Question Number	Scheme	Marks
4 (a)	States or uses $\cos AOD = \frac{4}{12} \Rightarrow$ angle $AOD = 1.231$ *	M1 A1*
		(2)
(b)	Attempts $\frac{1}{2}r^2\theta$ with $r = 12$ and $\theta = \pi \pm 1.231$ or 1.231	M1
	Attempts area $AOD = \frac{1}{2}\times"4"\times\sqrt{12^2-"4"^2}$ oe (22.627...)	M1
	Attempts sector − triangle $= \frac{1}{2}\times 12^2\times(\pi+1.231) - \frac{1}{2}\times"4"\times\sqrt{12^2-"4"^2}$ (314.8….) – (22.627…)	ddM1
	or Attempts circle-sector-triangle $\pi\times 12^2 - \frac{1}{2}\times 12^2\times(\pi-1.231) - \frac{1}{2}\times"4"\times\sqrt{12^2-"4"^2}$ 452.38… – 137.562…. – 22.627…… = awrt 292.2 (m^2)	A1
		(4)
(c)	Attempts $s = r\theta$ with $r = 12$ and $\theta = \pi \pm 1.231$ or 1.231	M1
	Attempts $P = 16 + \sqrt{12^2-4^2} + 12(\pi + 1.231)$ oe	dM1
	= awrt 79.8 (m)	A1
		(3) **(9 marks)**
Alt(a)	$AD = \sqrt{12^2-4^2} = 8\sqrt{2}$ $\cos AOD = \frac{12^2+4^2-(8\sqrt{2})^2}{2\times 12\times 4} \Rightarrow$ angle $AOD = \cos^{-1}\left(\frac{1}{3}\right) = 1.231$	M1A1*

(a)

M1 Attempts $\cos AOD = \frac{4}{12} \Rightarrow$ angle $AOD = ...$ via a correct method.

Alternatively attempts to find AD using Pythagoras' theorem correctly **and** uses the appropriate sine or tangent. They may attempt to use the cosine rule with all three side (see alt(a)).
Other candidates are finding angle *OAD* and using angles in a triangle to find angle *AOD*.

Do not award this mark for candidates who attempt to use 1.231 and compare with $\frac{4}{12}$

A1* Achieves angle $AOD = 1.231$ following a valid method and at least one step of working shown.

Minimum acceptable $\cos^{-1}\left(\frac{4}{12}\right) = 1.231$ or $\cos AOD = \frac{4}{12} \Rightarrow$ angle $AOD = 1.231$

Only withhold this mark if

- awrt 1.231 radians is not achieved following a correct method. FYI sight of 1.23095… is likely to imply both marks)
- they work in degrees but fail to achieve awrt 70.5˚ **before** proceeding to 1.231 radians

We are going to condone on this occasion any rounding that may be written as part of their intermediate steps as long as they achieve awrt 1.231. Ignore any omission of brackets.

(b)

M1 Attempts $\frac{1}{2}r^2\theta$ with $r=12$ and an allowable θ. ($\theta=\pi\pm1.231$ or 1.231).

$\angle AOC=$ awrt 1.911 which may appear as $(\pi-1.231)$ or $(2\pi-(\pi+1.231))$ (minor sector)

$\angle AOC=$ awrt 4.373 which may appear as $(\pi+1.231)$ or $(2\pi-(\pi-1.231))$ (major sector)

The embedded values in an expression is sufficient for this mark. (awrt 315, awrt 88.6 or awrt 138 also implies this mark. Condone candidates who round 1.231 or use eg awrt 4.4 or awrt 1.9 radians.

M1 Correct method to find area of triangle *AOD*. Eg $\frac{1}{2}\times"4"\times\sqrt{12^2-"4"^2}$, $\frac{1}{2}\times"4"\times12\sin1.231$, awrt 22.6.

The angle may be in degrees (70.5….) and condone using awrt 1.2 radians.
Also allow an alternative method finding the area of the rectangle – area of trapezium. Allow errors in their method to finding "4" but *r* must be 12.

ddM1 Full method to find the correct area $\frac{1}{2}\times12^2\times(\pi+1.231)-\frac{1}{2}\times"4"\times\sqrt{12^2-"4"^2}$ oe. The embedded values in an expression is sufficient for this mark and the angle may be awrt 4.4. It is dependent on the two previous method marks.
Alternatively they may find the area by
Area of circle – area of minor sector – area of triangle

$$\pi\times12^2-\frac{1}{2}\times12^2\times(\pi-1.231)-\frac{1}{2}\times"4"\times\sqrt{12^2-"4"^2}$$

A1 awrt 292.2 (m^2)

(c)

M1 Attempts $s=r\theta$ with $r=12$ and an allowable θ. ($\theta=\pi\pm1.231$ or 1.231 as above in part (b)). The embedded values in an expression is sufficient for this mark. (awrt 52.5 or awrt 14.8 or awrt 22.9 can imply this mark. Condone candidates who round 1.231 or use eg awrt 4.4 or awrt 1.9 radians).

dM1 Full method to find the perimeter $P=16+\sqrt{12^2-"4"^2}+12(\pi+1.231)$ oe. The embedded values in an expression is sufficient for this mark and the angle may be awrt 4.4 or awrt 1.9.
Alternatively they may find the perimeter *P* via circumference – minor arc + 16+"$8\sqrt{2}$"

$$P=16+\sqrt{12^2-"4"^2}+24\pi-12(\pi-1.231)$$

A1 awrt 79.8 (m)