Question	Scheme	Marks
5(a)	$\angle AOB = \cos^{-1}\dfrac{1.5}{4} = ...$ or $\angle AOB = \tan^{-1}\dfrac{\sqrt{4^2-1.5^2}}{1.5} = ...$ or $\angle AOB = \dfrac{\pi}{2} - \sin^{-1}\dfrac{1.5}{4} = \ldots$ or $\angle AOB = \dfrac{\pi}{2} - \tan^{-1}\dfrac{1.5}{\sqrt{4^2-1.5^2}} = ...$	**M1**
	= 1.186 *	**A1***
		(2)
(b)	$l = 4\times 1.186\left(= 4.744\right)$	**M1**
	$BC = 6 - 4\sin 1.186\left(= 6 - 3.708... = 2.29...\right)$ or $BC = 6 - 4\cos\left(\dfrac{\pi}{2} - 1.186\right)\left(= 6 - 3.708... = 2.29...\right)$ or $BC = 6 - \sqrt{4^2-1.5^2}\left(= 6 - 3.708... = 2.29...\right)\left(= \dfrac{12-\sqrt{55}}{2}\right)$ or $BC = 6 - \dfrac{1.5}{\tan"0.384"}\left(= 6 - 3.708... = 2.29...\right)$	**M1**
	Perimeter is $4\times 1.186... + \left(6 - 4\cos 0.384...\right) + 1.5 + 6 + 4 = ..$	**ddM1**
	= awrt 18.5 (m)	**A1**
		(4)
(c)	Area sector = $\dfrac{1}{2}\times 4^2 \times 1.186...$	**M1**
	Area *OBCD* Examples: $6\times 1.5 - \dfrac{1}{2}\times"3.708"\times 1.5$ or $\left(6-"3.708"\right)\times 1.5 + \dfrac{1}{2}\times"3.708"\times 1.5$ or $\dfrac{1}{2}\left(6+6-"3.708"\right)\times 1.5$ or $6\times 1.5 - \dfrac{1}{2}\times 1.5\times 4\sin 1.186$ or $\dfrac{1}{2}\times 6\times 1.5 + \dfrac{1}{2}\left(6-"3.708"\right)\times 1.5$ (= 6.219…)	**M1** **A1 on EPEN**
	$\dfrac{1}{2}\times 4^2 \times 1.186 + 6.219... =$	**ddM1**
	= awrt 15.7 (m^2)	**A1**
		(4)
		(10 marks)

Notes:

Allow equivalent correct work in degrees.
Ignore any presence or absence of units throughout.

(a)

M1: For a complete and correct method to find angle *AOB* in radians or degrees. May attempt angle *AOB* directly using cosine, or angle *BOD* using sine then subtract angle *BOD* from $\frac{\pi}{2}$ or equivalent work using tan.

A1*: Obtains angle *AOB* = 1.186 with no errors.

Example in degrees:

$$\sin \angle BOD = \frac{1.5}{4} \Rightarrow \angle BOD = \sin^{-1}\frac{3}{8} = 22.0243...$$
$$\angle AOB = 90 - 22.0243... = 67.9756...$$
$$= \frac{\pi \times 67.9756...}{180} = 1.186\ *$$

(b)

M1: Uses the correct arc length formula with *r* = 4 and 1.186. May be implied by awrt 4.74 or 4.75.

M1: Attempts the length of *BC* using an appropriate trig function and angle, or Pythagoras. May see $6-4\sin 1.186$ or $6-4\cos"0.384"$ or may use $6-\sqrt{4^2-1.5^2}$. May be implied by awrt 2.3 provided no incorrect working is seen.

ddM1: Depends on both previous marks. Adds the **five** lengths of the sides (or equivalent work) to obtain the perimeter.

A1: Correct answer, accept awrt 18.5. No units required and ignore any given.

(c)

M1: Correct attempt at the sector area. Look for $\frac{1}{2}\times 4^2 \times 1.186...$ but may be implied by e.g. $\frac{1186}{125}$ or awrt 9.5. Allow equivalent expressions in degrees e.g. $\frac{1}{2}\times 4^2 \times 67.9756...\times\frac{\pi}{180}$ but **not** e.g. $\frac{1}{2}\times 4^2 \times 67.9756$

M1: Correct attempt at the area of *OBCD* – which may be found as the difference of a rectangle and triangle or sum of rectangle and triangle or a trapezium. See scheme for details.
The attempt to find *BC*, if used, must have involved the use of trigonometry or e.g. Pythagoras.

ddM1: Depends on both previous marks. Correct attempt at the full area, so adds sector area to area of *OBCD*

A1: Correct answer, accept awrt 15.7. No units required and ignore any given.

Note that some candidates assume *BC* = 2 (i.e. 6 – 4) which greatly simplifies the question. The maximum possible marks in (b) and (c) are: (b) M1M0ddM0A0 (c) M1M0ddM0A0

Question	Scheme	Marks
6(a)	$\left(r-\frac{1}{r}\right)^2 = r^2 - r\times\frac{1}{r} - r\times\frac{1}{r} + \frac{1}{r^2}$	**M1**
	$= r^2 + \frac{1}{r^2} - 2$	**A1**
		(2)
(b)	$\frac{1}{3+2\sqrt{2}} = \frac{1}{3+2\sqrt{2}}\times\frac{3-2\sqrt{2}}{3-2\sqrt{2}}$	**M1**
	$= \frac{3-2\sqrt{2}}{3^2-\left(2\sqrt{2}\right)^2} = 3-2\sqrt{2}$	**A1**
		(2)
(b) ALT	$\frac{1}{3+2\sqrt{2}} = p+q\sqrt{2} \Rightarrow 1 = \left(p+q\sqrt{2}\right)\left(3+2\sqrt{2}\right) = 3p+4q+2p\sqrt{2}+3q\sqrt{2}$ $\Rightarrow \begin{matrix} 3p+4q=1 \\ 2p+3q=0 \end{matrix}$	**M1**
	$\Rightarrow \begin{matrix} 3p+4q=1 \\ 2p+3q=0 \end{matrix} \Rightarrow \begin{matrix} 6p+8q=2 \\ 6p+9q=0 \end{matrix} \Rightarrow q=-2 \Rightarrow 3p-8=1 \Rightarrow p=3$ $\frac{1}{3+2\sqrt{2}} = 3-2\sqrt{2}$	**A1**
		(2)
(c)	$\left(\sqrt{3+2\sqrt{2}} - \frac{1}{\sqrt{3+2\sqrt{2}}}\right)^2 = 3+2\sqrt{2}+\frac{1}{3+2\sqrt{2}}-2$	**M1**
	$= 3+2\sqrt{2}+3-2\sqrt{2}-2 = \ldots(=4)$	**dM1**
	so $\sqrt{3+2\sqrt{2}} - \frac{1}{\sqrt{3+2\sqrt{2}}} = 2$	**A1**
		(3)
(c) Alt	$\sqrt{3+2\sqrt{2}} - \frac{1}{\sqrt{3+2\sqrt{2}}} = 2 \Rightarrow 3+2\sqrt{2}-1 = 2\sqrt{3+2\sqrt{2}}$	**M1**
	$\Rightarrow \left(2+2\sqrt{2}\right)^2 = 4\left(3+2\sqrt{2}\right)$	**dM1**
	$\Rightarrow 4+8\sqrt{2}+8 = 12+8\sqrt{2}$ ✓ Hence true	**A1**
		(3)
		(7 marks)