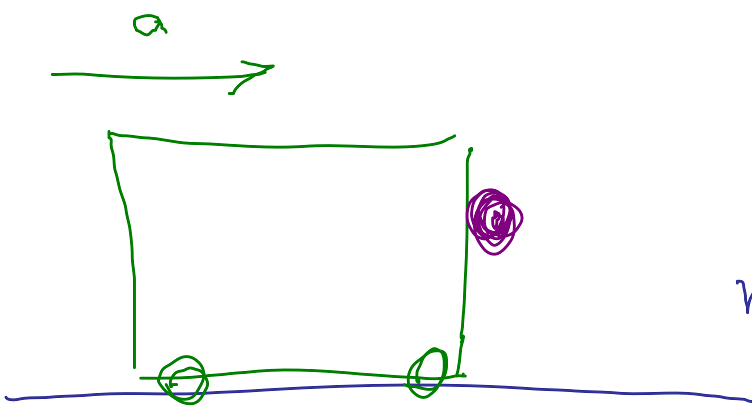
Phys 2110-5 10/1/12

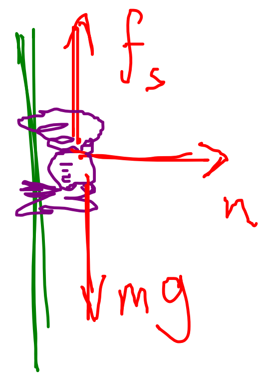
Note Title 10/1/2012

5.46 A bat crashes into vertical front of accel'ing subway train. If the fric coefficient between bat & train 0.86 what's the minimum accel. of train that will allow bat to stay in place?



$f_s = mg$

$n = ma$



No vertical accel

Horiz. accel

a_x

$$f_s^{max} = \mu_s n = \mu_s m a = m g$$

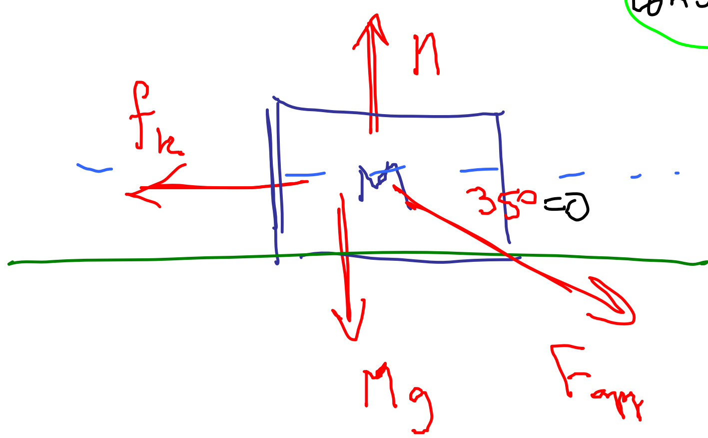
m's cancel

$$\mu_s a = g \qquad a = \frac{g}{\mu_s} = 11 \frac{m}{s^2}$$

5.44 Lawnmower ... goes at const. speed F_{app}

$M = 22$ kg

$$\vec{F} = m\vec{a}$$



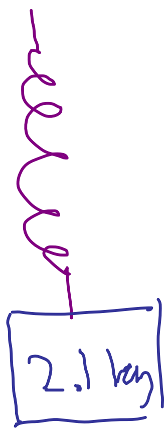
All forces cancel.

$$-f_k + F_{app}\cos\theta = 0$$

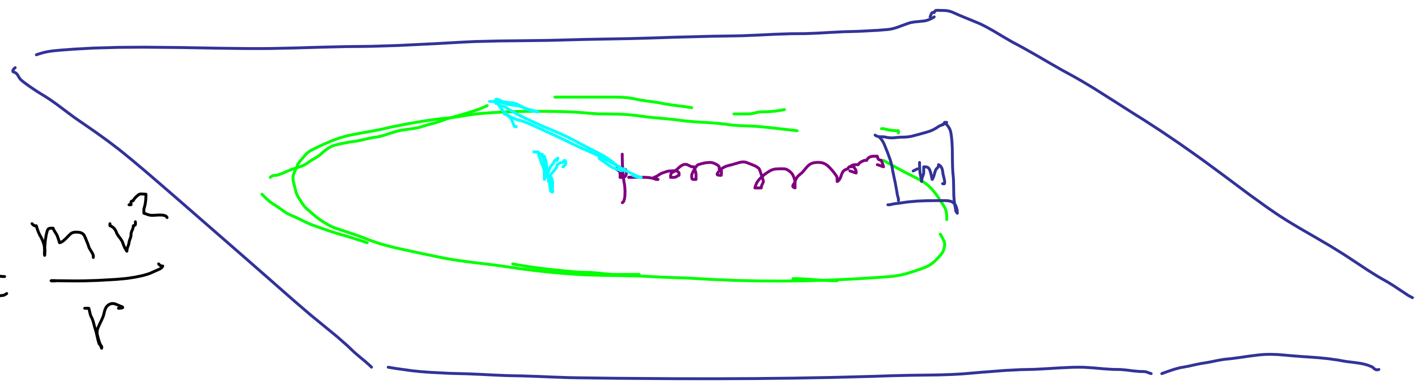
$$n - Mg - F_{app}\sin\theta = 0$$

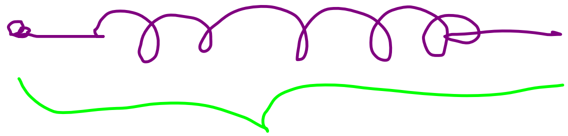
Solve for F_{app}.

5.65 A 2.1 kg mass is connected to a spring w/ spring constant $k = 150\ N/m$. Unstretched length 18 cm. They are mounted on frictionless table w/ free end of spring attached to frictionless. Mass is set into motion (circular) at 1.4 m/s. Find radius of its path

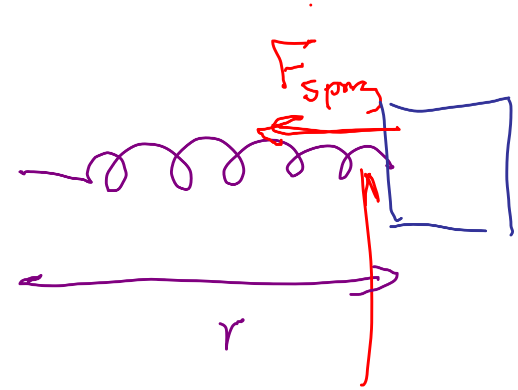


$$F_c = \frac{mv^2}{r}$$





$18 \text{ cm} = r_0$



$k(r - r_0)$

$$F_{spr} = k(r - r_0)$$

$F_{spr} = F_c$ $\qquad k(r - r_0) = \frac{mv^2}{r}$

mult by r, rearrange.

$kr^2 - kr_0 r - mv^2 = 0$ $\qquad$ Solve for r.

Quadratic formula

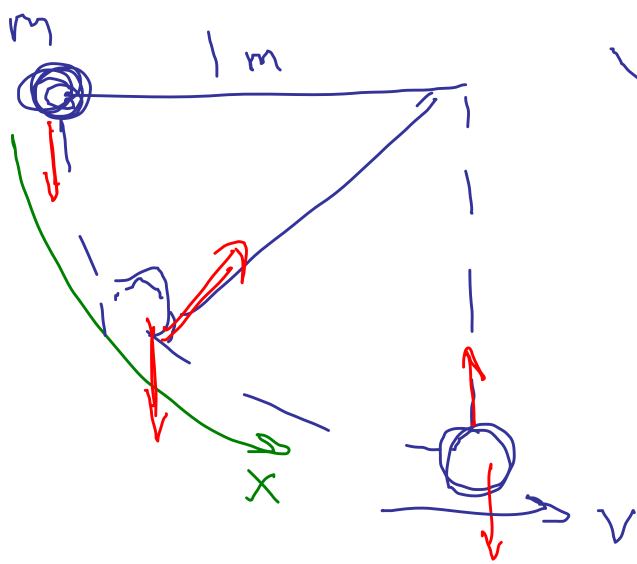
$\longrightarrow \boxed{r = 0.28 \text{ cm}}$

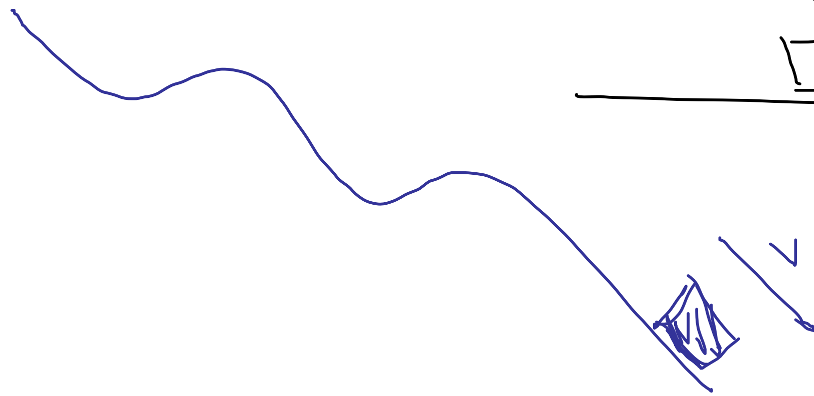
Chap 6

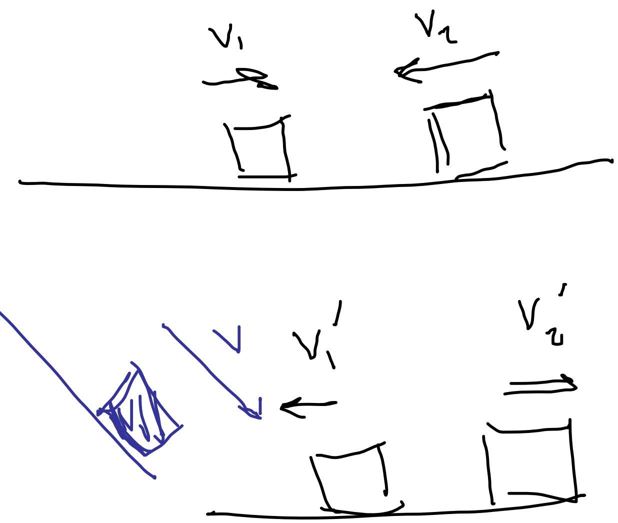
$\vec{F} = m\vec{a}$ is true.

Often to solve problems need other theorems & definitions.

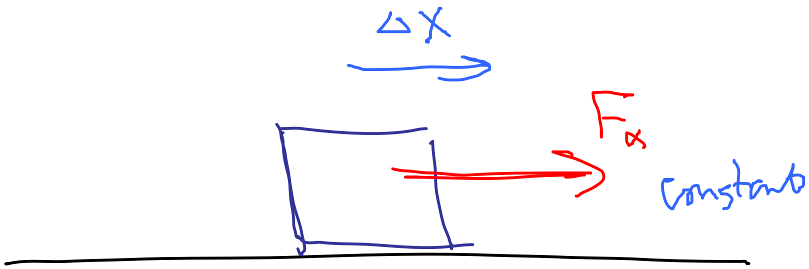
New quantities: Energy (Work), Momentum.







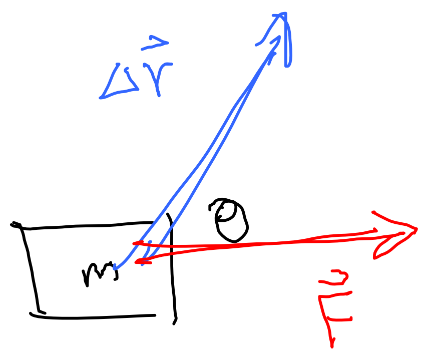
Ch 6 / Ch 7   Energy   Work



Constant force

$$W = F_x \Delta x$$

Work done on the object by force F_x



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

S

Also of energy

Units $[W] = [F][x]$

$$J = \frac{kg\ m^2}{s^2} = N \cdot m = \text{Joule} = J$$

$$1 \text{ erg} = 1 \frac{g \cdot cm^2}{s^2} = 10^{-7} J$$

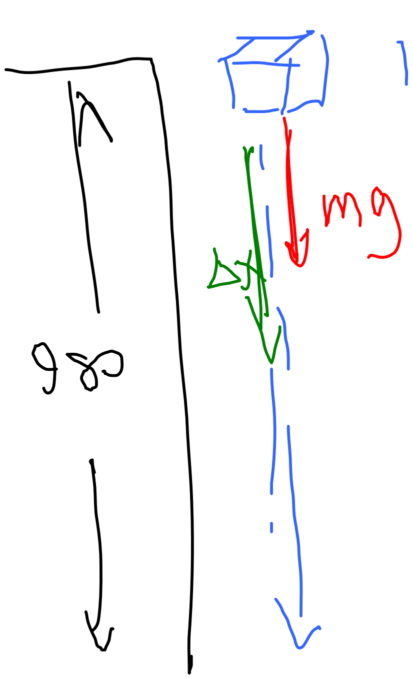
$$1 \text{ eV} = 1.602 \times 10^{-19} J$$

$$1 \text{ cal} = 4.184 J$$

$$\text{food calorie} = 10^3 \text{ cal} = \text{kcal}$$

$$1 \text{ Btu} = 1.054 \text{ kJ}$$

6.14 World's Highest waterfall Cherun-Meru in Venezuela, total drop 980 m. How much work does gravity do on cubic meter of water dropping over falls?

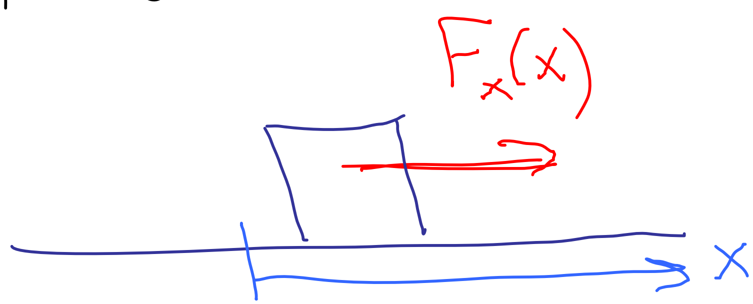


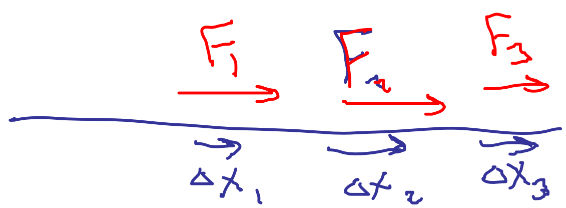
$1\,m^3 \longleftrightarrow 1000\,kg$

Density $1000\,kg/m^3$

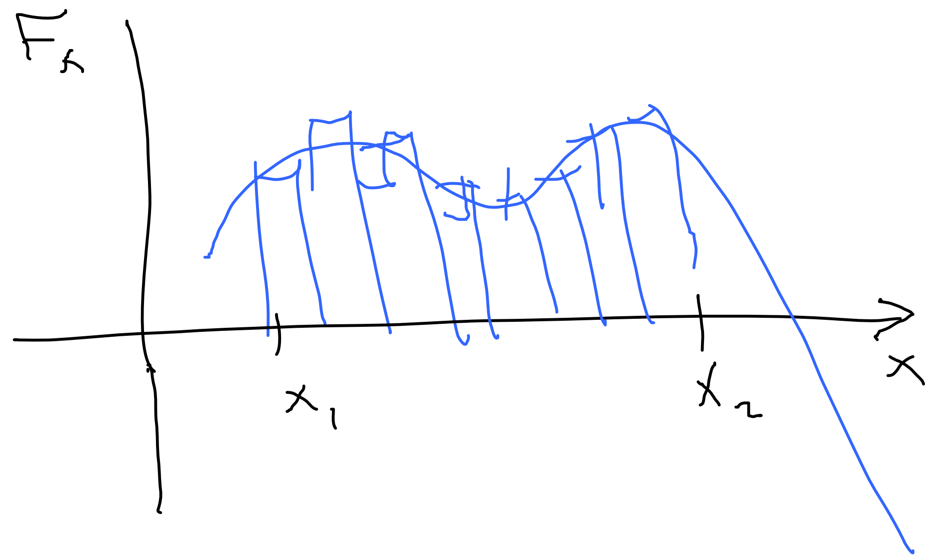
$$W = F\Delta x$$
$$= (mg)\Delta x = (9.8\times 10^3\,N)(980\,m)$$
$$= \boxed{9.6\times 10^6\,J}$$

$\Rightarrow$ Force not constant





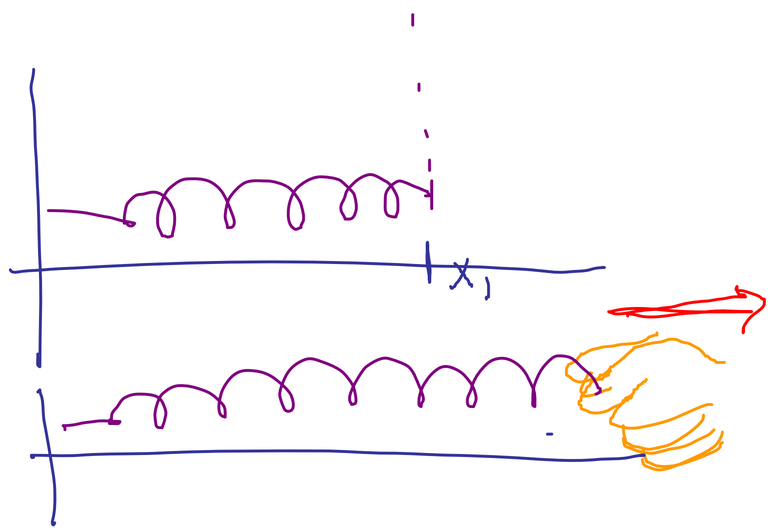
$$\sum_{i=1}^{N} F(x_i)\,\Delta x_i$$



$$\sum_i F_i \Delta x_i = W$$

Work done on mass as it moves $x_1 \to x_2$

$$W = \int_{x_1}^{x_2} F(x)\, dx$$



$$F_{ext} = -(-kx) = kx$$

opposite

Work done by external force.
Start from $x = 0$

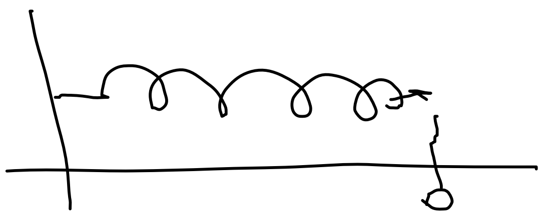
$$W_{hand} = \int_0^x F(x')\,dx' = \int_0^x kx'\,dx'$$

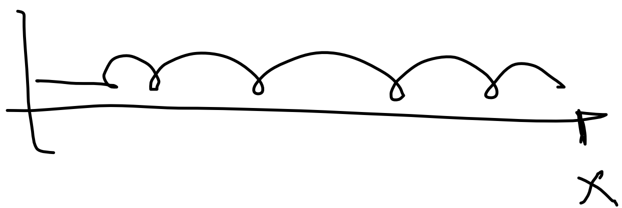
$$= \frac{k}{2} x'^2 \Big|_0^x = \boxed{\frac{k}{2} x^2}$$

Work

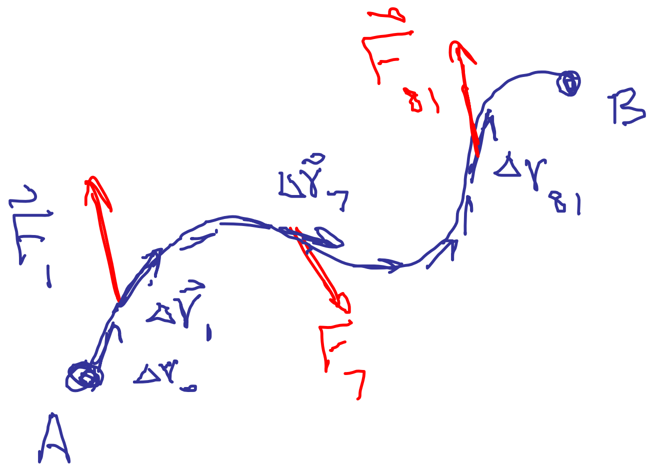
Extension

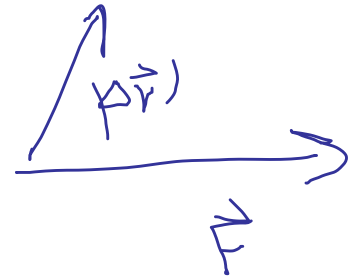
$0 \to x$





Force not constant, motion not in str. line





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

Dot product