35. 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?)

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

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

$$(24)(9.8)(5) + W_{NC} = \frac{1}{2}(24)(2.8)^2$$

$$W_{NC} = -1082\,J$$

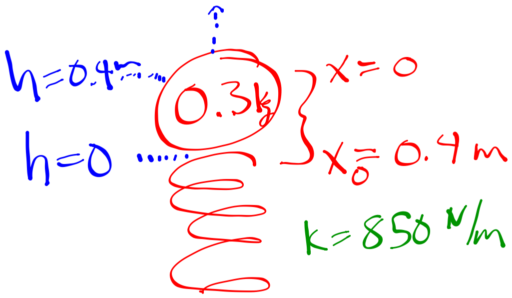
$$W_{NC} = W_{Fr} = -1082\,J$$

thermal energy = 1082 J

38. 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?



$$\frac{1}{2}\cancel{mv_0^2}^{\,0} + \cancel{mgh_0}^{\,0} + \frac{1}{2}kx_0^2 + \cancel{W_{NC}}^{\,0} =$$

$$\frac{1}{2}mv^2 + mgh + \cancel{\frac{1}{2}kx^2}^{\,0}$$

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

a) $\frac{1}{2}(850)(.4)^2 = \frac{1}{2}(.3)v^2 + (.3)(9.8)(.4)$

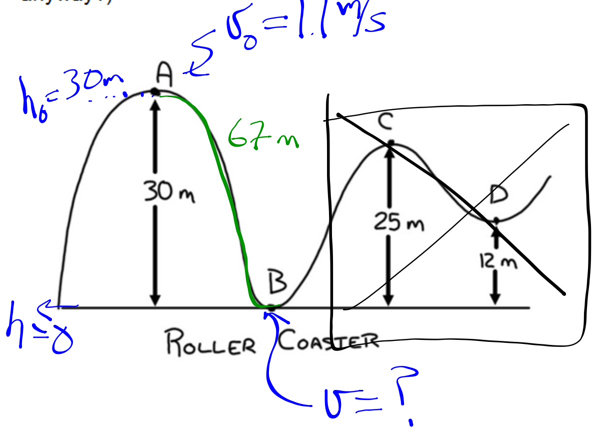
$$v = \sqrt{\frac{\left[\frac{1}{2}(850)(.4)^2 - (.3)(9.8)(.4)\right]2}{.3}}$$

$$v = 21.1\ \text{m/s}$$

b) $\frac{1}{2}(850)(.4^2) = (.3)(9.8)h$

$$h = 23.13\ \text{m}$$

42. 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?)



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

$$\frac{1}{2}mv^2 + \cancel{mgh} + \cancel{\frac{1}{2}kx^2}$$

$$\frac{1}{2}mv_0^2 + mgh_0 + W_{NC} = \frac{1}{2}mv^2$$

$$\frac{1}{2}m(1.1)^2 + m(9.8)(30) + W_{NC} = \frac{1}{2}mv^2$$

$$W_{NC} = W_{Fr} = F_{Fr} \cdot d = \boxed{\frac{1}{5}mgd}$$

$$W_{NC} = \boxed{-\frac{1}{5}m(9.8)(67)}$$

$$\frac{1}{2}\cancel{m}(1.1)^2 + \cancel{m}(9.8)(30) + -\frac{1}{5}\cancel{m}(9.8)(67) = \frac{1}{2}\cancel{m}v^2$$

since $m \neq 0$

$$\frac{1}{2}(1.1)^2 + (9.8)(30) + -\frac{1}{5}(9.8)(67) = \frac{1}{2}v^2$$

$$v = 18.07 \text{ m/s}$$

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

Form 2 (derived): $P = \frac{W}{t} = \frac{F \times \boxed{d}}{\boxed{t}} = F \cdot v$

if/only v is constant

Units (1 hp = 745.7 W)?

$\text{Power} = \frac{\text{Joules}}{\text{sec}} = \text{Watt (W)}$

Horsepower $\cong$ 746 W

Formula for Efficiency:

Form 1: $E = \frac{W_O}{W_I}$

Form 2: $E = \frac{P_O}{P_I}$

No units (ratio) $83\% = .83$