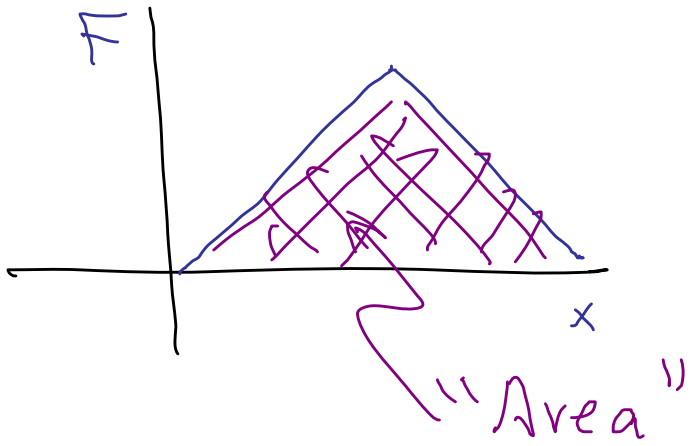
Phys 2110-4 10/10/11

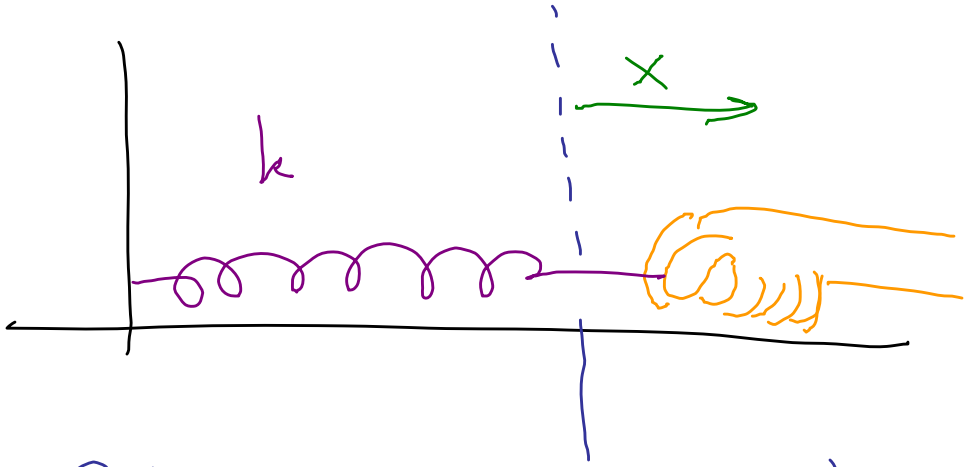
Note Title 10/10/2011

Chap 6: Work, Energy (Kinetic), Power

Work by non-constant force (1-Dim)

$$W = \int_{x_1}^{x_2} F_x \, dx$$





$$F_{spr} = -kx$$

For equilibrium

$$F_{hand} = -F_{spr} = kx$$

Pull a spring from x_1 to x_2

Find work done by you

$$W = \int_{x_1}^{x_2} kx\,dx = \frac{1}{2}kx^2 \Big|_{x_1}^{x_2} = \frac{1}{2}k\left(x_2^2 - x_1^2\right)$$

Power W

Rate at which work is done

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

Units? Units?

$$\frac{J}{s} = \frac{\frac{kg\ m^2}{s^2}}{s} = \frac{kg\ m^2}{s^3}$$

$$= 1\ Watt = 1\ W$$

Other units

1 horsepower = 746 W

$$P = \frac{dW}{dt} = \frac{\vec{F} \cdot d\vec{r}}{dt} = \vec{F} \cdot \vec{v}$$

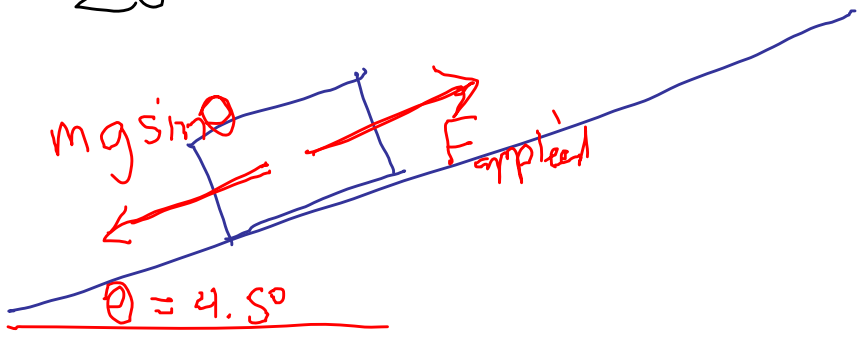
6.63 You're writing spec's for car

1750-kg car delivers energy to drive wheels at 35 kW. What do you list as greatest speed at which it climbs 4.5° slope?

$F_{applied} = mg\sin\theta$ (const. vel.)

$P = F_{road} \cdot v$ → 26 m/s

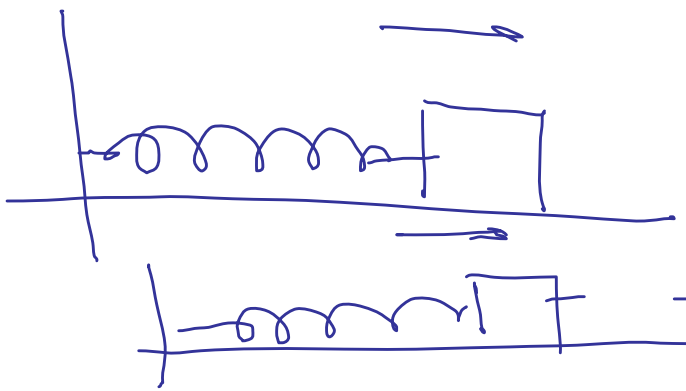
$v = \frac{P}{F} = \frac{35\ kW}{mg\sin\theta}$



Chap 7 Conservation of Energy

Ch 6: $W_{net} = \Delta K$

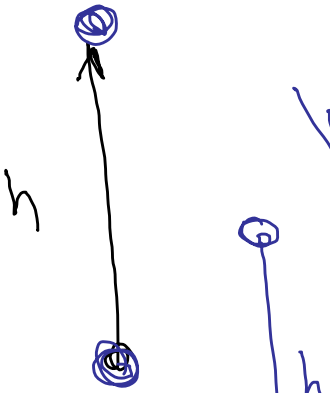
Work done in diff situations



$W_{spring} = -W_{hand} = \frac{1}{2}k\left(x_1^2 - x_2^2\right)$

Just depends on endpoints.

Springs give & take kinetic E



$W_{grav} = -mgh$

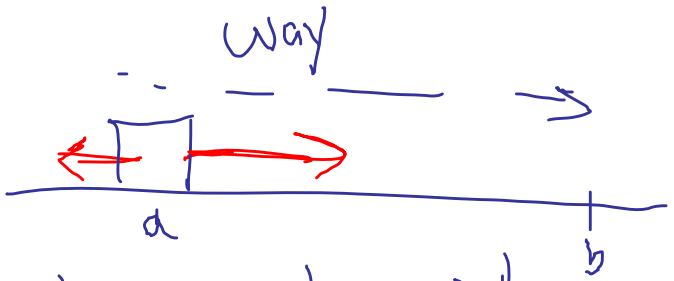
$W_{grav} = +mgh$

$$W = -mg\Delta y$$

Vertical lifting.

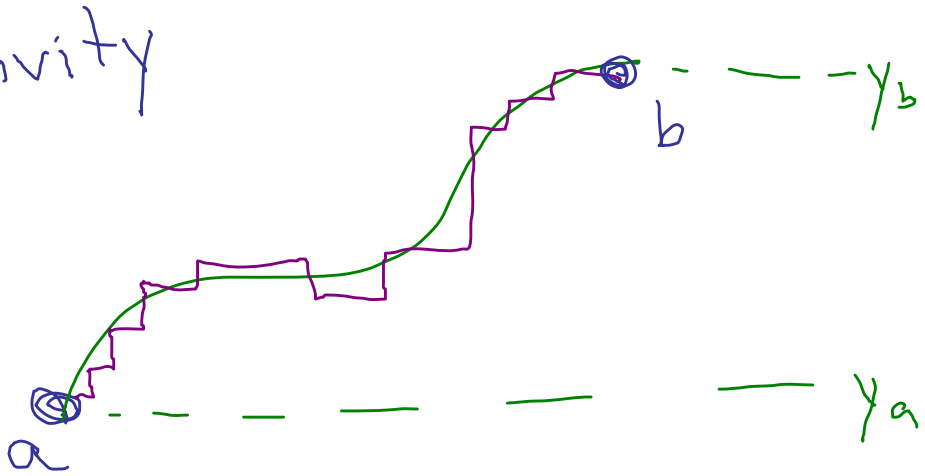
Gravity keeps all the energy!

Not all forces act this way



Fric opposes motion; negative work is done.

Gravity

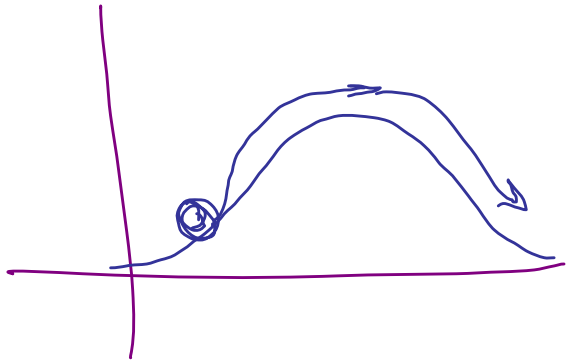


Gravity only does work on vertical segments, not on horiz. segments

$$W_{grav} = \sum_{v.bits} -mg(\Delta y)_{bit}$$

$$= -mg(y_b - y_a)$$

$$= -mg\Delta y$$



$W = \Delta K$

$\rightarrow W_1 + W_2 + W_3 \cdots$

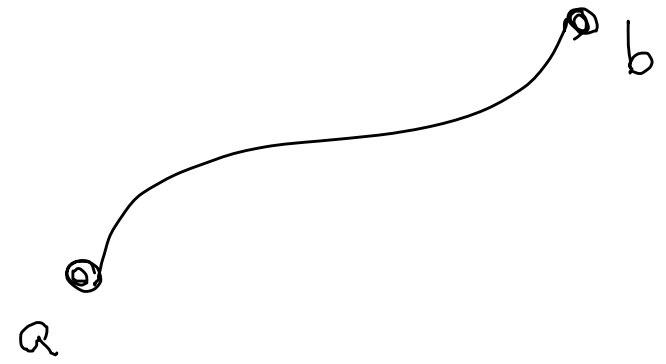
If force has property that the work done only depends on diff. in coords,

Conservative force

Gravity
Spring
"Normal" forces do no work

Friction is a non-cons. force.

(Work depends only one final & initial coord's, and it's written as a difference.)



$$W_{spring} = \frac{1}{2}k(x_1^2 - x_2^2)$$

$$W_{gra} = -mg\Delta y$$
$$= -mg(y_2 - y_1)$$

Consider a function $U(x)$

Want $W_{force} = -\Delta U$

$$U_{spring} = \frac{1}{2}kx^2$$

$$U_{gra} = mgy$$