Objectives for Today:

Finish Virtual Energy Lab (or get darn close)

CLEE problems

Power and Efficiency

Homework tonight (power and efficiency)

Thoughts on Virtual Energy Lab:

Be sure to create all of your equations in terms of our known variables: m, g, μ, θ, x_0, F_{app} ($x = \varnothing$ at the bottom of ramp)

$\cancel{W_{NC}}$, $\cancel{F_{fr}}$, $\cancel{F_N}$, $\cancel{W_{app}}$, $\cancel{W_{fr}}$

Be able to describe where energy is, where it goes, and what forces are doing the work to transfer it between various forms of storage

- +/– work
- energy storage
- cons. vs. non-conser.

} tell the energy story

What happens to the energy that is taken away by forces doing non-conservative work?

What work is being done?
What's doing the work?
Where is the energy transfered?

$$\cancel{\frac{1}{2}mv_0^2} + mgh_0 + \cancel{\frac{1}{2}kx_0^2} + W_{NC} = \frac{1}{2}mv^2 + \cancel{mgh} + \cancel{\frac{1}{2}kx^2}$$

$$v = \sqrt{\quad \ldots\ldots \quad \cancel{\boxed{W_{NC}}}}$$

$$W = F_{\parallel} \cdot d$$

$W_{NC} =$ some expression...

ΣF

50

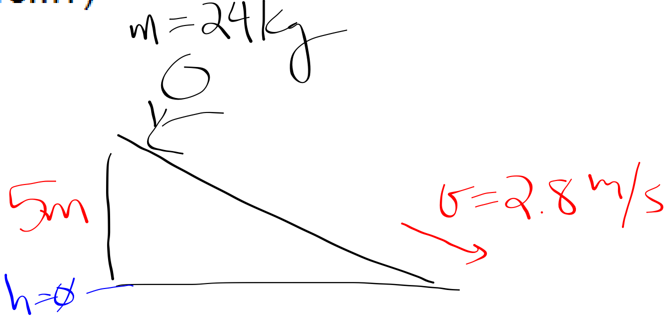
?

$\mu, \theta, g,$

$$W_{NC} = F_{NC} \cdot d$$

F_{Fr}, F_{app}

A 24-kg child descends a slide 5.0-m high and reaches the bottom with a speed of 2.8 m/s. How much thermal energy due to friction was generated in this process? (Hint: where must the thermal energy come from?)



$$\cancel{\frac{1}{2}mv_0^2} + mgh_0 + \cancel{\frac{1}{2}kx_0^2} + W_{NC} = \frac{1}{2}mv^2 + \cancel{mgh} + \cancel{\frac{1}{2}kx^2}$$

$$mgh_0 + W_{NC} = \frac{1}{2}mv^2$$

$$W_{NC} = \frac{1}{2}mv^2 - mgh_0$$

$$= \frac{1}{2}(24)(2.8^2) - (24)(9.8)(5)$$

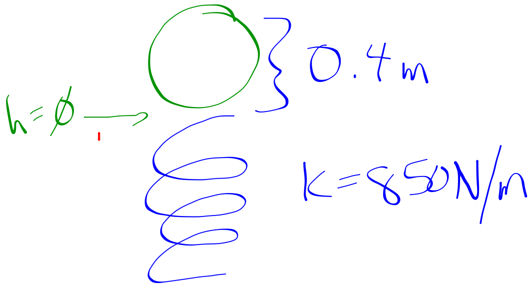
$$= -1081.9\ J$$

this much heat is generated in the child + slide due to friction

A vertical spring (ignore its mass) whose spring constant is 850 N/m stands on a table and is compressed 0.400 m.

a) What speed can it give to a 0.300-kg ball when released?

b) How high above its original position (spring compressed) will the ball fly?



(a) $$\frac{1}{2}m\cancel{v_0^2}^{0} + \cancel{mgh_0}^{0} + \frac{1}{2}kx_0^2 + \cancel{W_{NC}}^{0} = \frac{1}{2}mv^2 + mgh + \cancel{\frac{1}{2}kx^2}^{0}$$

$$\frac{1}{2}kx_0^2 = \frac{1}{2}mv^2 + mgh$$

$$\frac{1}{2}mv^2 = \frac{1}{2}kx_0^2 - mgh$$

$$v = \sqrt{\frac{2\left(\frac{1}{2}kx_0^2 - mgh\right)}{m}}$$

$$= \sqrt{\frac{2\left(\frac{1}{2}\right)(850)(0.4^2) - (0.3)(9.8)(.4)}{0.3}}$$

$$\boxed{v = 21.2\ m/s}$$

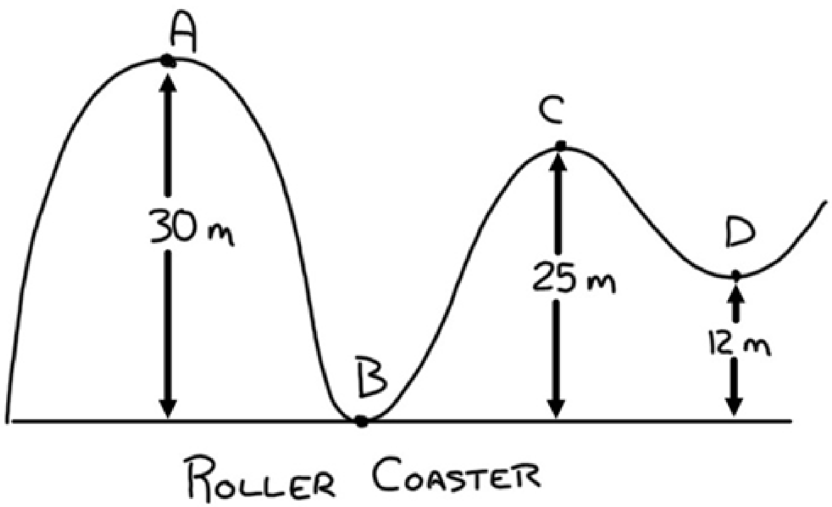
(b) $$\cancel{\frac{1}{2}mv_0^2}^{0} + \cancel{mgh_0}^{0} + \frac{1}{2}kx_0^2 + \cancel{W_{NC}}^{0} = \cancel{\frac{1}{2}mv^2}^{0} + mgh + \cancel{\frac{1}{2}kx_0^2}^{0}$$

$$\frac{1}{2}kx_0^2 = mgh$$

$$h = \frac{\frac{1}{2}kx_0^2}{mg} = \frac{\frac{1}{2}(850)(0.4)^2}{(0.3)(9.8)}$$

$$\boxed{h = 23.1\ m}$$

The roller coaster below passes point A with a speed of 1.10 m/s. If the average force of friction is equal to one-fifth of its weight, with what speed will it reach point B? The distance traveled is 67.0 m. (Don't you dare give up on this problem if you are thinking you don't have all of the information! What would Mr. K tell you to do anyway?)



Power and Efficiency:

Power: The rate at which work is done

Efficiency: The amount of power (or work) put *into* a system as it relates to the amount of power (or work) produced *by* a system

Formula for Power:

Form 1:

$$P = \frac{W}{t}$$

$$\left(\frac{\text{Joules}}{\text{sec}} = \text{Watt} \right)$$

Form 2 (derived):

$$P = \frac{W}{t} = \frac{F \cdot \Delta x}{t} = F \cdot v$$

if v is constant

Units (1 hp = 745.7 W)?

~~1 hp = 750 W~~

Formula for Efficiency:

Form 1:

$$E = \frac{W_o}{W_I} \qquad \frac{\text{(work done by system)}}{\text{(work done to system)}}$$

Form 2:

$$E = \frac{P_o}{P_I}$$

No such thing as 100% efficiency

No units (ratio)

Typically express as % or decimal