KEY

Work & Energy

FT Work and Energy (20)

Directions: Solve the following problems showing all work. Work in Pencil initially. With 10 minutes remaining, you will be asked to put away the pencil and change to blue or black pen. During the last 10 minutes, you will be able to talk as a large group as long as no answers are shared.

1) Determine the spring constant of a spring if a 75N force stretches the spring 3 cm.

Use the situation given here in bold to respond to questions 2-7.

A roller coaster has its highest hill 20 m high. The train and the people in it have a mass of 450 kg.

$F = kx$

$\frac{F}{x} = k = \frac{75N}{.03m} = 2500\ N/m = 25\ N/cm$

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A roller coaster has its highest hill 20 m high. The train and the people in it have a mass of 450 kg.

2) *How much work is done to lift the train to the top of this hill?*

$PE = W = mgh = (450kg)(9.8m/s^2)(20m) = 88200\ J$

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3) *What is the weight of the train and people in the train?*

(weight)

$W = mg$

$W = (450\,kg)(9.8\,m/s^2)$

$W = 4410\,N$

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4) *Determine the force needed to pull the train (with the people in it) up the hill if the hill is 66 m long*

$W = Fx$

$\frac{W}{x} = F$

$\frac{88200J}{66m} = 1336N$

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5) *How fast would you expect the train to be traveling at the bottom of the "first drop", assuming that it goes all the way to the ground.*

$KE = PE$

$\frac{1}{2}mv^2 = mgh$

$\frac{1}{2}v^2 = gh$

$v = \sqrt{2gh}$

$v = \sqrt{(2)(9.8\ m/s^2)(20\ m)}$

$v = 19.6\ m/s$

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6) *Assume no energy is lost during the ride. Determine the force needed to stop the train at the end of the ride if the braking section is 12 m long.*

$W = Fx$

$\frac{W}{x} = \frac{88200\,J}{12\,m} = 7350\,N$

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7) *How much power is needed to get the train to the top of the hill in 1.5 min?*

$$P = \frac{\text{Work}}{\text{time}} = \frac{88200\text{ J}}{(1.5\text{m})\left(\frac{60\text{s}}{1\text{m}}\right)} = 980 \text{ watts}$$

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8) Determine the power developed by a 65 kg person that is able to climb steps that are 2 m high in a time of 1.5 seconds.

$$P = \frac{PE}{t} = \frac{mgh}{t} = \frac{(65\text{kg})(9.8\text{m/s}^2)(2\text{m})}{(1.5\text{s})} = 849 \text{ watts}$$