

Question	Scheme	Marks	AOs
8(a)	$R = \sqrt{10}$	B1	1.1b
	$\tan \alpha = \frac{1}{3} \Rightarrow \alpha = \dots$	M1	1.1b
	$\alpha = 0.322$	A1	1.1b
		(3)	
(b)(i)	$6.5 - \sqrt{10}$ or awrt 3.34	B1ft	2.2a
(ii)	$\frac{\pi t}{13} - 4 - 0.322 = -\pi \Rightarrow t = \dots$	M1	3.1b
	$t = \text{awrt } 4.88$	A1	1.1b
	4:53 or 4hrs 53 minutes after midnight	A1	3.2a
		(4)	
(c)	$\theta = 6.5 + \sqrt{10} \cos\left(\frac{\pi t}{13} - 4.322\right)$ $\Rightarrow \frac{d\theta}{dt} = -\frac{\pi\sqrt{10}}{13} \sin\left(\frac{\pi t}{13} - 4.322\right) = -\frac{\pi\sqrt{10}}{13} \sin\left(\frac{\pi(12)}{13} - 4.322\right) = \dots$ <p style="text-align: center;">or</p> $\theta = 6.5 + 3 \cos\left(\frac{\pi t}{13} - 4\right) + \sin\left(\frac{\pi t}{13} - 4\right)$ $\Rightarrow \frac{d\theta}{dt} = -\frac{3\pi}{13} \sin\left(\frac{\pi t}{13} - 4\right) + \frac{\pi}{13} \cos\left(\frac{\pi t}{13} - 4\right)$ $= -\frac{3\pi}{13} \sin\left(\frac{12\pi}{13} - 4\right) + \frac{\pi}{13} \cos\left(\frac{12\pi}{13} - 4\right)$	M1	3.1b
	$= 0.756^\circ\text{C per hour}$	A1	3.2a
		(2)	

(9 marks)**Notes****(a)**

B1: Correct exact value

M1: Correct strategy to find α

A1: Awrt 0.322

(b)(i)B1ft: $6.5 - \sqrt{10}$ or awrt 3.34 or follow through their R **(b)(ii)**M1: Solves $\frac{\pi t}{13} - 4 - 0.322 = \pm\pi$ to reach a value for t A1: For $t = \text{awrt } 4.88$

A1: Correct time in hours and minutes. Accept either format as shown.

(c)M1: For the correct strategy to find the rate when $t = 12$. This requires an attempt to differentiate followed by the substitution of $t = 12$.A1: Awrt $0.756^\circ\text{C per hour}$