

Question	Scheme	Marks	AOs
<b>10 (a)</b>	Substitutes $t = 0, H = 20$ into $H = \frac{140}{A + 45 \sin 2t - 28 \cos 2t}$	M1	3.1b
	Full method to find A $20 = \frac{140}{A - 28} \Rightarrow A = \dots$	dM1	1.1b
	$H = \frac{140}{35 + 45 \sin 2t - 28 \cos 2t}$	A1	3.3
		(3)	
<b>(b)</b>	$\tan \alpha = \frac{28}{45}$	M1	1.1b
	$\alpha = 31.9$	A1	1.1b
		(2)	
	$H = \frac{140}{35 + 53 \sin(2t - 31.9)}$		
<b>(c)</b>	Obtains $H_{\min} = \frac{140}{"A" + 53}$	M1	3.4
	1.59 metres or 159 cm	A1	1.1b
		(2)	
<b>(d)</b>	Sets $35 + 53 \sin(2T_{\max} - 31.9) = 0$	M1	3.4
	The model is only valid for $(0, \dots) T < 126.6$ s	A1	3.5b
		(2)	

**(9 marks)**

**(a)**  
**M1:** Uses the given information to set an equation in A.

**M1:** Full method to find A.

**A1:** For writing out the equation of the model  $H = \frac{140}{35 + 45 \sin 2t - 28 \cos 2t}$

**(b)**  
**M1:** For  $\tan \alpha = \pm \frac{28}{45}$ ,  $\tan \alpha = \pm \frac{45}{28}$ ,  $\cos \alpha = \pm \frac{45}{53}$  or  $\sin \alpha = \pm \frac{28}{53}$

**A1:**  $\alpha = 31.9$

**(c)**  
**M1:** For using the model to obtain  $H_{\min} = \frac{140}{"A" + 53}$

**A1:** 1.59 metres or 159 cm

**(d)**

**M1:** For using the information to see that the model breaks down when  $35 + 53 \sin(2T_{\max} - 31.9) = 0$

**A1:**  $T < 126.6$  s