\times\sin 0.415$ or its decimal equivalent

A1: awrt 21.9 cm$^2$. There is no requirement for the units, so they may be ignored even if incorrect

(c)

M1: Attempts either

- length of arc *BCD* = $3(2\pi - 2.5)$ or decimal equivalent of $3(6.28 - 2.5)$ or greater accuracy
- or length $AO^2 = 3^2 + 8^2 - 2\times 3\times 8\cos(0.415)$ or equivalent

Alternatives for length *OA* include a sine rule approach or an area approach.
Be aware that *AO* may have been found in part (a) and it is fine just to use this in part (c) for the M1

dM1: Complete attempt at perimeter
E.g. $3(2\pi - 2.5) + 8 + \sqrt{3^2 + 8^2 - 2\times 3\times 8\cos(0.415)} - 3$
or decimal equivalent such as $3\times 3.78 + 5 + \frac{8\sin(0.415)}{\sin(2.5)}$ where $\pi$ is used as 3.14 or better

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A1: awrt 21.7 cm. There is no requirement for the units, so they may be ignored even if incorrect

| Question Number | Scheme | Marks |
|---|---|---|
| **6 (a)** | (i) $-6$ and $15$ | B1 |
| | (ii) $1$ and $8$ | B1 |
| | | **(2)** |
| **(b)** | $(f(x)) = k(x+2)(x-5)^2$ | M1 |
| | $(0,10) \Rightarrow 10 = k(0+2)(-5)^2 \Rightarrow k = ...$ | dM1 |
| | $(f(x)) = \frac{1}{5}(x+2)(x-5)^2$ | A1 |
| | | **(3)** |
| **(c)** | Correctly deduces that $x = -2$ | B1 |
| | $\frac{1}{5}\cancel{(x+2)}(x-5)^2 = 10\cancel{(x+2)} \Rightarrow (x-5)^2 = 50$ | M1 |
| | $\Rightarrow x-5 = \pm\sqrt{50} \Rightarrow x = 5 \pm 5\sqrt{2}$ | dM1, A1 |
| | | **(4)** |
| | | **(9 marks)** |

(a)(i)

B1: Requires both $-6$ and $15$. May be seen within the question. Condone repetitions, e.g $-6, 15$ and $15$

Condone roots being expressed as $(-6,0)$ and $(15,0)$ only if there are no other coordinates, e.g (0, 10)

(a)(ii)

B1: Requires both $1$ and $8$ May be seen within the question. Condone repetitions, e.g $1$, $8$ and $8$

Condone roots being expressed as $(1,0)$ and $(8,0)$ only if there are no other coordinates, e.g (3, 10)

SC: If a candidate writes down three coordinates for (i) including $(-6,0)$ and $(15,0)$

and three coordinates for (ii) including $(1,0)$ and $(8,0)$

they should be awarded SC: B1, B0. This may be also awarded from the result of two sketches

(b)

M1: States or implies that $f(x)$ or $y = k(x \pm 2)(x \pm 5)^2$. Allow with $k = 1$

dM1: Substitutes (0, 10) in $f(x) = k(x \pm 2)(x \pm 5)^2$ and finds a value for $k$

A1: States or implies that $f(x)$ or $y$ is $\frac{1}{5}(x+2)(x-5)^2$ o.e. ISW after a correct answer

Some candidates may be able to write this down with little or no working which is fine for 3 marks

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Alt (b) Note that the demand is that they should (**but not must**) leave $f(x)$ in a factorised form

So, if a candidate attempts to use the form $f(x) = ax^3 + bx^2 + cx + d$ and

- substitutes $(-2,0)$, $(5,0)$ and $(0,10)$ in $f(x) = ax^3 + bx^2 + cx + d$
- substitutes $(5,0)$ in $f'(x) = 3ax^2 + 2bx + c$

they can score M1, dM1 for an attempt at values for $a$, $b$, $c$ and $d$ and A1 for $f(x) = \frac{1}{5}x^3 - \frac{8}{5}x^2 + x + 10$