Question Number	Scheme	Marks
6 (a)	Angle $AFB = \dfrac{\pi - 2.275}{2} = 0.433$ *	B1*
		(1)
(b)	Attempts $r\theta = 6.2 \times 2.275 = (14.105)$	M1
	Attempts $\left(x^2\right) = 6.4^2 + 6.2^2 - 2 \times 6.4 \times 6.2 \cos(0.433) = (7.36)$ or $(x = 2.71)$	M1
	Correct attempt = $2x + r\theta + 12.8 = 2 \times 2.714 + 14.105 + 12.8 = 32.3\,(\text{m})$	dM1, A1
		(4)
(c)	Attempts $\dfrac{1}{2} r^2 \theta = \dfrac{1}{2} \times 6.2^2 \times 2.275 = (43.7255)$	M1
	Attempts $\dfrac{1}{2} ab \sin C = \dfrac{1}{2} \times 6.2 \times 6.4 \times \sin 0.433 = (8.325)$	M1
	Correct attempt = $2 \times 8.325 + 43.7255 = 60.4\left(\text{m}^2\right)$	dM1, A1
		(4)
		(9 marks)

(a)

B1*: Shows that angle $AFB = 0.433$ radians.

You may see the angle labelled θ or BFA. This is not an issue, just look for the calculation

It is a "show that" so it is important to see either $\dfrac{\pi - 2.275}{2}$ or decimal equivalent with at least this accuracy $\dfrac{3.1416 - 2.275}{2}$ before we see 0.433 written down. The bracketing if required must be correct. So $(\pi - 2.275) \div 2$ is correct but $\pi - 2.275 \div 2$ is not. Condone a more accurate answer being written down and left without rounding to 3 decimal places. E.g. $\dfrac{\pi - 2.275}{2}$ = 0.433296327

(b)

M1: Attempts $r\theta = 6.2 \times 2.275$. Implied by sight of awrt 14.1

Sight of $2 \times 6.2 \times 2.275$ would be M0 as this would imply an incorrect formula. There are not two arc lengths within the perimeter of the tunnel.

M1: Attempts to apply the cosine rule to find *AB* or *DE*.

Can be achieved for an attempt at $6.4^2 + 6.2^2 - 2 \times 6.4 \times 6.2 \cos(0.433)$ irrespective of the LHS.

Condone a larger calculation that includes $2 \times \left(\sqrt{6.4^2 + 6.2^2 - 2 \times 6.4 \times 6.2 \cos(0.433)}\right)$ or even $2 \times \left(6.4^2 + 6.2^2 - 2 \times 6.4 \times 6.2 \cos(0.433)\right)$ as both *AB* and *DE* are part of the perimeter.

The angle used must be 0.433 or a more accurate version of this

This can be implied by, for example, by sight of $AB^2 = 7.36...$ OR $AB = 2.71...$

Condone $\cos 0.433 = \dfrac{6.2^2 + 6.4^2 - AB^2}{2 \times 6.2 \times 6.4}$ leading to a value for AB^2 or *AB*

Attempts via right angled triangles and incorrect cosine rules, e.g. $\left(c^2\right) = a^2 + b^2 - ab \cos C$ are M0

dM1: Full attempt to find the perimeter of the tunnel. $2 \times$"2.714"+"14.105"+12.8

It is dependent upon both M's and a correct attempt at the cosine rule by square rooting their answer to $6.4^2 + 6.2^2 - 2 \times 6.4 \times 6.2 \cos(0.433)$ o.e.

A1: awrt $32.3\,(\text{m})$

(c)

M1: Attempts $\frac{1}{2}r^2\theta = \frac{1}{2}\times 6.2^2 \times 2.275$. Implied by awrt 43.7

M1: Attempts either $\frac{1}{2}ab\sin C = \frac{1}{2}\times 6.2\times 6.4\times \sin 0.433$ or $ab\sin C = 6.2\times 6.4\times \sin 0.433$

The angle used must be 0.433 or a more accurate version of this.

dM1: Full attempt to find the cross-sectional area of the tunnel.

It is dependent upon both M's and an attempt to add a sector and two triangles

A1: awrt $60.4\left(\text{m}^2\right)$

……..

Answers using degrees can still be awarded ALL of the marks.

In part (a) it would be difficult to score the mark but you should expect to see the following calculations

$$\text{angle } BFD = 2.275\times\frac{180}{\pi} = \text{awrt } 130.3°$$

$$\text{angle } AFB = \frac{180° - 130.34°}{2} = \text{awrt } 24.8° = 24.8\times\frac{\pi}{180} = 0.433$$

For parts (b) and (c) the calculations must be attempted using angles with (at least) the following accuracy.

$$\text{angle } BFD = \text{awrt } 130° \text{ and angle } AFB = \text{awrt } 25°$$

For (b)

M1: Attempts $\frac{\theta}{360}\times 2\pi r = \frac{130}{360}\times 2\pi\times 6.2$

M1: Attempts $\left(x^2\right) = 6.4^2 + 6.2^2 - 2\times 6.4\times 6.2\cos 25°$

For (c)

M1: Attempts $\frac{\theta}{360}\times \pi r^2 = \frac{130}{360}\times \pi\times 6.2^2$

M1: Attempts $\frac{1}{2}ab\sin C = \frac{1}{2}\times 6.2\times 6.4\times \sin 25$ or $ab\sin C = 6.2\times 6.4\times \sin 25$

Question Number	Scheme	Marks
7 (a)	States or implies that B is $(10, 6)$	B1
	$\left(AB^2\right) = (10-0)^2 + ("6"-2)^2 \Rightarrow AB = 2\sqrt{29}$	M1, A1
		(3)
(b)	States or implies that grad $AB = \frac{2}{5}$	B1
	Uses perpendicular gradient rule $\Rightarrow$ grad $l_2 = -\frac{5}{2}$	M1
	$y - "6" = "-\frac{5}{2}"(x-10) \Rightarrow 5x + 2y - 62 = 0$	dM1, A1
		(4)
(c)	C is $\left(\frac{62}{5}, 0\right)$	B1 ft
	$\left(BC^2\right) = \left(\frac{62}{5} - 10\right)^2 + ("6"-0)^2 \Rightarrow BC = \frac{6\sqrt{29}}{5} = (6.46)$	
	Area $ABCD$ = 69.6	M1, A1
		(3)
		(10 marks)

(a)

B1: States or implies that B is $(10, 6)$. May be awarded for sight of $x = 10$, $y = 6$ without reference to "B"

It is implied via sight of $(10-0)^2 + (6-p)^2$. Also be aware the answer may be on the Figure

M1: Attempts AB or $(AB)^2$ between $(0, 2)$ and their $(10, "6")$ **This must be in part (a) and not in part (c).**

Award for $\sqrt{(10-0)^2 + ("6"-2)^2}$ or $(10-0)^2 + ("6"-2)^2$ It is implied by $AB = \sqrt{116}$ or $AB^2 = 116$

There are other methods including $BH - AH = \sqrt{15^2 + 6^2} - \sqrt{5^2 + 2^2}$ where H is the x intercept of l_1

A1: $AB = 2\sqrt{29}$. This isn't a non-calculator question so minimal working is condoned/allowed.

(b)

B1: States or implies that grad $l_1 = \frac{2}{5}$ o.e such as 0.4, $\frac{6}{15}$ It is implied by grad $l_2 = -\frac{5}{2}$

It cannot be awarded for just writing the equation of l_1 as $y = \frac{2}{5}x + \ldots$.

Candidates must know which part of the equation is the gradient

M1: Uses perpendicular gradient rule $\Rightarrow$ grad $l_2 = -\frac{1}{\text{grad } l_1}$

dM1: Full attempt at equation of line l_2 $y - "6" = "-\frac{5}{2}"(x-10)$

For this to be awarded

- the gradient of l_2 must be either $-\frac{1}{\text{their grad } l_1}$ or if that was not attempted $-\frac{5}{2}$ or $-\frac{1}{0.4}$
- the point used must be $x = 10$ and their $y = 6$ (see part (a) for their B)

If the form $y = mx + k$ is used then the method must proceed as far as k = ...

A1: $5x + 2y - 62 = 0$ or any integer multiple of this