Question Number	Scheme	Marks
8(a)(i)	$2\pi - \frac{2\pi}{3} = \frac{4\pi}{3}$	B1
	Area of sector $= \frac{1}{2} \times 3^2 \times "\frac{4}{3}\pi" = 6\pi$ (m^2)	M1A1
(ii)	Length of arc $= 3 \times "\frac{4}{3}\pi" \Rightarrow$ Perimeter $= 4\pi + 6$ (m)	M1A1
		(5)
(b)	$\frac{1}{2} \times 3^2 \times \sin\left(\frac{2}{3}\pi\right) = \frac{9\sqrt{3}}{4}$ (m^2)	M1A1
		(2)
(c)	Eg $AB^2 = 3^2 + 3^2 - 2 \times 3 \times 3 \times \cos\left(\frac{2}{3}\pi\right) \Rightarrow AB^2 = 27 \Rightarrow AB = 3\sqrt{3}$ (m) *	M1A1*
		(2)
(d)	$\frac{\sin BAC}{8} = \frac{\sin\left(\frac{\pi}{6}\right)}{3\sqrt{3}} \Rightarrow \sin BAC = ...$ or $BAC = ...$	M1
	$\sin BAC =$ awrt $\frac{4\sqrt{3}}{9}$ or $BAC =$ awrt 0.88 (0.8785…)	A1
	Area $ABC = \frac{1}{2} \times 3\sqrt{3} \times 8 \times \sin(\pi - \frac{\pi}{6} - "0.88")$ (= 20.4896....)	M1
	Total area = "18.8"+"3.90"+"20.5"	dM1
	= awrt 43 (m^2)	A1
		(5)
		(14 marks)

If lengths or areas are found in other parts then credit can be awarded for these as long as they are referred to or used in the relevant part.

(a)(i)

B1 Finds the correct angle for the sector *AOBX*. They may find the minor sector first and then subtract from the area of the whole circle so may be implied from later work. They may also work in degrees. Sight of $\theta = \frac{4\pi}{3}$ on the diagram or within their working scores this mark.

M1 States or uses $\frac{1}{2}r^2\theta$ with $r = 3$ and $\theta = \frac{2\pi}{3}$ or $\theta = \frac{4\pi}{3}$ or the equivalent method working in degrees. May be implied by the correct answer, expression or awrt 9.42 or awrt 18.8

A1 6π (m^2) cao must be exact. Isw after a correct answer.

(ii)

M1 States or uses $r\theta$ with $r = 3$ and $\theta = \frac{2\pi}{3}$ or $\theta = \frac{4\pi}{3}$ or the equivalent method working in degrees. The addition of two radii to find the perimeter is not required for this mark. May be implied by the correct answer, expression or awrt 6.28 or awrt 12.6

A1 $4\pi + 6$ (m) cao must be exact. Isw after a correct answer.

(b)

M1 States or uses $\frac{1}{2}ab\sin C$ with $a = b = 3, \theta = \frac{2}{3}\pi$ (or may work in degrees). Alternatively, they may split the isosceles triangle into two right angled triangles including finding *AB*. Score for the overall method or awrt 3.90

A1 $\frac{9\sqrt{3}}{4}$ (m^2) or exact equivalent. Isw after a correct answer

(c)

M1 Correct method (which may be seen in earlier work but referred to in (c)) by for example

- using the cosine rule with $a=b=3, \theta = "\frac{2}{3}\pi"$
- splitting the isosceles triangle into two right angled triangles eg $2\times 3\times \sin\left(\frac{\pi}{3}\right)$
- using the sine rule such that $\frac{AB}{\sin\left(\frac{2\pi}{3}\right)} = \frac{3}{\sin\left(\frac{\pi}{6}\right)} \Rightarrow AB = ...$

A1* $3\sqrt{3}$ (m) with no errors in their calculations. Minimum expected to see is a simplified expression for AB (or AB^2) which is not $3\sqrt{3}$. Eg via the cosine rule this would be either $AB^2 = 27$ or $AB = \sqrt{27}$ via the sine rule eg $\frac{3\sin(\frac{2\pi}{3})}{\sin(\frac{\pi}{6})}$ or via splitting the triangle up into two right angle triangles $2\times 3\times \sin\left(\frac{\pi}{3}\right)$ oe. Accept alternative labelling for AB eg x

You do not need to see the exact values for the the trig functions within their working.

(d) **Beware there are many methods with incorrect working leading to 43 so you will need to check carefully that their method is sound.**

M1 Attempts to use the sine rule to find sin BAC or angle BAC. Award for the appropriate lengths and angles in the correct positions within a correct equation. Do not be concerned with the mechanics of the rearrangement, although it must be a solvable equation. Alternatively attempts to solve a quadratic in AC using the cosine rule.

$(3\sqrt{3})^2 = AC^2 + 8^2 - 2\times AC\times 8\times \cos\left(\frac{\pi}{6}\right) \Rightarrow AC = ...\ (= \sqrt{11} + 4\sqrt{3} = \text{awrt } 10.2)$

A1 Correct value for $\sin BAC$, angle BAC (awrt 0.88 or 50.3 in degrees) or AC

M1 Correct method to find the area of triangle ABC using either their angle ABC from $\pi - \frac{\pi}{6} - "BAC"$ or their length AC. May work in degrees.

dM1 Adds their (a)(i) + their (b) + their triangle ABC together to the find area of the pond. It is dependent on all of the previous method marks in (d) only

A1 awrt 43 (m^2) from a correct method. Also allow the exact answer $6\pi + 2\sqrt{11} + \frac{41}{4}\sqrt{3}$ oe

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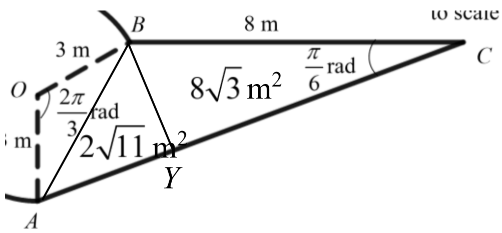
Alt (d) Forms two right angled triangles with the perpendicular to side AC from point B



M1 Height of the triangle ABC is $BY = 8\sin\left(\frac{\pi}{6}\right)$

A1 $BY = 4$ may be implied

M1 Attempts to find the area of triangle ABC. Usually this is by attempting to find length AC split into AY and YC eg $AY = \sqrt{\left(3\sqrt{3}\right)^2 - "4"^2}\ \left(=\sqrt{11}\right)$ and length $YC = 8\cos\left(\frac{\pi}{6}\right) = 4\sqrt{3}$

$\Rightarrow$ Area $ABC = \frac{1}{2}\times\left(\sqrt{11} + 4\sqrt{3}\right)\times 4$. Score for the overall method condoning slips.

Alternatively, they may attempt the cosine rule to find $AC \Rightarrow$ Area $ABC = ...$

dM1A1 Follows main scheme