Roller Coaster Physics
Assignment for Lesson 4

Name: _____

Given:

- The mass of the roller coaster train (including passengers) is 5000 kg.
- The height of the first hill is 95 meters.
- The height of the second hill is 65 meters.
- The length of the track going up the first hill is 176 meters.
- It takes the train 20 seconds to be pulled to the top of the first hill.

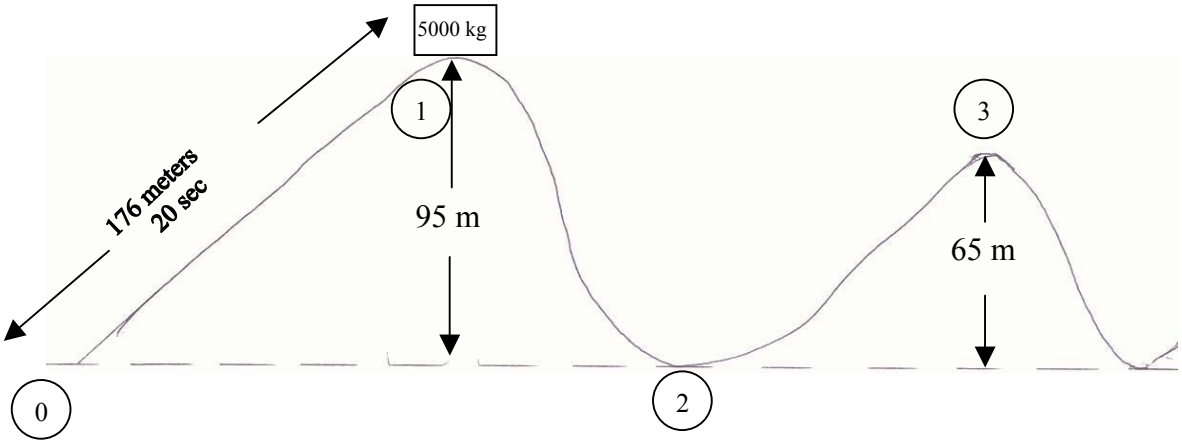
Find the Following:

1. Draw a diagram showing information given and label all points of interest.
2. Find the speed of the coaster at the top of the first hill in meters per second.
3. How much work is done to lift the train to the top of the first hill? (Assume the velocity at the bottom of hill just as the train hooks onto the chain lift is zero.)

Some Important Formulas, Constants and Conversion Factors	
$KE_1 + PE_1 + W_{1-2} = KE_2 + PE_2$ $KE_1 = \frac{1}{2}mv_1^2$ newton-meters $PE_1 = mgh_1$ newton-meters $F = ma$ newtons $W = Fd$ newton-meters, joules $P = \frac{W}{t}$ $\frac{\text{newton-meters}}{\text{sec}}$, $\frac{\text{joules}}{\text{sec}}$ $a_{centripetal} = \frac{v^2}{r}\frac{\text{meters}}{\text{sec}^2}$ $chairforce = ma_{centripetal}$ newton-meters $FF = \frac{chair\,force}{weight} = \frac{v^2}{rg} \pm 1$ $d = vt$	$g = 9.8\frac{m}{\text{sec}^2} = 32.2\frac{ft}{\text{sec}^2}$ $1kw = 1000\frac{joules}{\text{sec}}$ $1.34hp = 1kw$ $2.2lb = 1kg$ $2.2\frac{mi}{hr} = 1\frac{m}{\text{sec}}$ $1yd = 3ft = 0.9144m$

Work:

1. Draw a diagram showing information given and label all points of interest.



2. Find the speed of the coaster at the top of the first hill (v_1) in meters per second.

$$d = vt$$
$$v_1 = \frac{d}{t}$$
$$v_1 = \frac{176m}{20\,\text{sec}}$$
$$v_1 = 8.8\,\frac{m}{\text{sec}}$$

3. How much work is done to lift the train to the top of the first hill ($W_{0\text{-}1}$)? (Assume the velocity at the bottom of hill just as the train hooks onto the chain lift is zero.)

$$\cancel{KE_0}^{\,0} + \cancel{PE_0}^{\,0} + W_{0-1} = KE_1 + PE_1$$
$$W_{0-1} = \tfrac{1}{2}mv_1^{\,2} + mgh_1$$
$$= m\cdot\left(\tfrac{1}{2}v_1^{\,2} + gh_1\right)$$
$$= (5000kg)\left[\left(\tfrac{1}{2}\right)\left(8.8\,\tfrac{m}{\text{sec}}\right)^2 + \left(9.8\,\tfrac{m}{\text{sec}^2}\right)(95m)\right]$$
$$= 4{,}848{,}600\,\tfrac{kg\cdot m^2}{\text{sec}^2} = 4{,}848{,}600\,\tfrac{kg\cdot m}{\text{sec}^2}\cdot m$$
$$W_{0-1} = 4{,}848{,}600\,N\cdot m \text{ or } joules$$