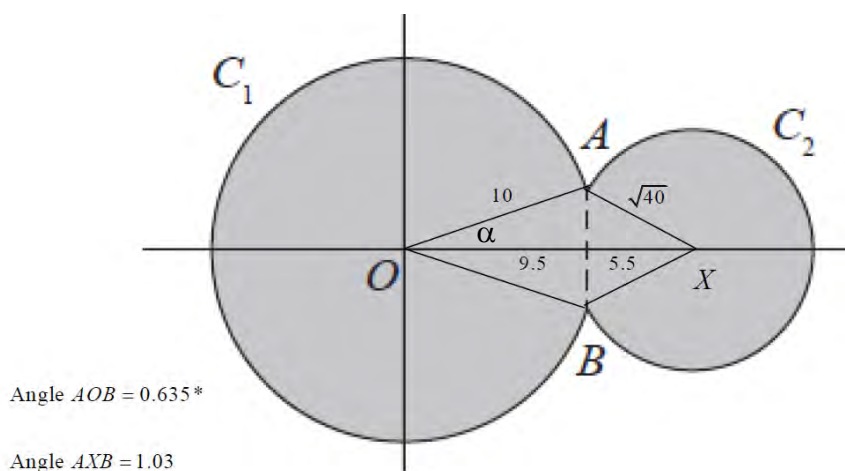| Question	Scheme	Marks	AOs
11 (a)	Solves $x^2 + y^2 = 100$ and $(x-15)^2 + y^2 = 40$ simultaneously to find x or y $\qquad$ E.g. $(x-15)^2 + 100 - x^2 = 40 \Rightarrow x = ...$	M1	3.1a
	Either $\qquad \Rightarrow -30x + 325 = 40 \Rightarrow x = 9.5$ Or $\qquad y = \dfrac{\sqrt{39}}{2} = $ awrt ± 3.12	A1	1.1b
	Attempts to find the angle AOB in circle C_1 Eg Attempts $\cos\alpha = \dfrac{"9.5"}{10}$ to find α then $\times 2$	M1	3.1a
	Angle $AOB = 2 \times \arcos\left(\dfrac{9.5}{10}\right) = 0.635$ rads (3sf) $\quad$ *	A1*	2.1
		(4)	
(b)	Attempts $10 \times (2\pi - 0.635)$ $\qquad\qquad = 56.48$	M1	1.1b
	Attempts to find angle AXB or AXO in circle C_2 (see diagram) E.g. $\qquad \cos\beta = \dfrac{15 - "9.5"}{\sqrt{40}} \Rightarrow \beta = ...$ $\qquad$ (Note $AXB = 1.03$ rads)	M1	3.1a
	Attempts $10 \times (2\pi - 0.635) + \sqrt{40} \times (2\pi - 2\beta)$	dM1	2.1
	$= 89.7$	A1	1.1b
		(4)	
		(8 marks)	
Notes:			

Angle $AOB = 0.635$ *

Angle $AXB = 1.03$

(a)

M1: For the key step in an attempt to find either coordinate for where the two circles meet.
Look for an attempt to set up an equation in a single variable leading to a value for x or y.

A1: $x = 9.5$ (or $y = \dfrac{\sqrt{39}}{2} = $ awrt ± 3.12)

M1: Uses the radius of the circle and correct trigonometry in an attempt to find angle AOB in circle C_1

E.g. Attempts $\cos\alpha = \dfrac{"9.5"}{10}$ to find α then $\times 2$

Alternatives include $\tan\alpha = \dfrac{\sqrt{100-"9.5"^2}}{"9.5"} = (0.3286...)$ to find α then $\times 2$

And $\cos AOB = \dfrac{10^2+10^2-\left(\sqrt{39}\right)^2}{2\times 10\times 10} = \dfrac{161}{200}$

A1*: Correct and careful work in proceeding to the given answer. Condone an answer with greater accuracy.
Condone a solution where the intermediate value has been truncated, provided the trig equation is correct.

E.g. $\sin\alpha = \dfrac{\sqrt{39}}{20} \Rightarrow \alpha = 0.317 \Rightarrow AOB = 2\alpha = 0.635$

Condone a solution written down from awrt $36.4°$ (without the need to shown any calculation.)
E

(b)

M1: Attempts to use the formula $s = r\theta$ with $r = 10$ and $\theta = 2\pi - 0.635$

The formula may be embedded. You may see $\underline{2\pi10}+2\pi\sqrt{40}\underline{-10\times0.635}...$ which is fine for this M1

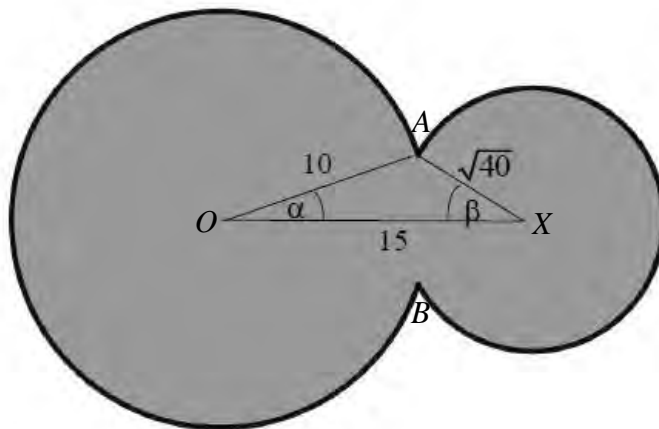**M1:** Attempts to use a correct method in order to find angle AXB or AXO in circle C_2

Amongst many other methods are $\tan\beta = \dfrac{"3.12"'}{15-9.5}$ and $\cos AXB = \dfrac{40+40-\left(\sqrt{39}\right)^2}{2\times\sqrt{40}\times\sqrt{40}} = \dfrac{41}{80}$

Note that many candidates believe this to be 0.635. This scores M0 dM0 A0

dM1: A full and complete attempt to find the perimeter of the region.
It is dependent upon having scored both M's.

A1: awrt 89.7

....

(a)
M1: For the key step in attempting to find all lengths in triangle OAX, condoning slips

A1: All three lengths correct

M1: Attempts cosine rule to find α then $\times 2$

A1*: Correct and careful work in proceeding to the given answer

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