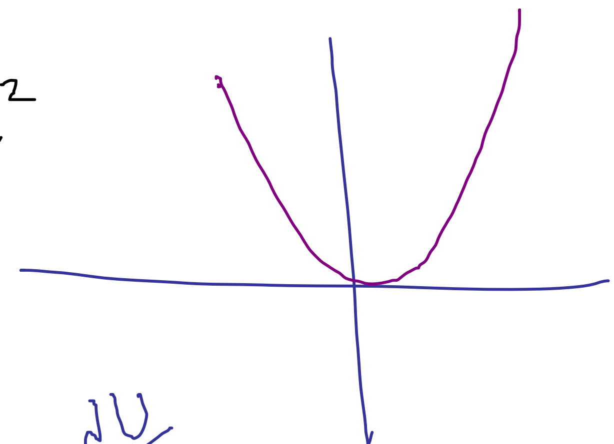
Phys 2110 - 4   3/6/13

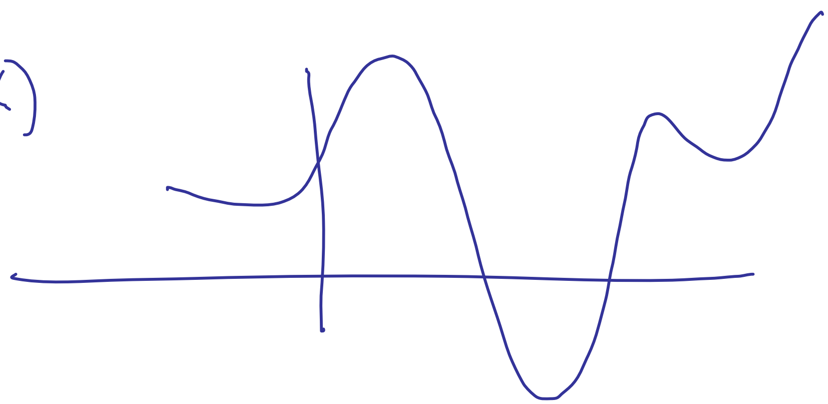
Note Title   3/6/2013

Potential Energy functions

$U_{grav} = mgy$ $U_{spr} = \frac{1}{2}kx^2$



$U(x)$

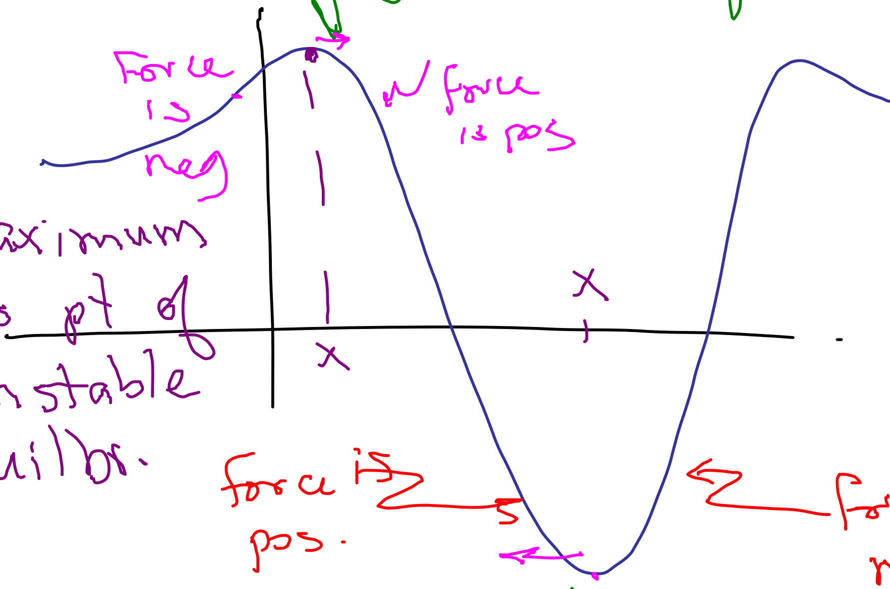


$F_x = -\frac{dU}{dx}$

$\vec{F} = -\nabla U$

No force (Equil)

$$F_x = -\frac{dU}{dx}$$



Force is neg

force is pos

Maximum is pt of unstable equilibr.

force is pos.

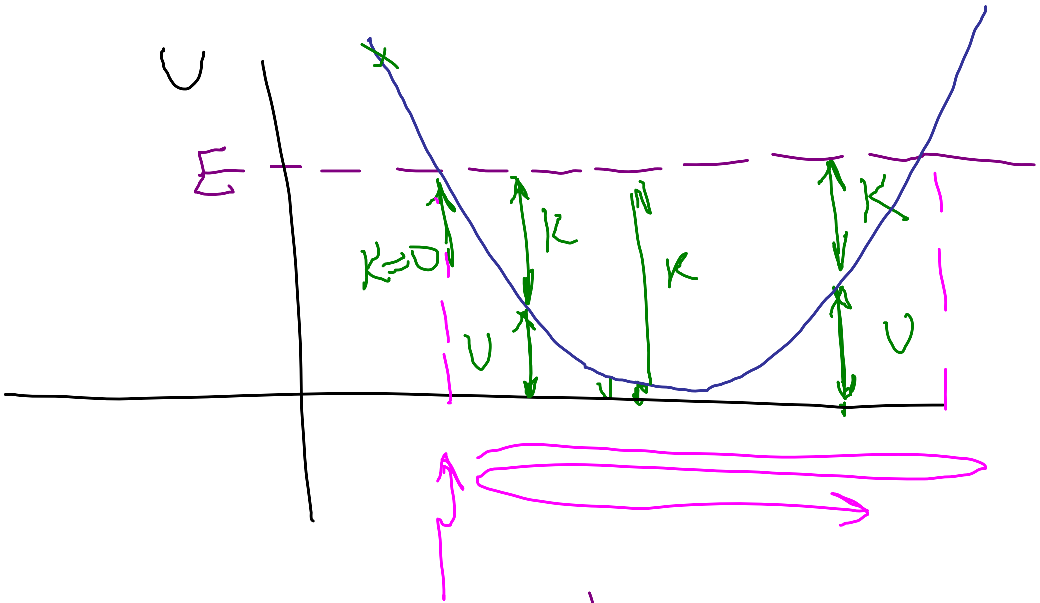
Force is neg.

No force (Equilibrium point)

Minimum → Point of stable equilibrium

Particle has energy E

K is always pos.



particle stops
turns around

Turning point of motion.

(Depends on $U(x)$, E)

$$E = U(x)$$

7.48 A particle with total energy 3.5 J is trapped in a potential well desc'd by

$U = 7.0 - 8.0x + 1.7x^2$ U in joules, x in m

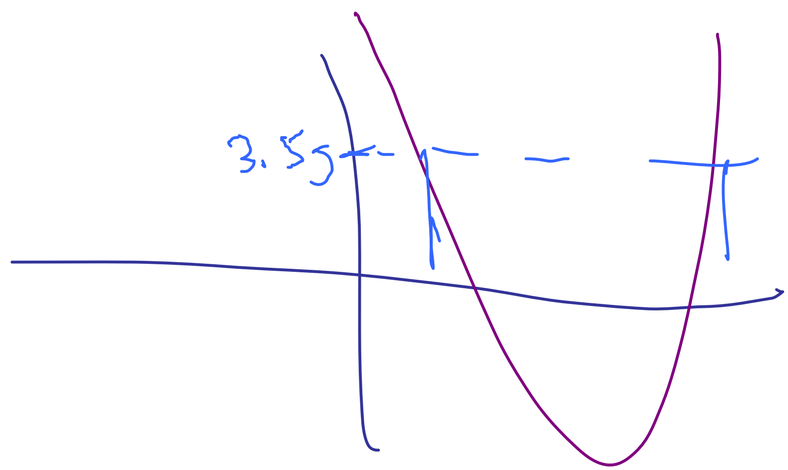
Find turning pts.

Solve $E = U(x)$

$3.5 = 7.0 - 8.0x + 1.7x^2$

$\xrightarrow[\text{Do it}]{}$ $X = 0.488$ m

4.22 m



7.49 a) Derive an expression for the pot'l energy of an object subj. to force $F_x = ax - bx^3$ where $a = 5\ N/m$ $b = 2\ N/m^3$ taking $U = 0$ at $x = 0$ b) Graph pot'l energy for $x > 0$ find turning pts for object w/ total energy $-1\ J$

a) $F_x = ax - bx^3 = -\frac{dU}{dx}$

$U = 0$ when $x = 0$

$c = 0$

$U = -\frac{1}{2}ax^2 + \frac{b}{4}x^4 + C$

$$U = -\frac{1}{2}ax^2 + \frac{b}{4}x^4$$

Find turning points:

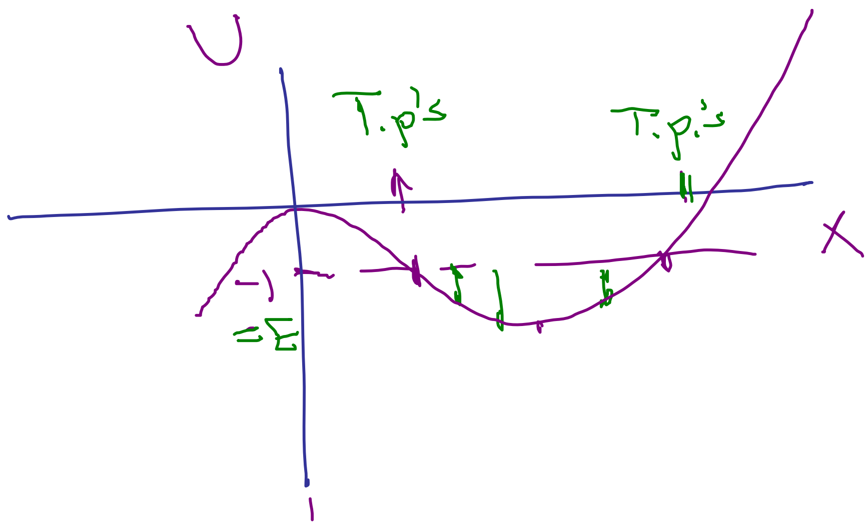
$E = -1\,J = U$

Solve, substitute

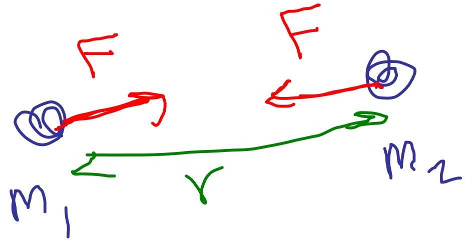
$$-1 = -\frac{5}{2}x^2 + \frac{1}{2}x^4$$

Quadr. eqn for x^2

$x = 0.7\,m,\ 2\,m$

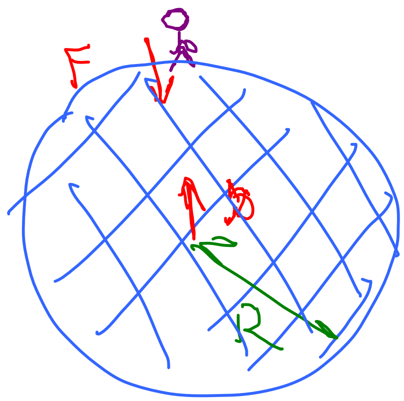


Ch 7 Law of Gravity



$$F = G\frac{m_1 m_2}{r^2}$$

$$G = 6.67\times10^{-11}\ \frac{N\,m^2}{kg^2}$$

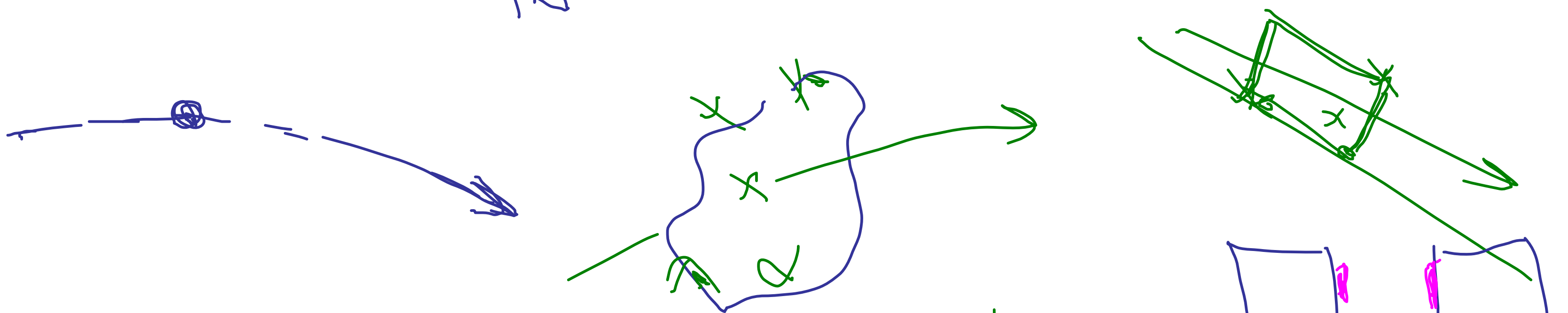


$$F_{grav} = G\frac{\cancel{m} M}{R^2} = \cancel{m} g \quad \text{on surface}$$

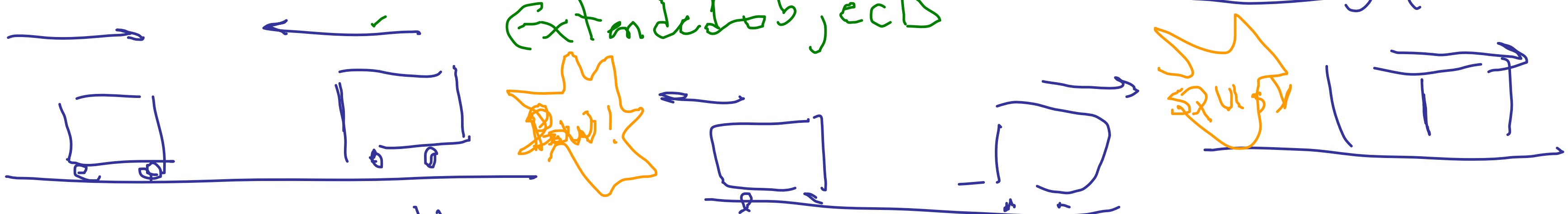
$$g = G\frac{M}{R^2} = 9.8\ \frac{m}{s^2}$$

Ch 9 "Momentum"

Systems of particles



Extended objects



Collisions

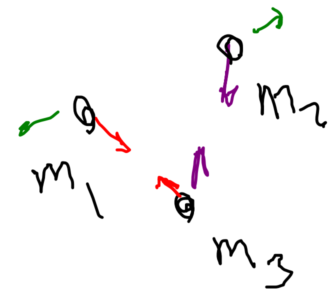
Momentum

$$\vec{p} = m\vec{v}$$

General Thms

System of particles

$m_1, m_2, \ldots$



Total force on all particles

$$\vec{F} = \sum_{i = \text{particle}} \vec{F}_{net,\, i}$$

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

$$\vec{F}_{Total} = \sum_i \vec{F}_{net,i} = \sum_{i=\text{partcl}} m_i \vec{a}_i$$

Make it look like 2nd law for one particle

$$= \sum_i m_i \frac{d^2 \vec{r}_i}{dt^2}$$

$$\vec{a} = \frac{d^2 \vec{r}}{dt^2}$$

$$M = \sum_i m_i$$

Total mass

$$= M \sum_i \frac{m_i}{M} \frac{d^2 \vec{r}_i}{dt^2}$$

$$= M \frac{d^2}{dt^2} \sum \frac{m_i \vec{r}_i}{M}$$

$$\vec{R} = \sum_i \frac{m_i \vec{r}_i}{M}$$

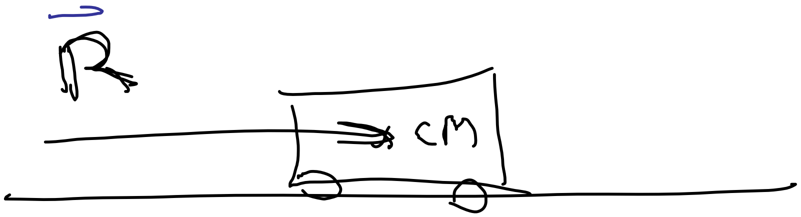
= location of center of mass.

$$= M \frac{d^2}{dt^2} (\vec{R})$$

Total mass

$$\vec{F} = M \vec{A}$$

$\vec{A}$ = Accel. of CM



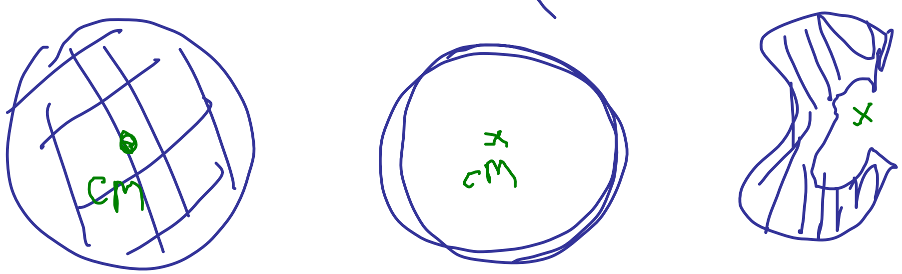
$$\vec{F} = M\vec{A}$$

external force

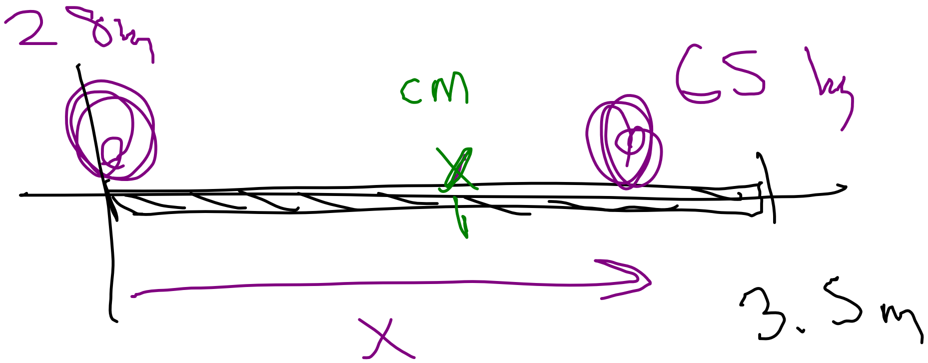
cm

$$\vec{R} = \frac{1}{M}\sum m_i \vec{r}_i$$

$$x_{cm} = \frac{\sum m_i x_i}{M} \qquad y_{cm} = \sum \frac{m_i x_i}{M} \quad \ldots$$



9.12 A 28 kg child sits on one end of 3.5 m long seesaw. Where should 65 kg father sit so that CM will be at center of seesaw.



Result: He sits 75.4 cm from center

Solve

$$x_{cm} = 1.75\,m = \frac{m_{ch}x_{ch} + m_f x_f}{M}$$

$$= \frac{(28\,kg)(0) + (65\,kg)x}{93\,kg}$$