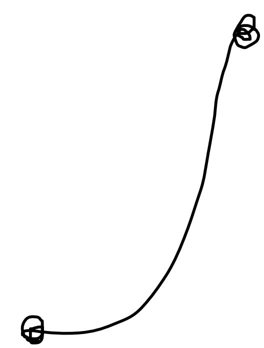
Phys 2110-4 10/12/11

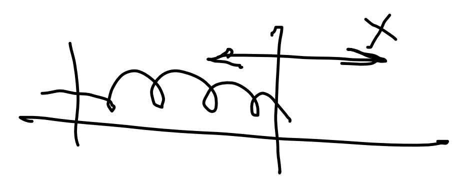
Note Title 10/12/2011

→ Chapter 7

Work done by a force

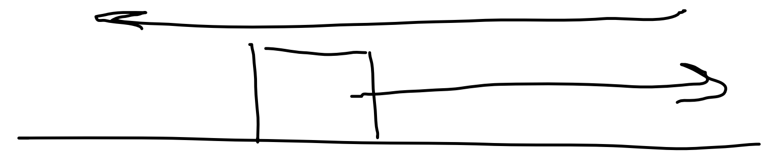
$$W_{grav} = -mg\Delta y$$
$$= -mg(y_2 - y_1)$$
$$W_{spring} = \frac{1}{2}k(x_1^2 - x_2^2)$$





W_{fric}

Nasty force



W for the nice forces is a difference of function involving coord's

Conservative force

Non conservative force

For conservative forces

$$W = -\Delta U$$

Grav: $U = mgy$

Spring: $U = \frac{1}{2}kx^2$

U = Potential Energy function

Units are J

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

Energy is never lost or created. Changes forms.

Cons of energy

Ch. 6

$$W_{net} = \Delta K$$

$$= W_{cons} + W_{non\ cons}\ (\text{friction})$$

$$W = -\Delta U \qquad = \underbrace{W_1}_{\text{grav}} + \underbrace{W_2}_{\text{spring}} + \ldots \quad W_{non-cons}$$

$$\Delta K = W_1 + W_2 + \cdots W_{\text{non-cons}}$$

$$= -\Delta U_1 - \Delta U_2 + \cdots + W_{\text{non cons}}$$

$$\left(\Delta U_1 + \Delta U_2 + \cdots \Delta K\right) = W_{\text{non cons.}}$$

Def: $U = U_1 + U_2 + \cdots$ Total stored energy

$E = U + K = K + U$ (Total mechanical energy)

$$\boxed{\Delta E = W_{\text{non-cons}}}$$

$$\Delta E = \Delta U + \Delta K = W_{\text{non-cons}}$$

(friction)
(applied)

Suppose no friction, etc.

$$\longrightarrow W_{\text{non-cons}} = 0$$

$$\boxed{\Delta E = 0}$$

No non-cons.

$$E = U + K$$

Conservation of Energy
Sec 7.3

Energy

$K = \frac{1}{2} m v^2$

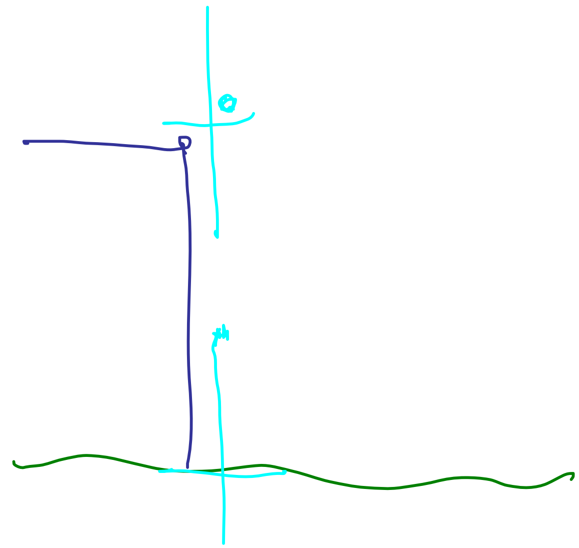
$U_{grav} = m g y$

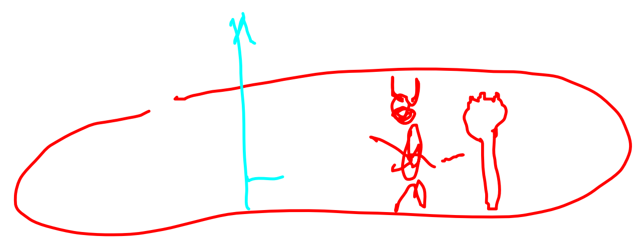
$U_{spring} = \frac{1}{2} k x^2$

$U_{elec} = \ldots$ — —

Origin is arbitrary

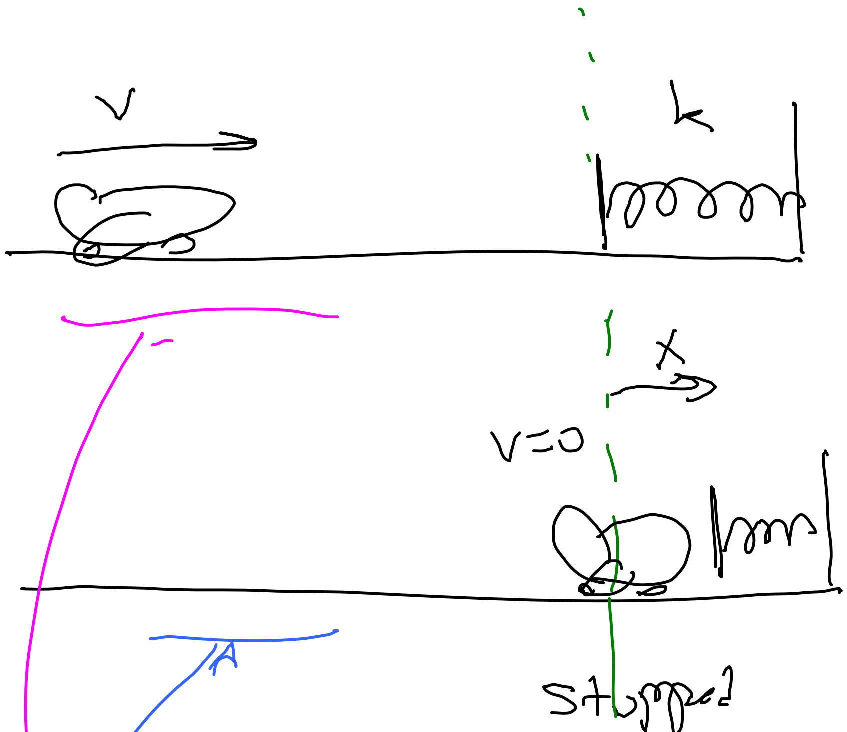
Δy $\quad \Delta U = m g \Delta y$





Problems involving cons of Energy Ch 7

7.20 A 10,000 kg Navy jet lands on aircraft carrier & snags cable to slow it down. Cable attached to spring w/ $k = 40 \, kN/m$. Spring stretches by 25 m to stop plane. What was its landing speed?



Ignore friction.

$$\Delta E = 0$$

$$U + K = \text{const}$$

$$U_1 + K_1 = U_2 + K_2$$

$$E_1 = U_1 + K_1 = 0 + \frac{1}{2}mv^2$$

$U_1 = 0$
$K_1 = \frac{1}{2}mv^2$

$$E_2 = U_2 + K_2 = \frac{1}{2}kx^2 + 0$$

$U_2 = \frac{1}{2}kx^2$
$K_2 = 0$

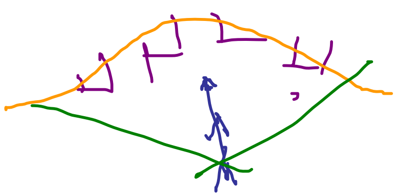
$$\frac{1}{2}kx^2 = \frac{1}{2}mv^2$$

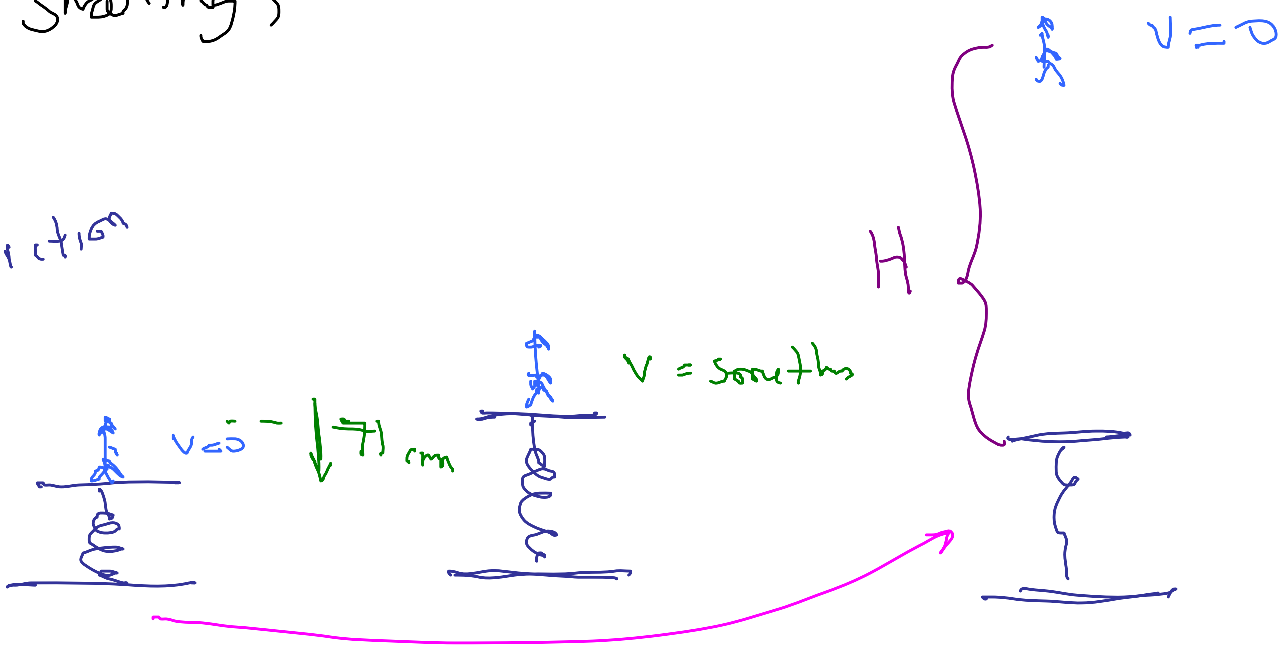
$$\longrightarrow \quad v^2 = \frac{k}{m}x^2 = \frac{40 \times 10^3 \ \frac{N}{m}}{10,000 \ kg}(25m)^2$$

$$\Longrightarrow \quad v = 50 \ \frac{m}{s}$$

7.21 A 120-g arrow is shot vertically from a bow whose eff spr constant is $k = 430 \, N/m$. If bow is drawn 71 cm before shooting, to what height does arrow rise?

No friction



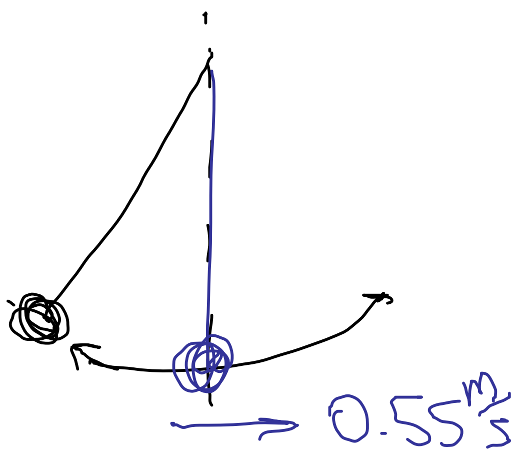


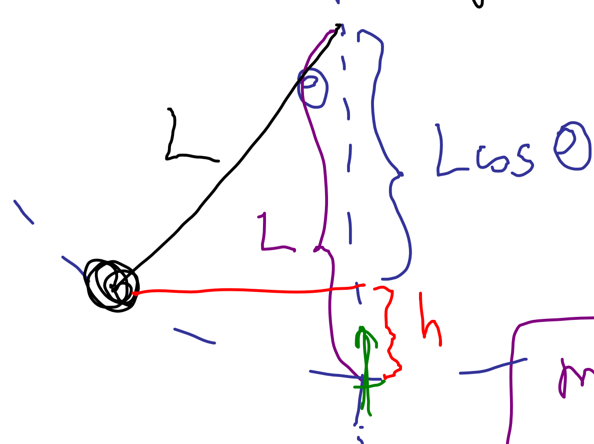
$$E_{first} = E_{last} \qquad \frac{1}{2}kx^2 + 0 = mgH + 0$$

$$H = \frac{\frac{1}{2}kx^2}{mg} = \frac{1}{2}\frac{(430\ \frac{N}{m})(0.71\ m)^2}{(0.120\ kg)(9.8\ \frac{m}{s^2})}$$

$$= 92.2\ m$$

7.46 The maximum speed of a pendulum bob in a g-father clock is $0.55\ \frac{m}{s}$. If the pendulum makes a max angle of 8.0° w/ vertical what is the length of pendulum?





$\theta = 8.0^\circ$

$h = L - L\cos\theta$

$\boxed{mgh = \frac{1}{2}mv^2}$ etc.