Question			Answer	Marks	AO	Guidance	
10			Length BC: $l^2 = 30^2 + 15^2 - 2\times 30\times 15\cos\theta$	**M1**	**3.1a**		If M0 awarded here allow SC1 for $BC = \sqrt{675} = 15\sqrt{3}$ found using $\theta = \frac{\pi}{3}$
			$l^2 = 1125 - 900\cos\theta$ $l = (1125 - 900\cos\theta)^{1/2}$	**A1**	**1.1b**	Soi Allow equivalent in metres	If working in metres $l^2 = 0.1125 - 0.0900\cos\theta$
			$\frac{dl}{d\theta} = \frac{1}{2}(1125 - 900\cos\theta)^{-\frac{1}{2}} \times 900\sin\theta$	**M1** **A1**	**3.1a** **1.1b**	Attempt to use the chain rule Any form	
			$\frac{d\theta}{dt} = 0.1$	**B1**	**1.2**	Soi eg from $\theta = 0.1t$	
			$\frac{dl}{dt} = \frac{dl}{d\theta} \times \frac{d\theta}{dt} = \frac{450\sin\theta}{(1125 - 900\cos\theta)^{\frac{1}{2}}} \times 0.1$	**M1**	**1.1a**	Using the chain rule to find $\frac{dl}{dt}$	
			When $\theta = \frac{\pi}{3}$ $\frac{dl}{dt} = \frac{45\sin\frac{\pi}{3}}{(1125 - 900\cos\frac{\pi}{3})^{\frac{1}{2}}} = \left[\frac{45\sqrt{3}}{2\times 15\sqrt{3}} = \frac{3}{2}\right]$	**M1**	**1.1a**	Substitute $\theta = \frac{\pi}{3}$ into their $\frac{dl}{d\theta}$	
			1.5 cm s^{-1}	**A1**	**3.2a**	Must have correct unit for the value Allow written as cm per second oe	0.015 m s^{-1}
				[8]			

Question	Answer	Marks	AO	Guidance	
	Alternative method				
	$l^2 = 30^2 + 15^2 - 2\times 30\times 15\cos\theta$	**M1**			
		A1			If working in metres $= 0.1125 - 0.0900\cos\theta$
	$l^2 = 1125 - 900\cos\theta$				
	$2l\dfrac{\mathrm{d}l}{\mathrm{d}\theta} = 900\sin\theta$	**M1**		Attempt to use the implicit differentiation. Any form	
		A1		soi	
	$\dfrac{\mathrm{d}\theta}{\mathrm{d}t} = 0.1$	**B1**			
	$\dfrac{\mathrm{d}l}{\mathrm{d}t} = \dfrac{\mathrm{d}l}{\mathrm{d}\theta}\times\dfrac{\mathrm{d}\theta}{\mathrm{d}t} = \dfrac{450\sin\theta}{l}\times 0.1$	**M1**		Using the chain rule to find $\dfrac{\mathrm{d}l}{\mathrm{d}t}$	
	When $\theta = \dfrac{\pi}{3}$ $\dfrac{\mathrm{d}l}{\mathrm{d}t} = \dfrac{45\sin\frac{\pi}{3}}{15\sqrt{3}} = \dfrac{3}{2}$	**M1**		Substitute $\theta = \dfrac{\pi}{3}$ into their $\dfrac{\mathrm{d}l}{\mathrm{d}\theta}$	
	1.5 cm s^{-1}	**A1**		Must have correct unit for the value Allow written as cm per second oe	0.015 m s^{-1}
		[8]			