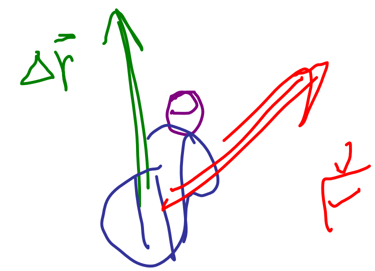
Phys 2110-4 2/27/13

Note Title 2/27/2013

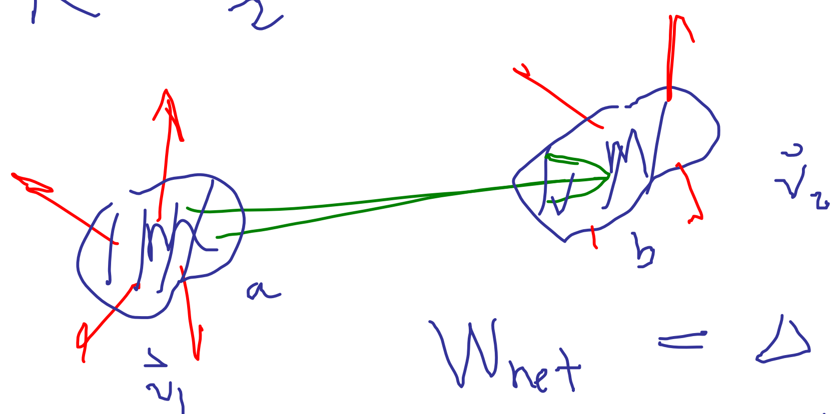
Work: $W = \vec{F} \cdot \Delta\vec{r}$

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



Kinetic Energy $K = \frac{1}{2}mv^2$ Units: J

W-E Theorem:



$W_{net} = \Delta K$

$= \frac{1}{2}m(v_2^2 - v_1^2)$

Dot Product

Example: Find angle between $\vec{A} = 3\hat{i} + 2\hat{j}$ and $\vec{B} = -\hat{i} + 6\hat{j}$

$$\vec{A}\cdot\vec{B} = AB\cos\theta = A_xB_x + A_yB_y$$

$$A = \sqrt{13} \qquad B = \sqrt{37}$$

$$A_xB_x + A_yB_y = 9$$

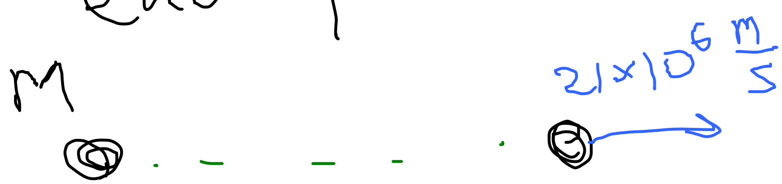
$$\cos\theta = \frac{9}{\sqrt{13}\sqrt{37}}$$

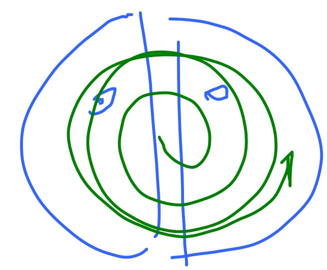
$$\cos\theta = 0.4104$$

$$\theta = 65.8^\circ$$

WE Thm: $W_{net} = \Delta K$

6.26 A cyclotron accel's protons from rest to $21 \frac{Mm}{s}$. How much work does it do on each proton?

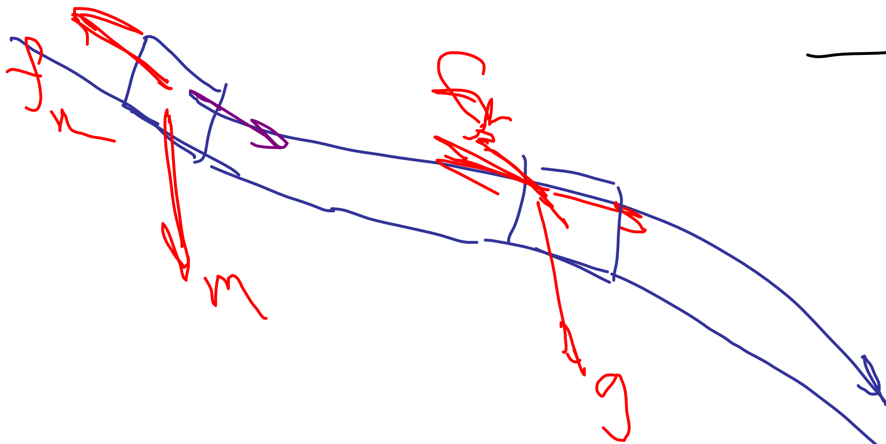


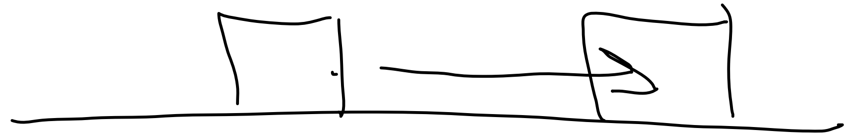


$$m = 1.67 \times 10^{-27}\ kg$$

$$W_{net} = \Delta K$$
$$= \frac{1}{2} m \left(v_{fin}^2 - 0\right)$$
$$= \frac{1}{2}\left(1.67 \times 10^{-27}\ kg\right)\left(21 \times 10^6\ \frac{m}{s}\right)^2$$
$$= 3.68 \times 10^{-13}\ J$$

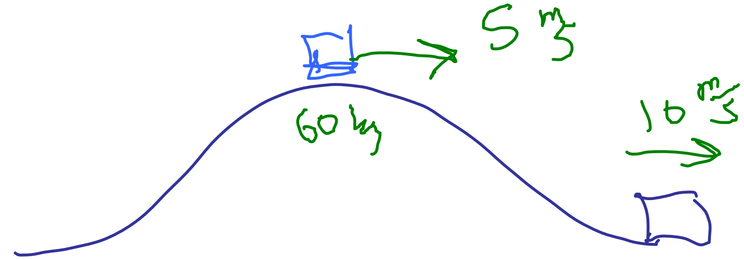
$W_{net} = \Delta K$





$W_{net} = \Delta K$

6.28 A 60 kg skateboarder comes over top of hill at 5.0 $\frac{m}{s}$ and reaches 10 $\frac{m}{s}$ at bottom. Find total work done on the skateboarder between top & bottom.



$$W_{net} = \Delta K = \frac{1}{2}(60\ kg)\left(\left(10\ \frac{m}{s}\right)^2 - \left(5\ \frac{m}{s}\right)^2\right)$$

$$= 2250\ J$$

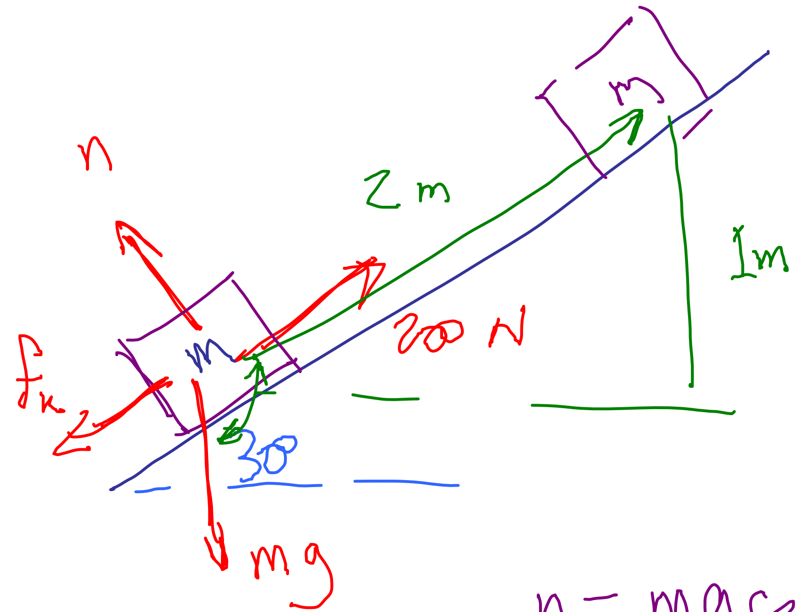
6.41 You slide box of books at constant speed up a 30° ramp app'ing force of 200 N dir'd up slope. The coeff. of fric. is 0.18. a) How much work have you done when box has risen 1m vertically?

b) What's mass of box?

Speed constant

$$W_{net} = 0$$

$$W = \boxed{(200\,N)(2\,m)} + mg(2\,m)(\cos 120^\circ) + (\mu_k mg\cos\theta)(2\,m)(-1) + 0 = 0$$



$n = mg\cos\theta$

$f_k = \mu_k mg\cos\theta$

Do arith. $\longrightarrow$ m = 31.1 kg

a) 400 J

b) m = 31.1 kg

Work (Change KE)

Rate at which work is done

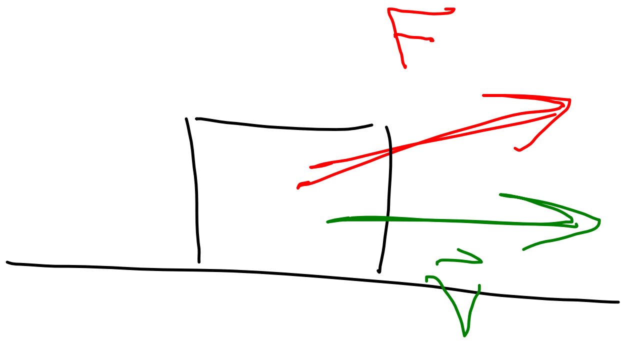
Suppose work W done on object in time Δt.

$\Longrightarrow$ J/s

$$\text{Power} = P = \frac{W}{\Delta t}$$

$$\text{Units} = J/s = \frac{kg\, m^2/s^2}{s} = \frac{kg\, m^2}{s^3} = \text{Watt}$$

1 watt = 1 W   1 horsepower = 746 W

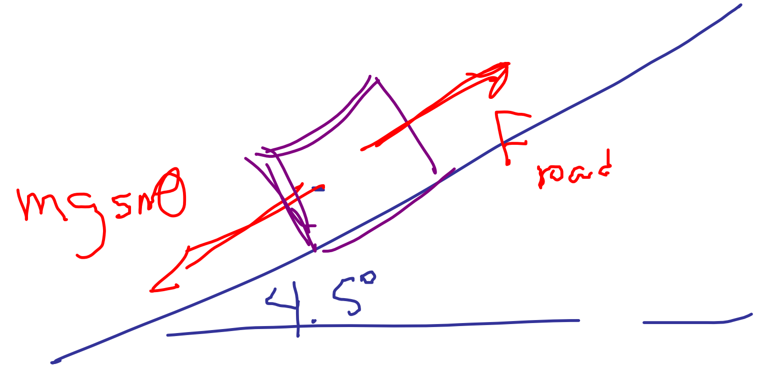


$$P = \frac{W}{\Delta t} = \frac{\vec{F}\cdot\Delta\vec{r}}{\Delta t} = \vec{v}$$

$$= \vec{F}\cdot\vec{v}$$ Instantaneous power

6.63 The 1750-kg car delivers energy .. at a rate of 35 kW. Neglecting resistance what do you list for greatest speed at which it can climb 4.5° slope?

$P = 35\ kW$



$P = F_{road} \cdot v$

$\approx 35\ kW$

mg sin θ

$F_{road} = mg\sin\theta$

$$v = \frac{P}{mg\sin\theta} = 26\ \frac{m}{s}$$

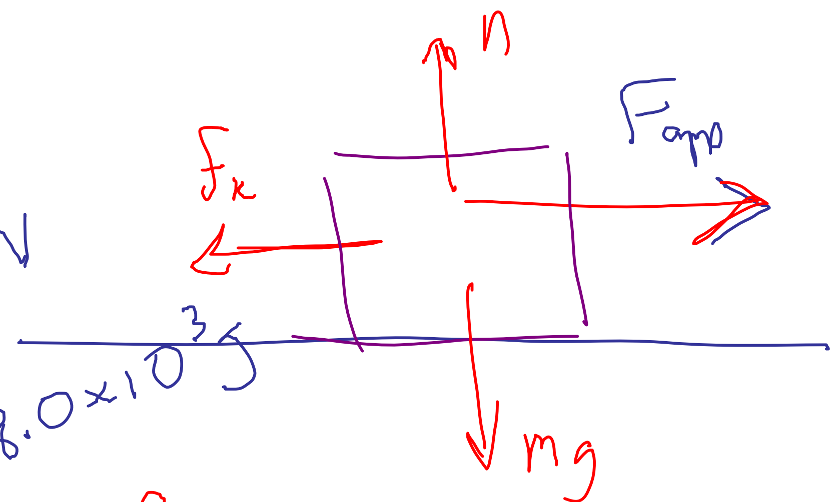
6.67 a) What power is needed to push 95-kg crate at 0.62 $\frac{m}{s}$ along horiz. floor where coeff. of fric is 0.78 b) How much work is done in pushing crate 11 m

$v = \text{const} \quad a = 0$

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

$P = F_{app} \cdot v = 450\,W$

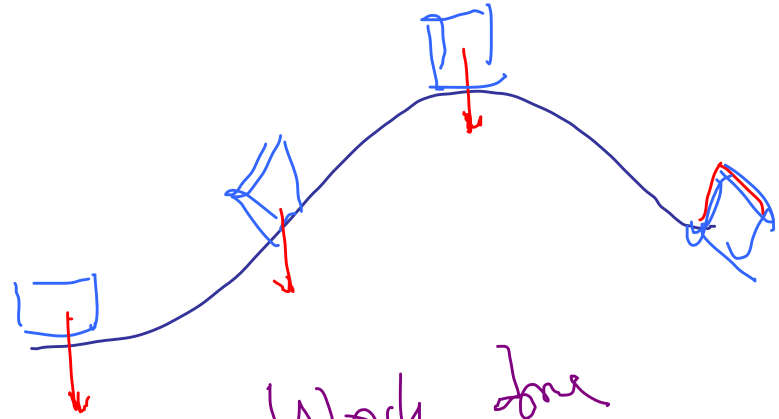
b) $W = F \cdot d = (726\,N)(11\,m) = 8.0 \times 10^3\,J$



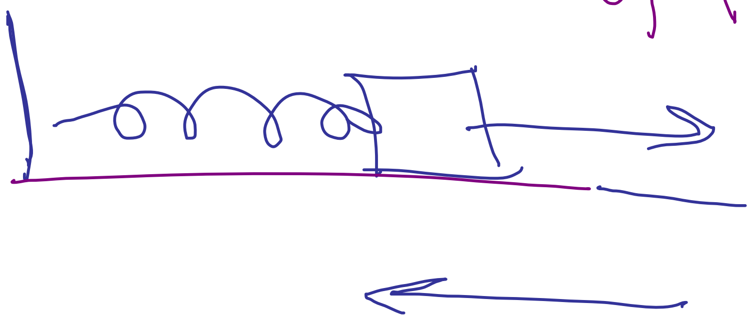
$f_k = \mu_k n = \mu_k m g$

Chap 7

Work done ag. fric lost



Work done against grav not lost

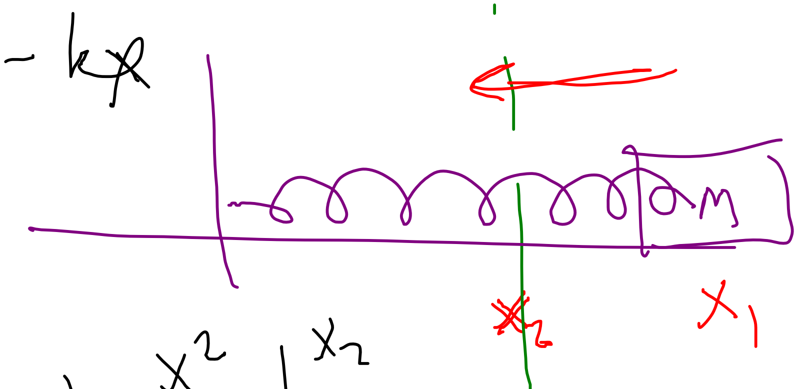


Work done against spring not lost.

Energy can be stored in some cases (not friction)

$\Longrightarrow$ Potential energy

$$W_{spr} = \int_{x_1}^{x_2} F_x \, dx \qquad F_{spr} = -kx$$



$$= -k \int_{x_1}^{x_2} x \, dx = -k \left. \frac{x^2}{2} \right|_{x_1}^{x_2}$$

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

Depends only on initial & final points.