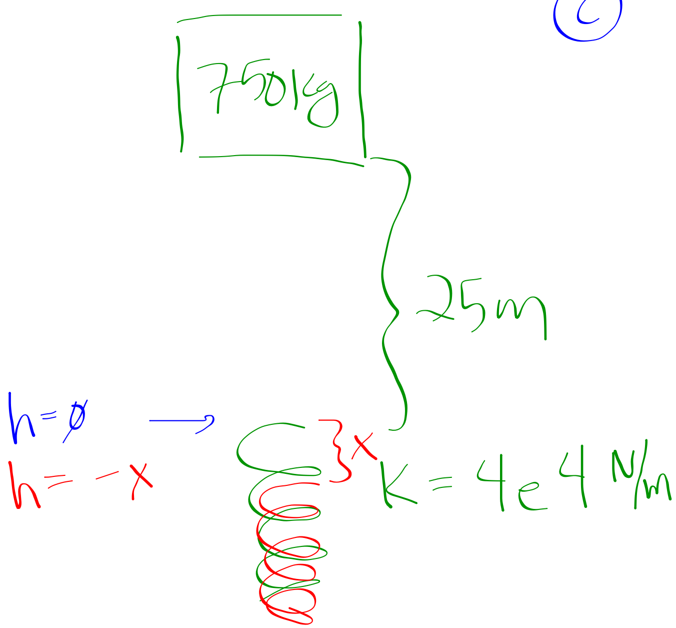
23. An elevator cable breaks when a 750-kg elevator is 25 m above a huge spring ($k=4.0\times10^4$ N/m) at the bottom of the shaft. Calculate

a) the work done by gravity on the elevator before it hits the spring.
b) the speed of the elevator just before striking the spring.
c) the amount the spring compresses (Hint: remember that work is done by both the spring and gravity in this part).



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

$$(750)(9.8)(25) = (750)(9.8)(-x) + \frac{1}{2}(4e4)x^2$$

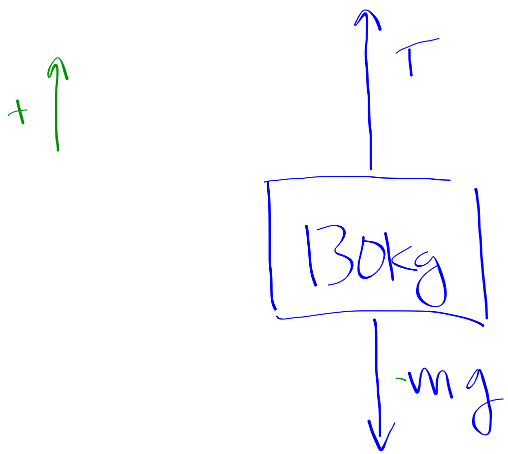
$$2e4x^2 - 7350x - 183750 = 0$$

$\boxed{x = 3.22\text{ m}}$ or -2.85 m

22. A 130-kg load is lifted 30 m vertically by a single cable with an acceleration a = 0.15 g (one "g" is 9.8 m/s^2). Determine

a) the tension in the cable
b) the net work done on the load
c) the work done by the cable on the load.
d) the work done by gravity on the load.
e) the final speed of the load assuming it started from rest.

$W_{NC} = W_T = T \cdot \Delta x$



$\Sigma F = ma$

$T - mg = ma$

$\underline{T = ma + mg}$

$W_{net} = \Sigma F \cdot \Delta x$

$W_g = mg \cdot \Delta x$

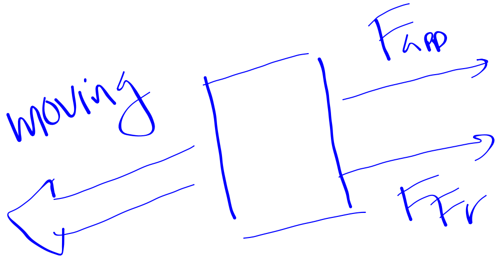
$\frac{1}{2}mv^2 = \ldots$

(from CLEE)

Prelimary lab → gives you equations in terms of $m, g, \mu, F_{app}, \theta, x_0, x$

(at bottom of ramp)

$$x = \sqrt{\frac{\theta^2 - mg\mu F_{app}}{x_0 - \boxed{W_{NC}} + m}}$$



$d = \Delta x$

$$W_{NC} = W_{app} + W_{Fr}$$

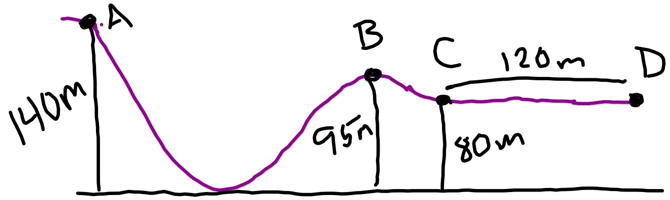
$$= F_{app} \cdot \Delta x + F_{Fr} \cdot \Delta x$$

$$= (F_{app} + F_{Fr})(x - x_0)$$

$\emptyset$ at bottom of ramp
Unknown at end of movement

1. An 850 kg roller-coaster cart is released from rest at Point A of the track shown in the figure below. Assume there is no friction or air resistance between Points A and C.

* solve using variables first!



a) How fast is the roller-coaster moving at Point B?

b) How fast would the roller-coaster cart be moving at Point B if it didn't have any riders and its mass was 560 kg?

W_{NC}

c) What average force is required to bring the 850 kg roller-coaster to a stop at Point D if the brakes are applied at Point C?

↳ doing non-conservative work

a/b: $\frac{1}{2}mv_0^2 + mgh_0 + \cancel{\frac{1}{2}kx_0^2}^{\,0} + \cancel{W_{NC}}^{\,0} = \frac{1}{2}mv^2 + mgh + \cancel{\frac{1}{2}kx^2}^{\,0}$

$$\frac{1}{2}mv^2 = \frac{1}{2}mv_0^2 + mgh_0 - mgh$$

$$v = \sqrt{\frac{\cancel{\frac{1}{2}mv_0^2}^{\,0} + \cancel{m}gh_0 - \cancel{m}gh}{\frac{1}{2}\cancel{m}}}$$

$$v = \sqrt{\frac{(9.8)(140) - (9.8)(95)}{\frac{1}{2}}}$$

$$\cong 29.7 \text{ m/s}$$

c: $\cancel{\frac{1}{2}mv_0^2}^{\,0} + mgh_0 + \cancel{\frac{1}{2}kx_0^2} + \underset{F_{app}(\Delta x)}{\underset{\parallel}{W_{NC}}} = \cancel{\frac{1}{2}mv^2}^{\,0} + mgh + \cancel{\frac{1}{2}kx^2}^{\,0}$

$$F_{app} = \frac{mgh - mgh_0}{\Delta x} = \frac{(850)(9.8)(80) - (850)(9.8)(140)}{120}$$

$F_{app} = 4165\text{N}$ (opposite direction of motion...)

2. A child's toy that is made to shoot ping pong balls (2.7 g) consists of a tube, a spring (k = 18 N/m) and a catch for the spring that can be released to shoot the balls. When a ball is loaded into the tube, it compresses the spring 9.5 cm. If you shoot a ping pong ball straight up out of this toy, how high will it go?

Challenge: Answer the question posed in this video

https://www.youtube.com/watch?v=FhmLBxyX8Dw&feature=youtu.be

Explain your answer... also, explain what is going on in terms of mechanical energy... At what point is GPE max, KE max, and EPE max during the jump? Why does the jumper eventually come to rest?