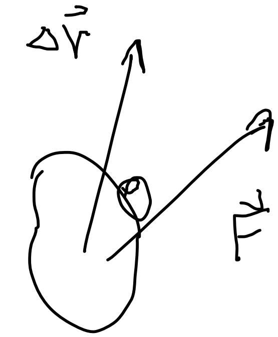
Phys 2110-5 10/5/12

Note Title 10/5/2012

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

Work $W = \oint \vec{F}\cdot d\vec{r}$




Joules . . .

$W = \vec{F}\cdot\Delta\vec{r}$
$= |\vec{F}||\Delta\vec{r}|\cos\theta$

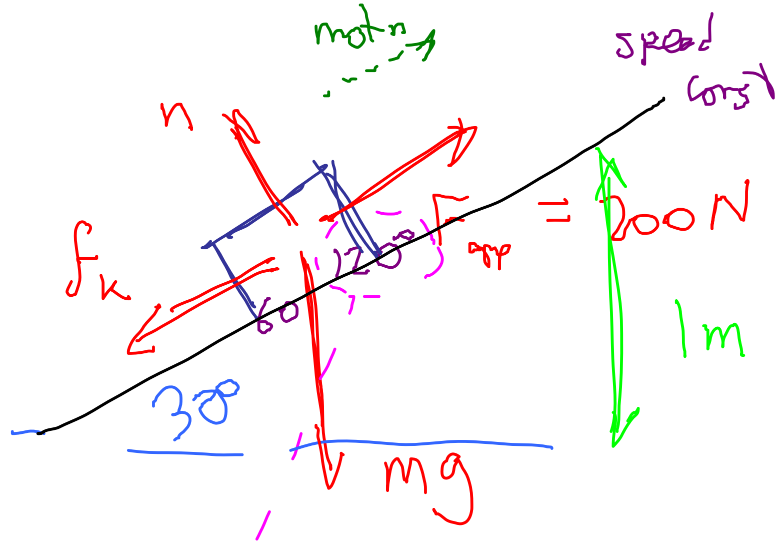
Work-energy theorem

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

6.41 You slide a box at constant speed up 30° ramp applying a force of 200 N directed up slope. Coeff of fric in 0.18. a) How much work have you done when box has risen 1m vertically? b) what is mass of the box?

$$W = W_{you} + W_{fric} + W_{grav}$$

$$W = Fr\cos\theta$$




a) $W_{you} = (200N)(2m)$

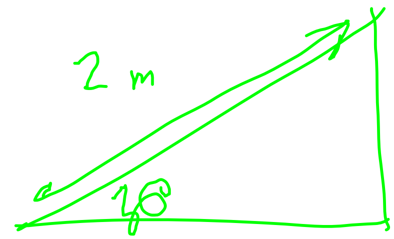
$= 400 J$

b) $W_{net} = 0 = \Delta K$

$$W_{net} = 400J + f_k(2m)(-1) + (mg)(2m)\cos 120^\circ$$

$$= 400J - \mu_k mg\cos\theta\,(2m) - mg\,(2m)\sin 30^\circ = 0$$

b) $m = 31.1\,kg$




$-\sin 30^\circ$

$f_k = \mu_k mg\cos\theta$

## Power

**Work** $W = Fr\cos\theta \ldots$

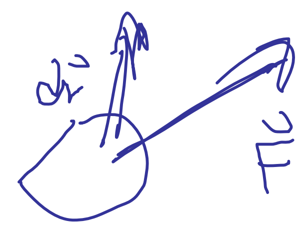
Rate at which work is done $\quad P = \dfrac{W}{\Delta t}$

Scalar (Like W, K scalar)

Units $\quad [P] = \dfrac{[W]}{[\Delta t]} = J/s = \text{Watt}$

1 horsepower = 746 W

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




in $dt$

$d\vec{r}/dt$

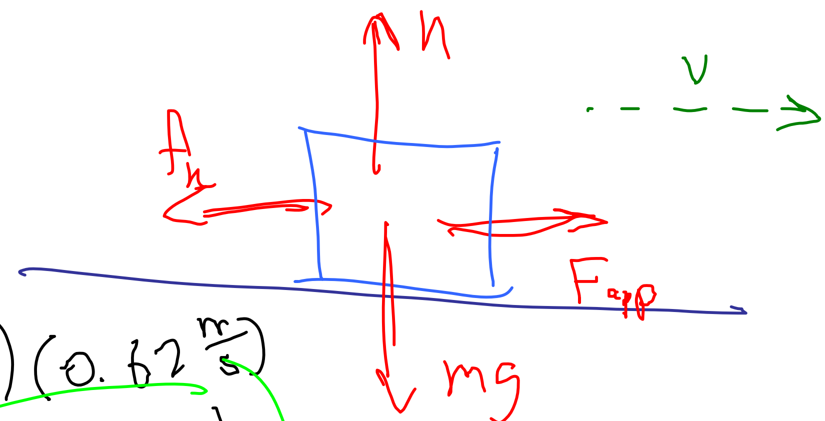
6.67 a) What power is needed to push 95 kg crate at 0.62 $\frac{m}{s}$ along horiz. floor where coeff fric is 0.78?

b) How much work is done in pushing crate 11 m?

a)
$$P = Fv$$

$$F_{app} = f_k = \mu_k mg$$
$$= 726\,N$$

$$P = Fv$$
$$= (726\,N)(0.62\,\tfrac{m}{s})$$
$$= \boxed{450\,W}$$



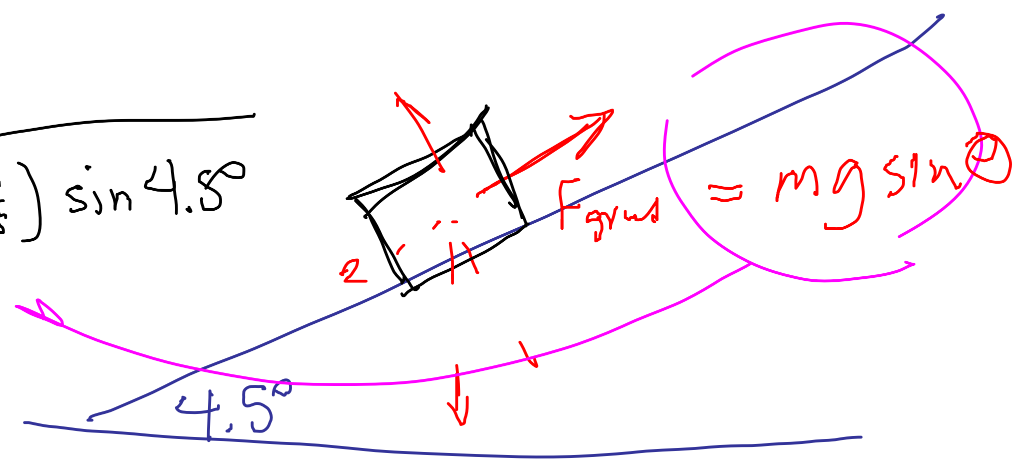

b)
$$W = F_{app} d = (726\,N)(11\,m)$$
$$= \boxed{8.0\,kJ}$$

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

$$P = F_{gr} \cdot v$$

$$v = \frac{P}{F_{grav}} = \frac{(35\ kW)}{(1750\ kg)(9.8\ \frac{m}{s^2})\sin 4.5°}$$

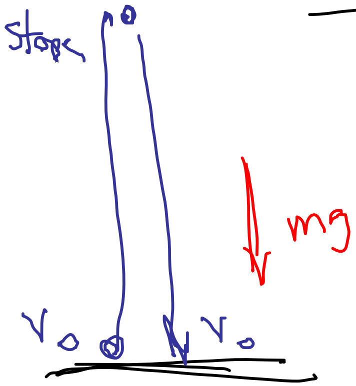
$$= 26\ \frac{m}{s}$$

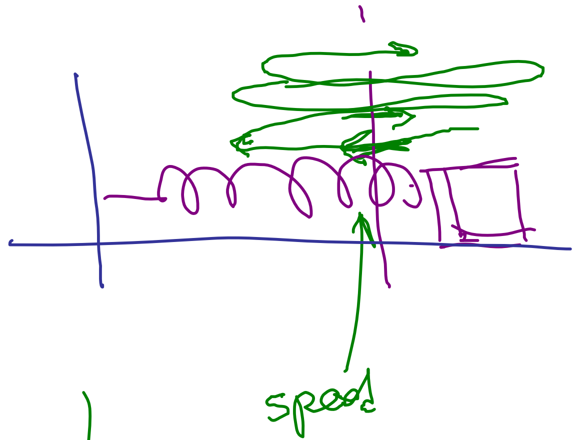


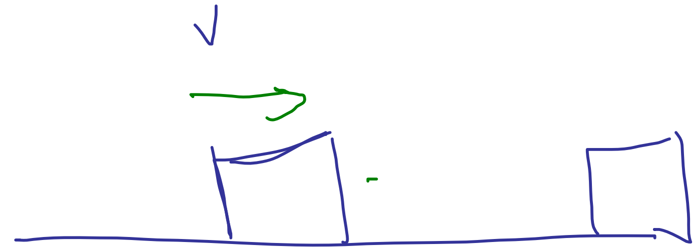
# Chap 7

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

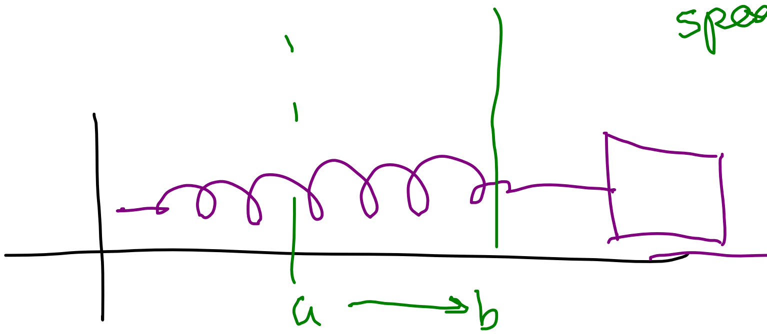
$\longrightarrow$ Potential Energy




Lose the KE




$$W_{spring} = \int_a^b (-kx)\, dx$$

$$= \frac{k}{2}(a^2 - b^2)$$

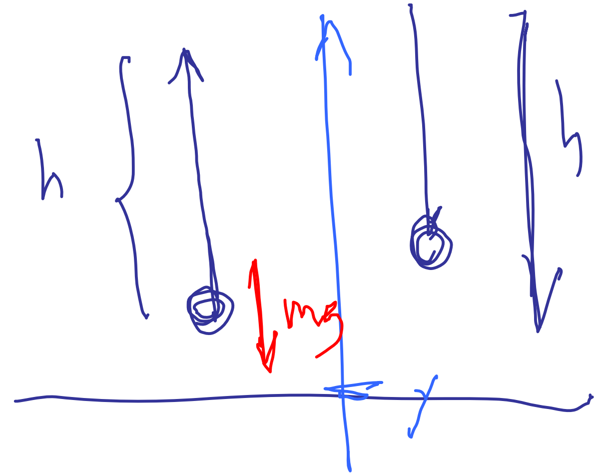
$$= \frac{k}{2}(x_1^2 - x_2^2)$$

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

Depends only on init & final coords.

# Gravity

$$W = -mgh$$
$$W = +mgh$$



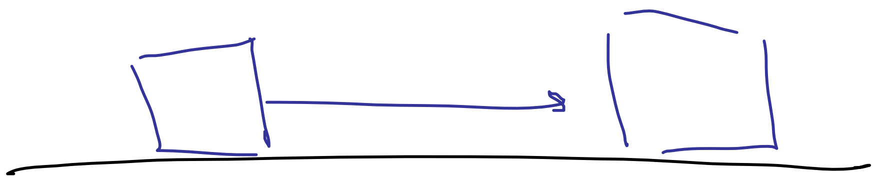

$$\boxed{W = -mg\Delta y = -mg(y_2 - y_1)}$$

Depends only on init & final.

These Forces find, function for $W = \cancel{\Delta U} = -\Delta U$

Grav $W = \Delta(-mgy) = -\Delta U \qquad U = mgy$

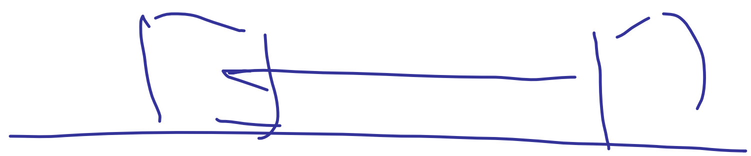
Spring $W = \Delta\left(-\frac{k}{2}x^2\right) = -\Delta U \qquad U = \frac{k}{2}x^2 = \frac{1}{2}kx^2$



U is potential energy
(for a certain force)

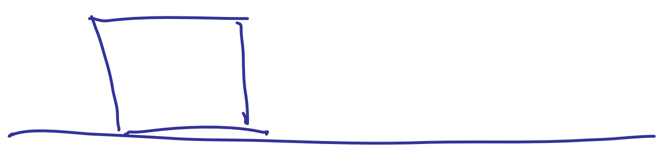
Joules

$W_{force} = -\Delta U$



$W_{fric}$ = neg number

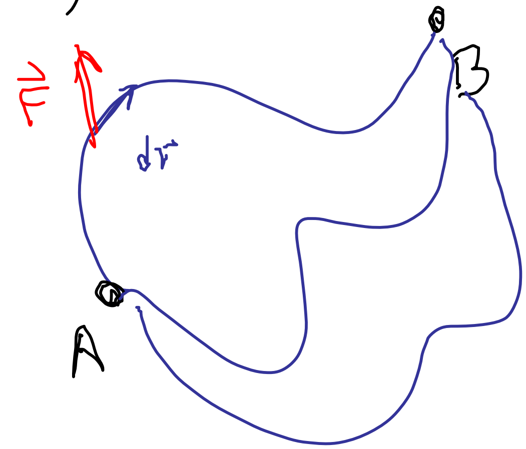
Stored energy



Forces which allow us to get $U(x)$ conservative force.

# Conservative force (more to it ...)

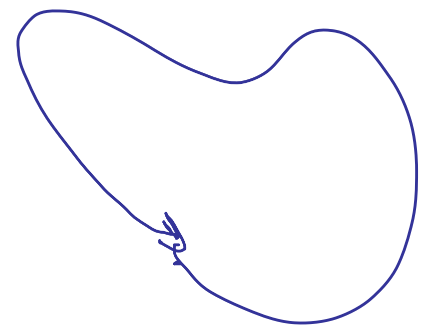
$$W = \int_A^B \vec{F} \cdot d\vec{r}$$




Conserv forces: W does not depend on path

$\Longrightarrow$ Closed path

$$\oint \vec{F} \cdot d\vec{r} = 0$$



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

$$\underbrace{W_1 + W_2 + W_3 + \cdots}_{\text{Conserv.}} + W_{non\text{-}cons.} = \Delta K$$

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

$$\Delta K + \underbrace{\Delta U_1 + \Delta U_2 + \cdots}_{\Delta U_{Tot}} = W_{non\,cons}$$

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

Suppose $W_{non\text{-}cons} = 0$ (no fric)

$$\Delta K + \Delta U = 0$$

$$E = K + U$$

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