

Question	Scheme	Marks	AOs
<b>13(a)</b>	$a = 60$	B1	3.1b
	$2 = "60" - b(-20)^2 \Rightarrow b = \dots$	M1	3.4
	$H = 60 - 0.145(t - 20)^2$	A1	3.3
		(3)	
<b>(b)</b>	Height = 2 m	B1	3.4
		(1)	
<b>(c)</b>	$\alpha = 180$ or $\beta = 31$	M1	3.4
	$H = 29 \cos(9t + 180)^\circ + 31$	A1	3.3
		(2)	
<b>(d)</b>	e.g. "The model allows for more than one circuit"	B1	3.5a
		(1)	

**(7 marks)**

### Notes

<b>(a)</b>	<p>B1: <math>a = 60</math> (may be seen in their final equation of the model or implied by 60 substituted for <math>a</math> in the model)</p> <p>M1: Attempts to find <math>b</math> by substituting in <math>t = 0</math>, <math>H = 2</math> and their <math>a</math> and proceeding to a value for <math>b</math>. May be seen as two simultaneous equations formed:  <math>2 = a - b(-20)^2</math> and <math>60 = a - b(20 - 20)^2</math> proceeding to a value for <math>b</math></p> <p>A1: <math>H = 60 - 0.145(t - 20)^2</math> or equivalent such as <math>H = -\frac{29}{200}t^2 + 5.8t + 2</math> or <math>H = 60 - \frac{29}{200}(t - 20)^2</math> isw once a correct equation for the model is seen. Must be in terms of <math>H</math> and <math>t</math>. If they just state <math>a = 60</math>, <math>b = 0.145</math> then A0  A correct answer with no working seen scores full marks.</p>																																		
<b>(b)</b>	<p>B1: 2 cao (condone lack of units) This can be scored even if their model in (a) is incorrect (they may have used symmetry to determine this value)</p>																																		
<b>(c)</b>	<p>M1: <math>(\alpha =) 180</math> or <math>(\beta =) 31</math> Condone <math>(\alpha =) \pi</math></p> <p>A1: <math>H = 29 \cos(9t + 180)^\circ + 31</math> or equivalent e.g. <math>H = -29 \cos(9t) + 31</math> isw once a correct equation for the model is seen. Must be in terms of <math>H</math> and <math>t</math>. If they just state <math>\alpha = 180</math>, <math>\beta = 31</math> then A0.  A correct equation with no working seen scores both marks. Does not require the degree symbol.</p>																																		
<b>(d)</b>	<p>B1: Score for a reason which makes reference to any of</p> <ul style="list-style-type: none"> <li>the alternative model allows repetition (allow phrases e.g. "multiple cycles", "repeated circuits", "cyclical", "periodic", "loops around", "the original model can only go up and down once")</li> <li>the alternative model after 2 minutes the carriage will be back at the start (e.g. "at 2 mins, <math>H = 2</math>")</li> <li>the original/quadratic model after 40 seconds (or any time after this) will be negative (e.g. "the height will be negative which cannot happen")</li> <li>the original model after 2 minutes would not be back at the start</li> </ul> <p>Do not allow vague responses on their own e.g. "the original model is a parabola"  If calculations are used then they must be correct using a correct model (allow rounded or truncated)  Look for a valid reason and ignore reference to anything else as long as it does not contradict</p> <table border="1"> <tbody> <tr> <td><math>t</math></td> <td>0</td> <td>5</td> <td>10</td> <td>15</td> <td>20</td> <td>25</td> <td>30</td> <td>35</td> <td>40</td> <td>45</td> <td>50</td> <td>55</td> <td>60</td> <td>80</td> <td>100</td> <td>120</td> </tr> <tr> <td><math>h</math></td> <td>2</td> <td>27</td> <td>46</td> <td>56</td> <td>60</td> <td>56</td> <td>46</td> <td>27</td> <td>2</td> <td>-31</td> <td>-71</td> <td>-118</td> <td>-172</td> <td>-462</td> <td>-868</td> <td>-1390</td> </tr> </tbody> </table>	$t$	0	5	10	15	20	25	30	35	40	45	50	55	60	80	100	120	$h$	2	27	46	56	60	56	46	27	2	-31	-71	-118	-172	-462	-868	-1390
$t$	0	5	10	15	20	25	30	35	40	45	50	55	60	80	100	120																			
$h$	2	27	46	56	60	56	46	27	2	-31	-71	-118	-172	-462	-868	-1390																			