Phys 2110-3 10/15/10

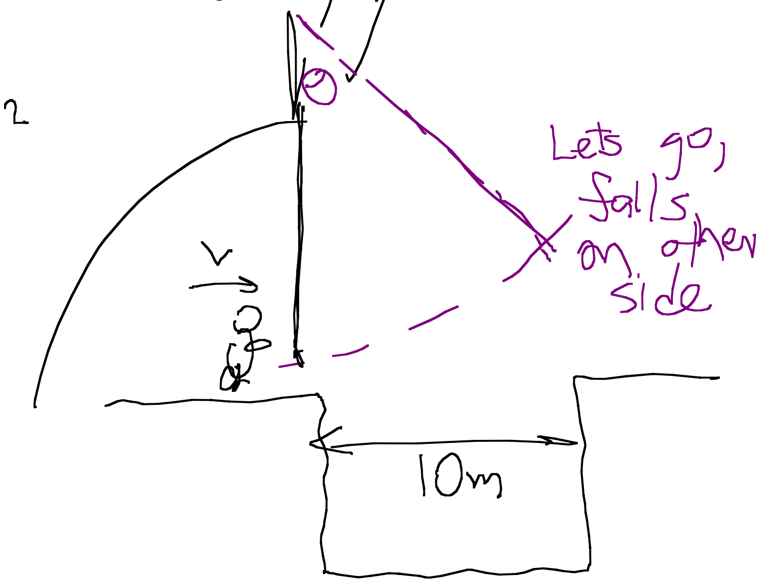
Chap 7 Conservation of Energy

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

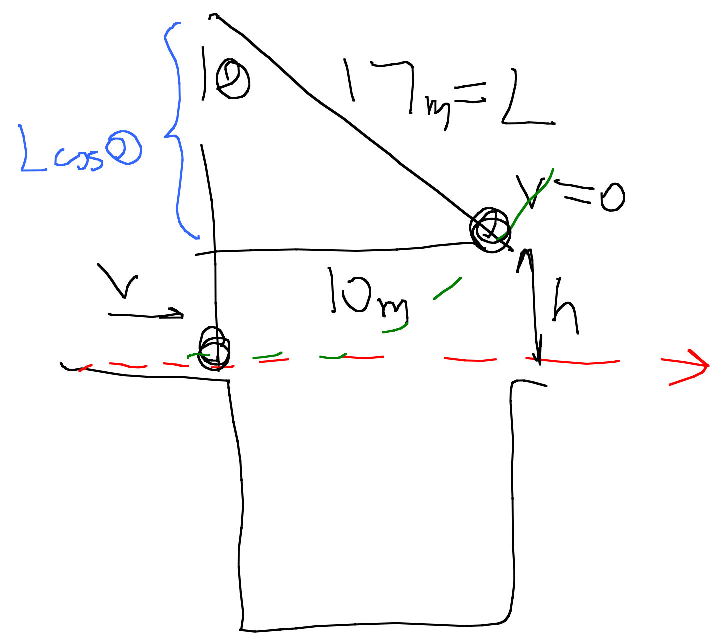
U = potential energy, stored energy

$U_{grav} = mgy \quad U_{spr} = \frac{1}{2} k x^2$

7.64



$\theta = 36^\circ$ when he lets go



$$E_1 = E_2$$

$$\frac{1}{2}\cancel{m}v^2 = mgh$$

$$= \cancel{m}gL(1-\cos\theta)$$

solve for v $\quad v = 7.98\,\frac{m}{s}$

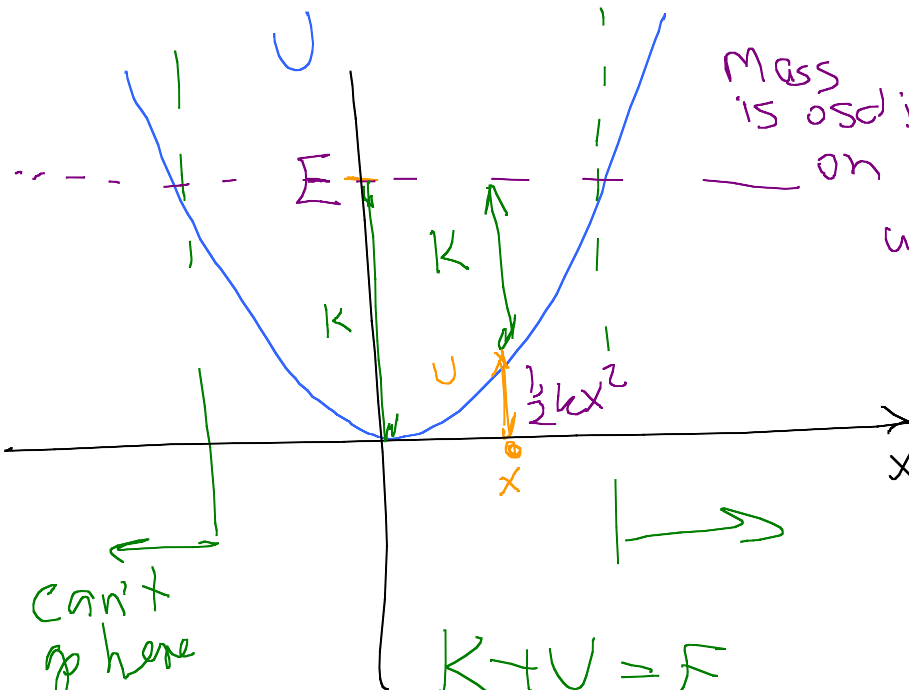
1-D motion $\quad W = \int_a^b F_x\,dx = -\Delta U$

$$\Delta U = -\int_a^b F_x\,dx$$

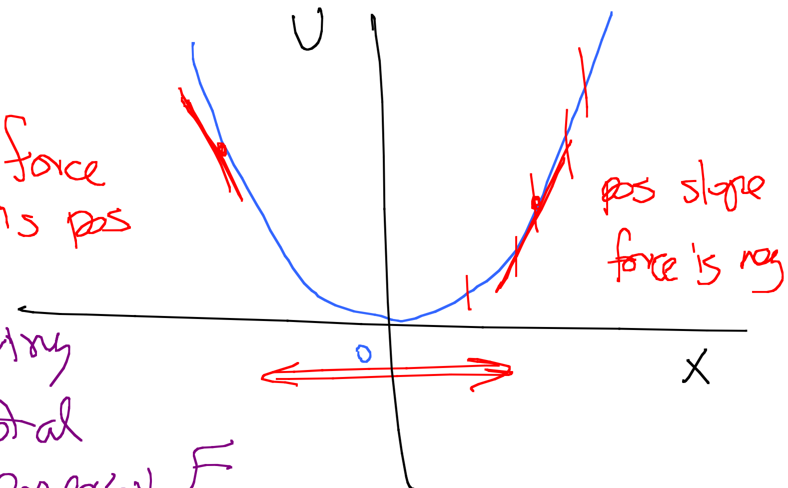
or $\quad U(x) = -\int_0^x F_x(x)\,dx + \text{const}$

It follows that $F_x = -\frac{dU}{dx}$

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



Mass is oscillating on spring w/ total energy E



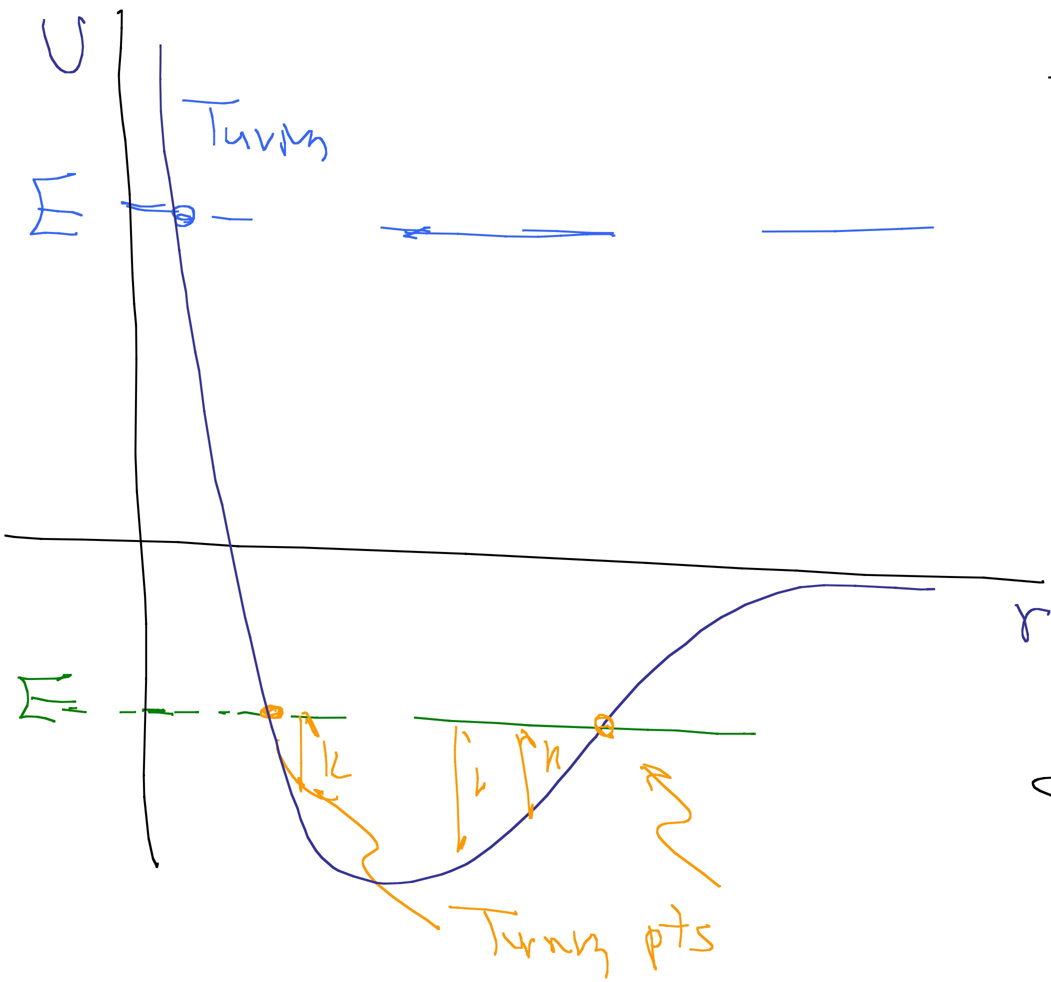
$K + U = E$

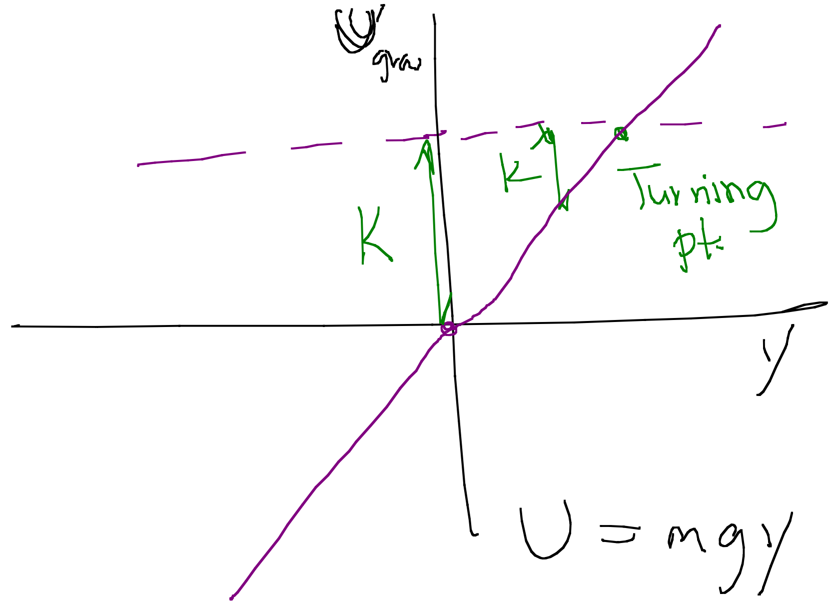
At edges of motion, energy is all pot'l

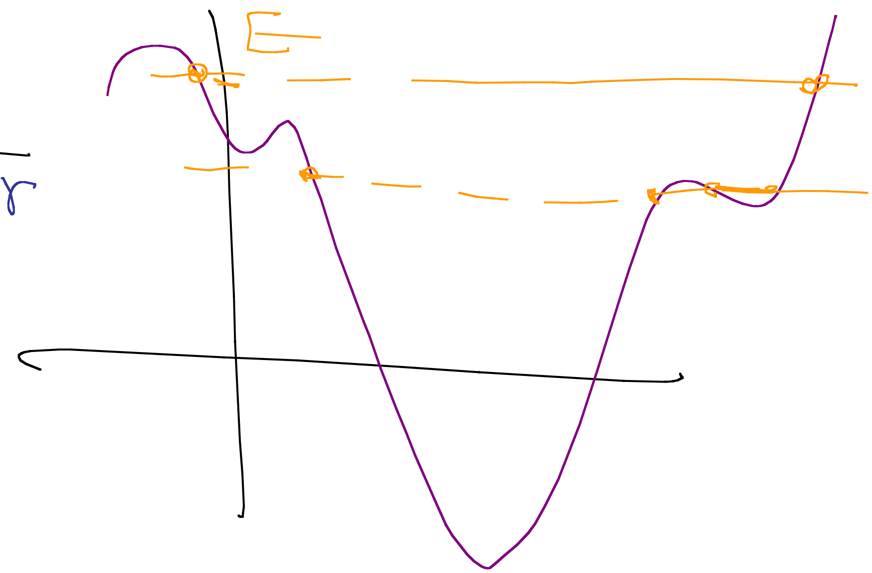
$K = 0 \quad V = 0$

"Turning points" of motion.

p. 110







(1-Dim) $F_x = -\frac{dU}{dx}$

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

for conservative forces $\vec{\nabla} \times \vec{F} = \vec{0}$

7.49 A particle with total energy 3.5 J is trapped in a pot'l well described by

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

U in Joules
x in m

Find turning points

$E = U$ $\quad 3.5 = 7.0 - 8.0x + 1.7x^2$

Solve quad' $\quad x = 0.488\text{ m} \quad 4.22\text{ m}$

Skip Chap 8

Chap 9 Momentum

Systems of particles.

Collisions

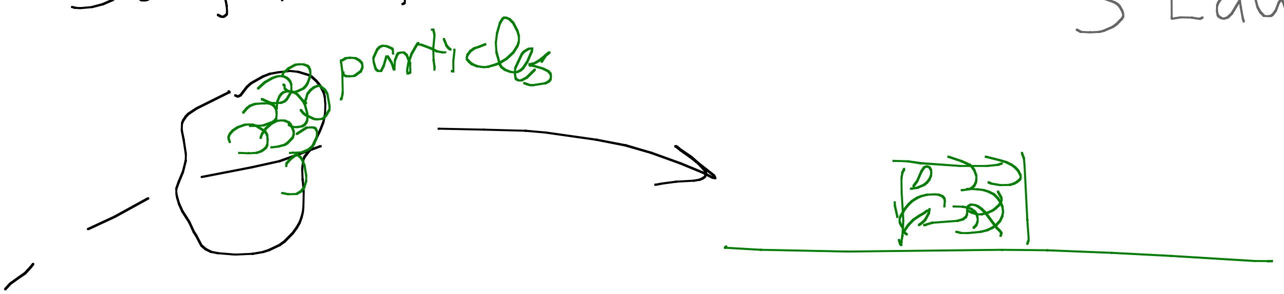
Force

strong, acting for a short time

Unknown.

3^{rd} Law: $F_{AB} = -F_{BA}$

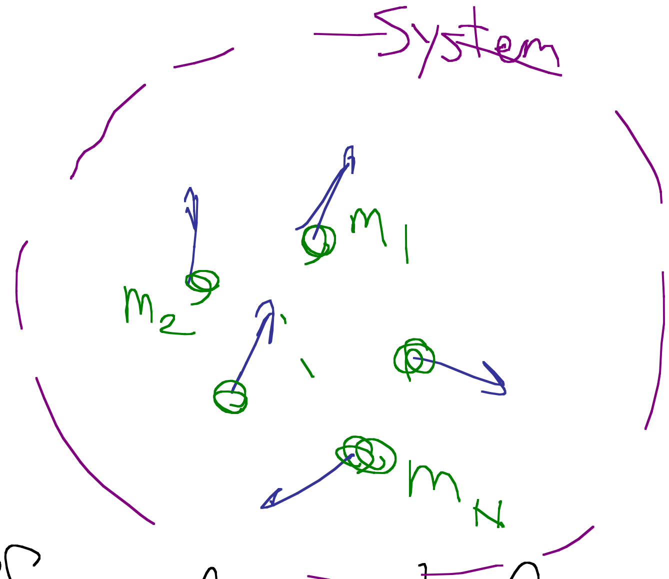
So far "particle"



Eventually, momentum $\vec{p} = m\vec{v}$

Systems of particles

$m_i \quad \vec{v}_i \qquad \vec{r}_i, \vec{v}_i, \vec{a}_i$



For the first time

We will add forces on different particles

$$\boxed{\vec{F}_{\substack{\text{Total} \\ \text{(all particles)}}}} = \sum_{i=1}^{N} \vec{F}^{\,i}_{net} = \sum m_i \vec{a}_i = \sum_i m_i \frac{d^2\vec{r}_i}{dt^2}$$

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

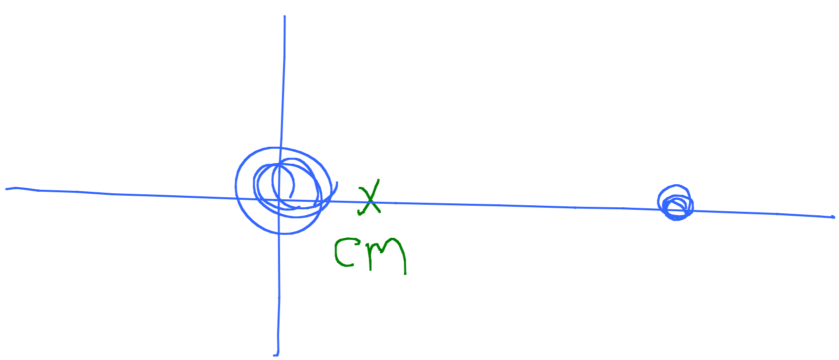
$$\vec F_{net} = \frac{d^2}{dt^2}\sum_i m_i \vec r_i \qquad\qquad M = \sum_i m_i$$

$$= M \frac{d^2}{dt^2}\frac{1}{M}\sum_i m_i \vec r_i$$

Avg location of masses

$$\vec r_{cm} = \frac{1}{M}\sum_i m_i \vec r_i$$

coord of center of mass



Continuous system

$$\vec{r}_{cm} = \frac{1}{M}\sum_i m_i \vec{r}_i$$

Take d/dt

$$\vec{v}_{cm} = \frac{1}{M}\sum_i m_i \vec{v}_i$$

$$\vec{a}_{cm} = \frac{1}{M}\sum_i m_i \vec{a}_i$$

$$x_{cm} = \frac{1}{M}\sum m_i x_i$$

$$y_{cm} = \frac{1}{M}\sum m_i y_i$$