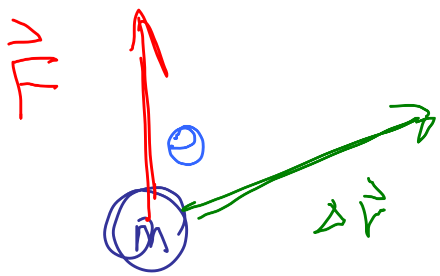
Phys 2110-4 2/22/12

Note Title 2/22/2012

Chap 6 Work, Energy $\longrightarrow$ Chap 7



constant $\vec{F}$

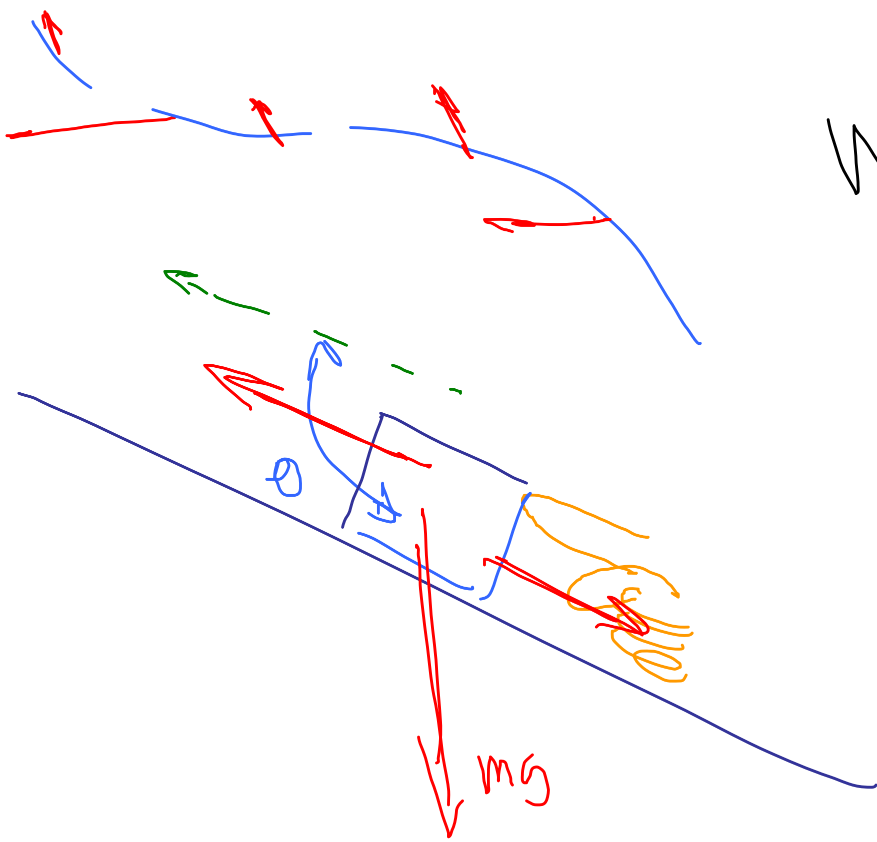
$$W = \vec{F} \cdot \Delta\vec{r}$$

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

Units $J = N \cdot m$

1-D, not constant:

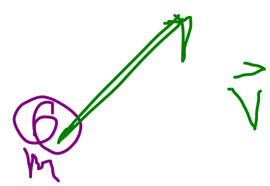
$$W = \int_{x_1}^{x_2} F_x \, dx$$



$$W = \int_{\vec{r}_1}^{\vec{r}_2} \vec{F} \cdot d\vec{r}$$

J
Scalar

$$W_{Total} = W_{fing} + W_{grav} + W_{fric.}$$

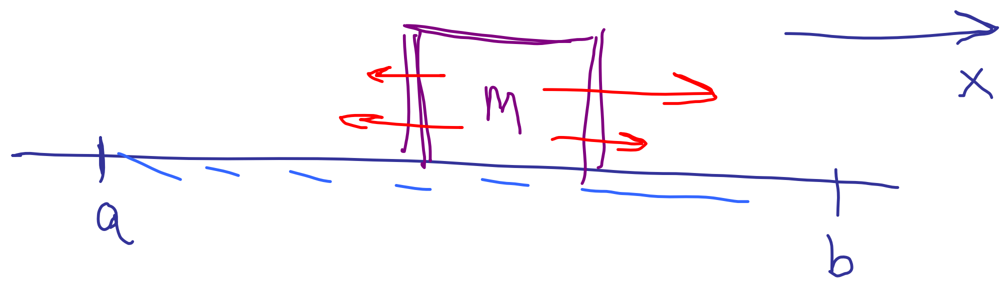


$$K = \frac{1}{2} m v^2$$

Scalar
v = speed.
J

Why make these def's ?

1-D motion



$$W^{net\,(total)}_{a \to b} = \int_a^b F_{net}\, dx$$

$$= m \int_a^b a(x)\, dx$$

Accel is treated as fn of x

$$a = \frac{dv}{dt} = \frac{dv}{d\cancel{x}} \cdot \frac{d\cancel{x}}{dt} = v\frac{dv}{dx} = \frac{1}{2}\frac{d(v^2)}{dx}$$

$$W = m\int_a^b \left[\frac{1}{2}\frac{d(v^2)}{dx}\right] dx = \frac{m}{2} v^2 \Big|_a^b$$

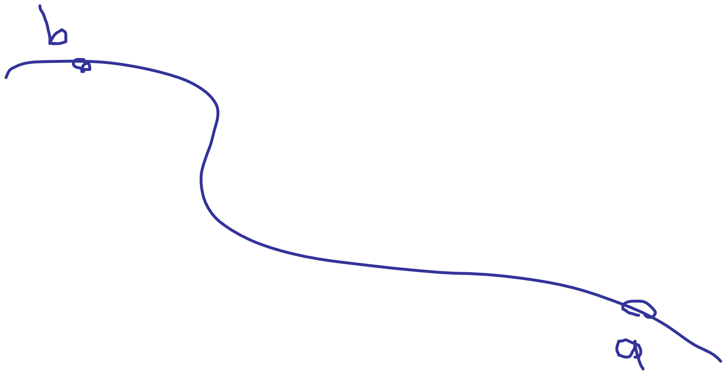
$$= \frac{m}{2}\left(v_b^2 - v_a^2\right) = \frac{1}{2}mv_b^2 - \frac{1}{2}mv_a^2$$

$$= K_b - K_a = \Delta K$$

Work-energy theorem

$$\boxed{W_{a\to b}^{\text{net}} = \Delta K}$$

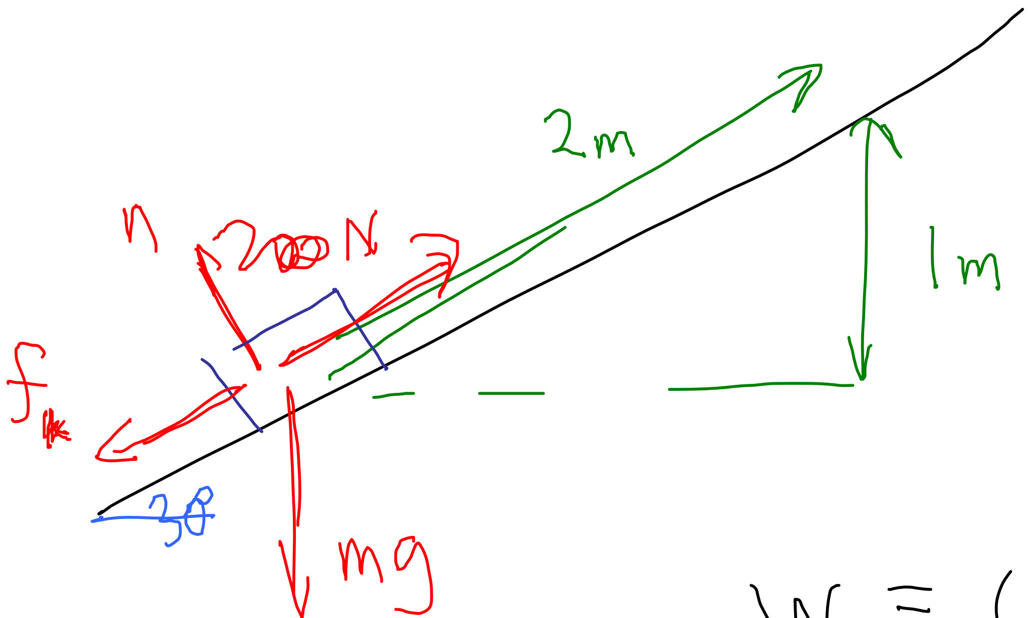
p 92



In 3-D, still true

6.41 You slide a box at constant speed up a 30° ramp, applying a force of 200 N directly up slope. The coefficient of kin fric is 0.18. a) How much work have you done when box has risen 1m vert'ly

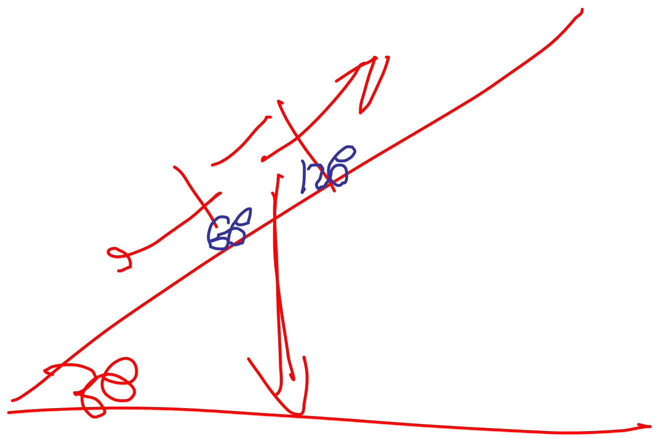
b) What's mass of box?



$$W = (200\,N)(2\,m)$$
$$= 400\,J$$

b) Const v $\Rightarrow$ K = const

$$\Delta K = 0 = W_{net} = W_{push} + W_{grav} + W_{fric}$$



$$W_{ton} = 400\ J$$

$$W_{grav} = (2m)(mg)\cos(120)$$

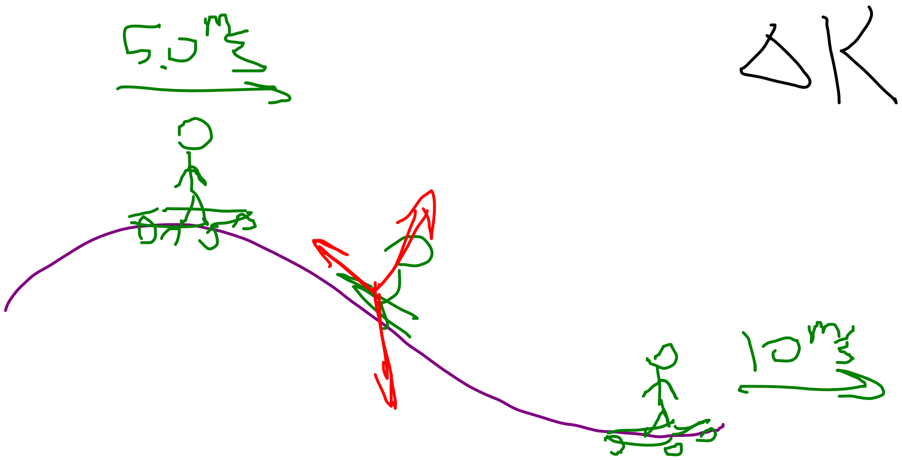
$$W_{fric} = (f_k)(2m)(-1)$$

$$f_k = \mu_k mg\cos\theta$$

$$0 = 400\ J + (2m)(mg)\cos(120) - (\mu_k mg\cos\theta)(2m)(-1)$$

b) $m = 31.1\ kg$

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



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

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

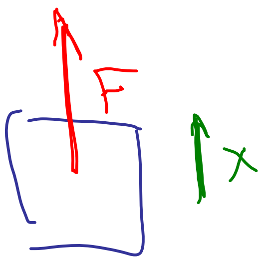
$$= \frac{1}{2}(60\,kg)\left[\left(10\,\frac{m}{s}\right)^2 - \left(5.0\,\frac{m}{s}\right)^2\right]$$

$$= 2250\,J = 2.25\,kJ$$

Power

$$\text{Work} = \int F\,dx = F_x \Delta x$$

constant



One can do work at diff rates.

For a little bit of work ΔW — Bad notation.

occuring in time Δt, power delivered by force is

scalar

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

Units $= \mathrm{J}/\mathrm{s} = 1$ watt $= 1\,\mathrm{W}$.

$$\frac{\mathrm{kg\,m^2}}{\mathrm{s^3}}$$

James Watt

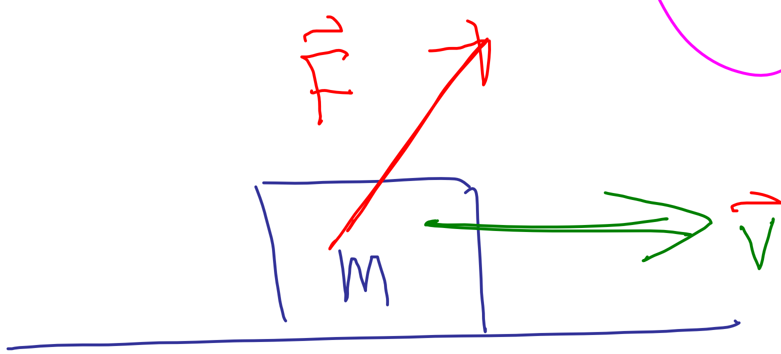
Power & velocity

p. 96

Small amt of work

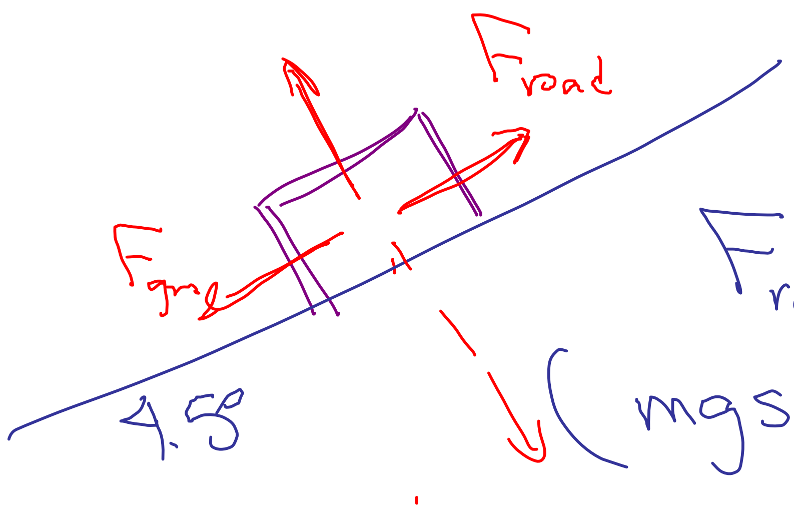
$$dW = \vec{F} \cdot d\vec{r}$$

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



$$P = \vec{F} \cdot \vec{v}$$

6.63 A 1750-kg car .. delivers energy to drive wheels at a rate 35 kW. Neglecting air resistance at what speed can to climb 4.5° slope?



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

$$F_{road} \cdot v = P \approx 26\,\frac{m}{s}$$

$$(mg\sin\theta)(\cdot v) = P_p$$

$$v = \frac{P}{mg\sin\theta}$$

$W_{net} = \Delta K$

Stored

Potential