Phys 2110-4 10/14/11

Note Title 10/14/2011

Conservation of Energy

$$\boxed{\Delta E = W_{non-cons}}$$

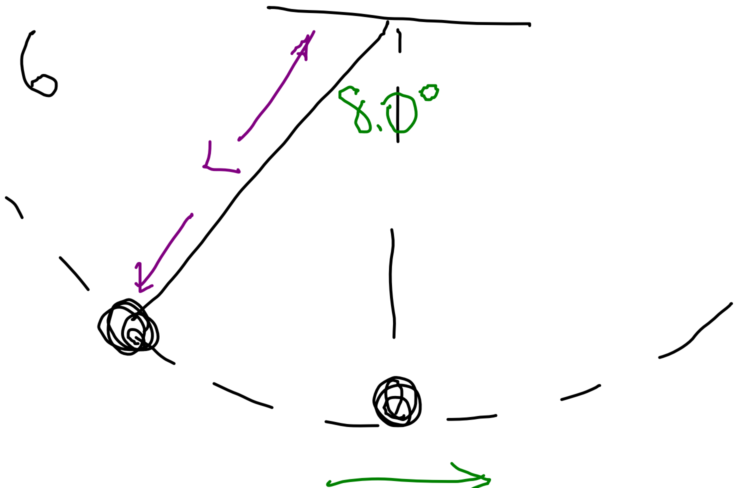
$$\Delta U + \Delta K = W_{non-cons}$$

If $W_{non-cons} = 0$, then $\Delta E = 0$

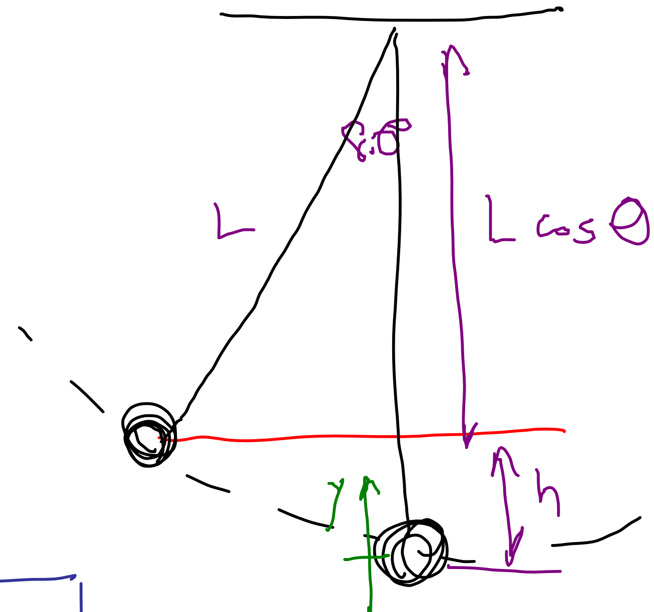
$$\boxed{\Delta U + \Delta K = 0}$$

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

7.46



Pendulum



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

$$gL(1-\cos\theta) = \frac{v^2}{2}$$

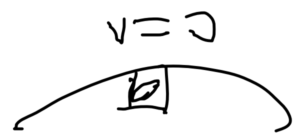
$$\boxed{L = 1.59\,m}$$

$$h = L - L\cos\theta$$
$$= L(1-\cos\theta)$$

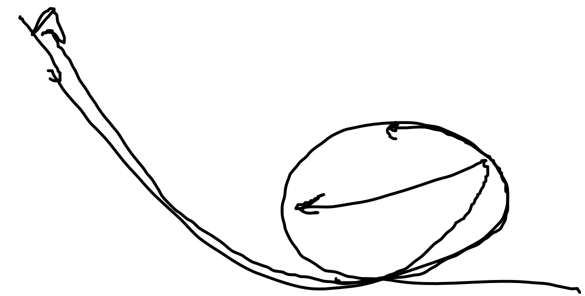
7.45 No friction

Block slides on frictionless track as shown

Find min. height h at which it starts and makes around loop.

Why not $h = 2R$. If so 

impossible on circular track.



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

$$mg + n = \frac{mv^2}{R}$$

Minimum $v \rightarrow n = 0$

$$\rightarrow \cancel{m}g = \frac{\cancel{m}v^2}{R} \qquad v^2 = gR$$

Cons of Energy

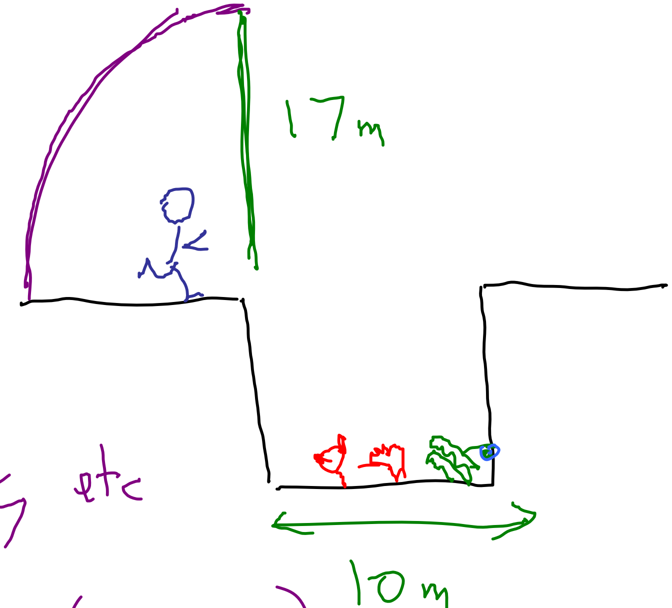
$$\frac{1}{2}mv^2 + mg(2R) = mgh$$

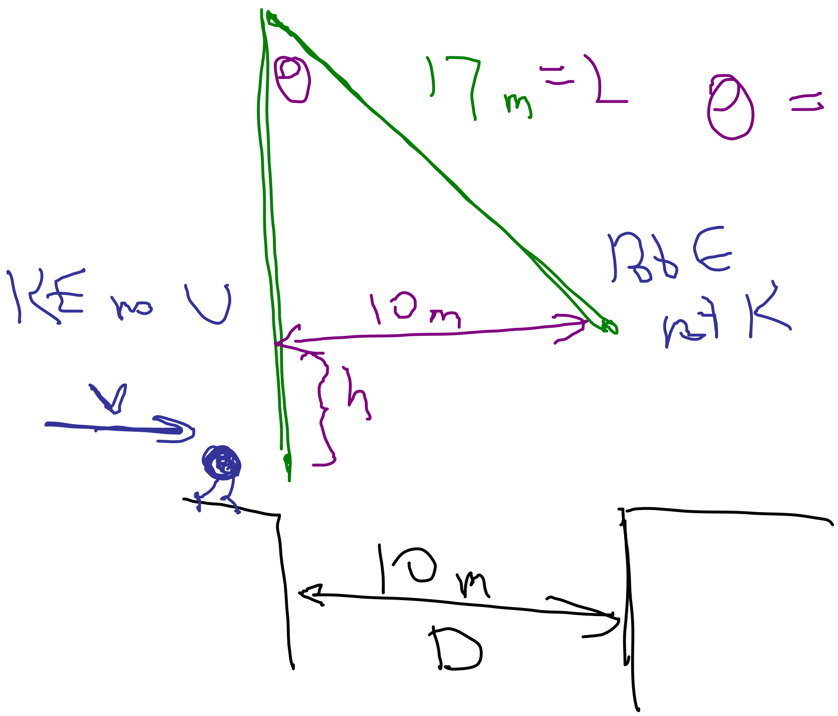
Sub.

$$\frac{1}{2}\cancel{mg}R + 2\cancel{mg}R = \cancel{mg}h$$

$$\boxed{h = \frac{5}{2}R}$$

7.62 Tarzan drops down vert'ly on other side.
How fast must he run?





$\theta = \sin^{-1}\frac{10}{17}$ etc

$h = 17(1-\cos\theta)$

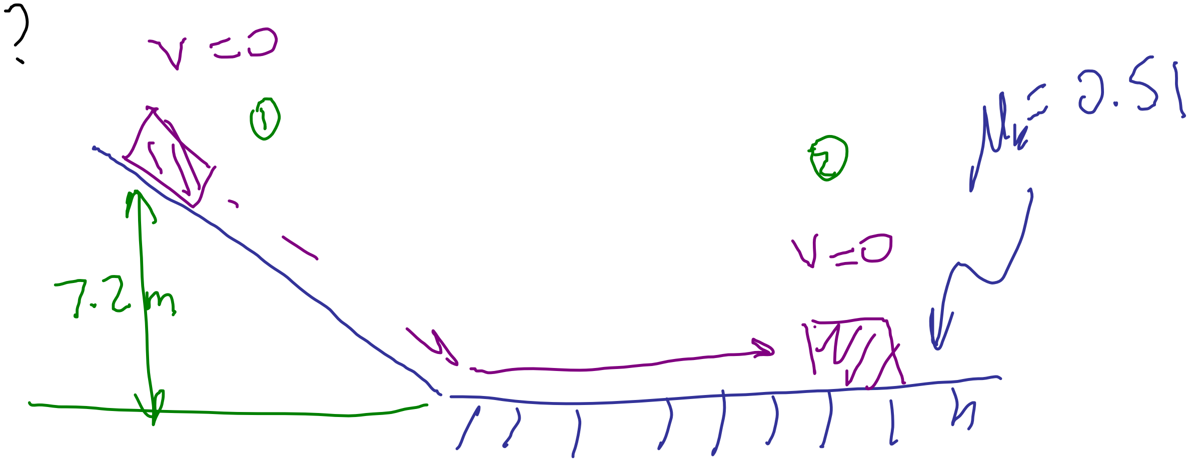
Cons of E

$\frac{1}{2}mv^2 = mgh$

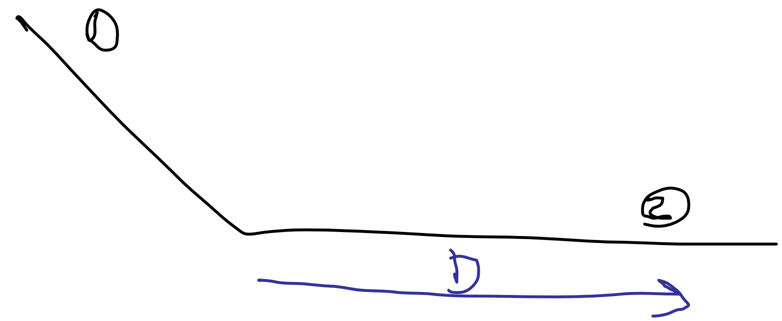
etc. $v = 7.98\,\frac{m}{s}$?

7.59 A child sleds down a frictionless hill whose vertical drop is 7.2 m. At the bottom is a level but rough stretch where the coeff of kin. fric. is 0.51. How far does she slide across the level stretch?

$$\Delta E = W_{fric}$$

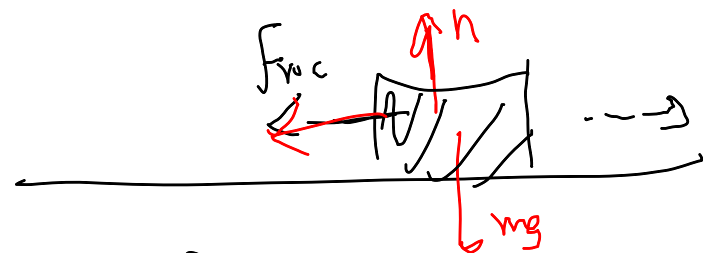


$$\Delta E = \Delta U + \Delta K$$



$$= mg\Delta y + 0$$

$$= mg(-7.2\,m)$$



$$W_{fric} = f_k (D)(-1)$$

$$= -\mu_k m g D$$

$$f_k = \mu_k n$$

$$= \mu_k m g$$

$$-\cancel{mg}(7.2\,m) = -\mu_k \cancel{mg} D$$

$$D = \frac{7.2\,m}{\mu_k} = 14.1\,m$$

7.55 190 g block

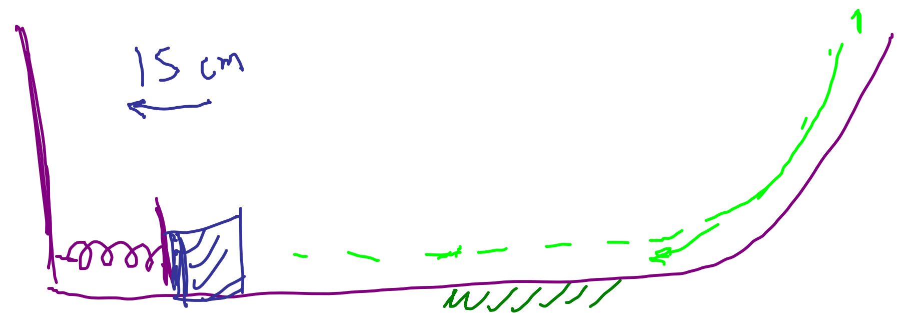
comp'd against

$k = 200 \frac{N}{m}$ spring by 15 cm

released. Part of surface

flat, rough $\mu = 0.27$, length 85 cm

Where does block finally come to rest?



Initially energy is $U_{spr} = \frac{1}{2}kx^2 = 2.25\ J$

On each pass of rough part,

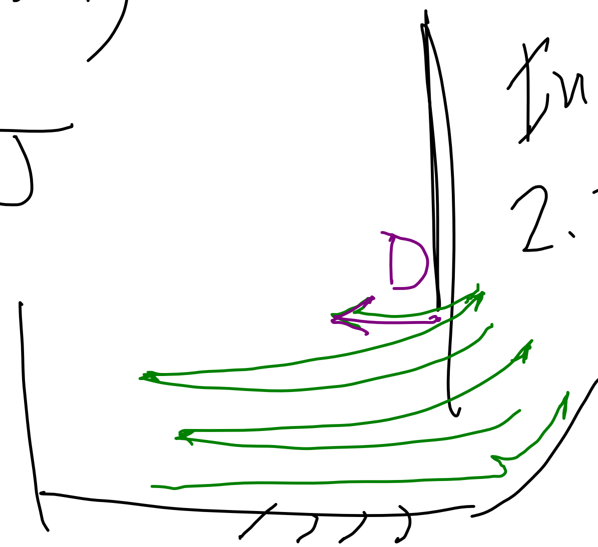
$$W_{fric} = -(\mu_k mg)(0.85\,m)$$

$$= -0.427\ J$$

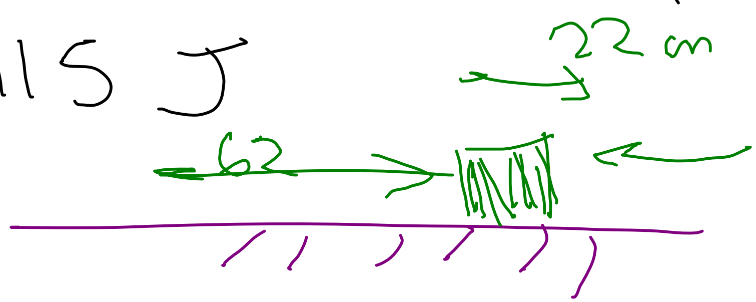
Good for 5 passes

After that, got

0.115 J



Initially, 2.25 J

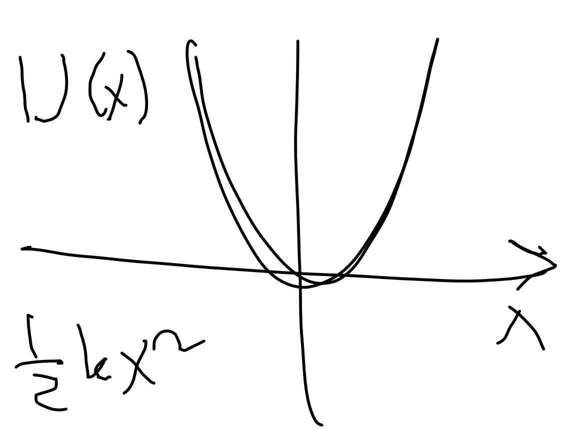


$$W_{fric} = -\mu_k mg D$$

$$= -0.115\ J$$

Graphing $U(x)$

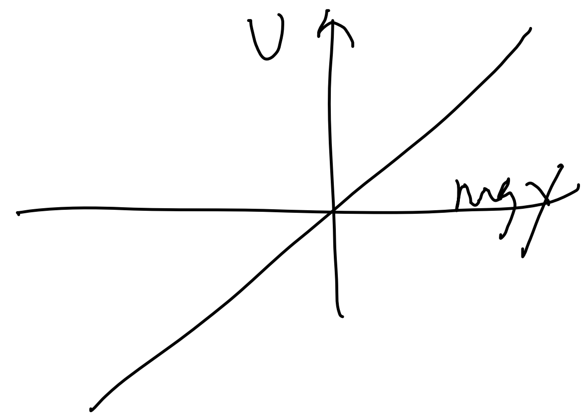
In one dim.



$$W_{\text{force}} = -\Delta U = -[U(x) - U(0)]$$

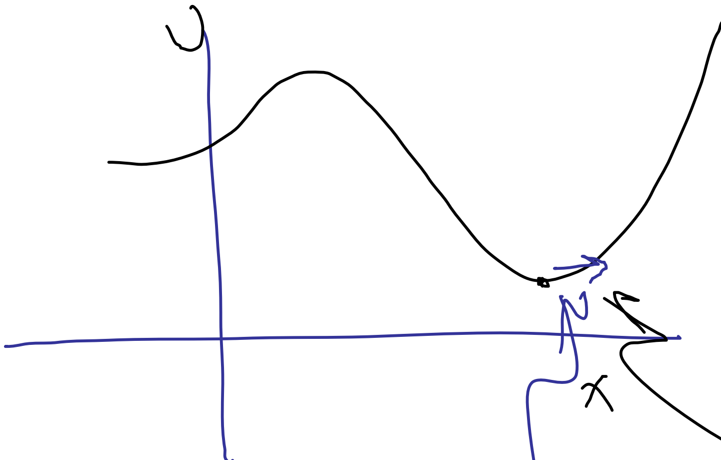
$$= \int_0^x F_x(x')\,dx'$$

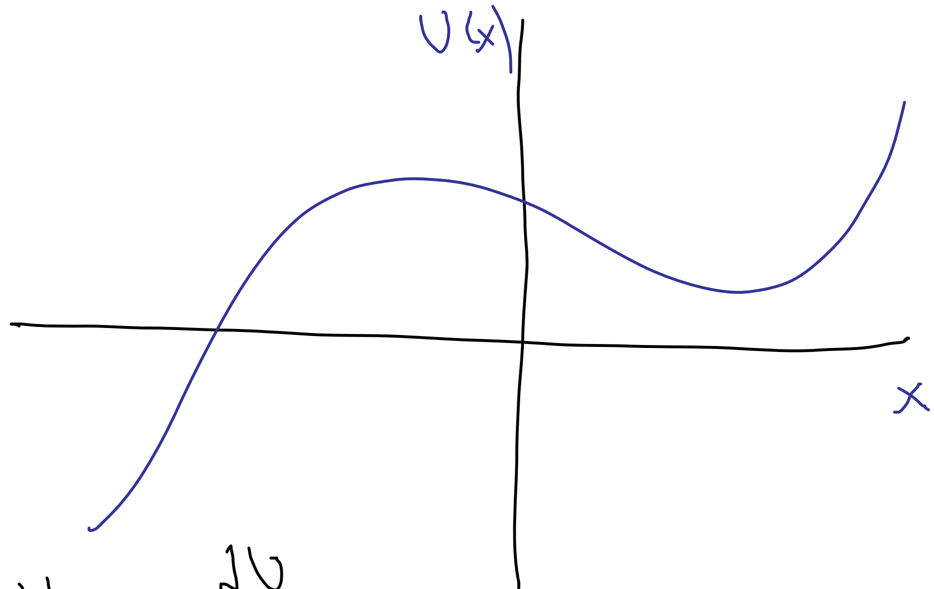
Choose zero energy point.



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

Plot $U(x)$





Bottom $\frac{dU}{dx} = 0$

$\frac{d^2U}{dx^2} > 0$

Force pushes you back

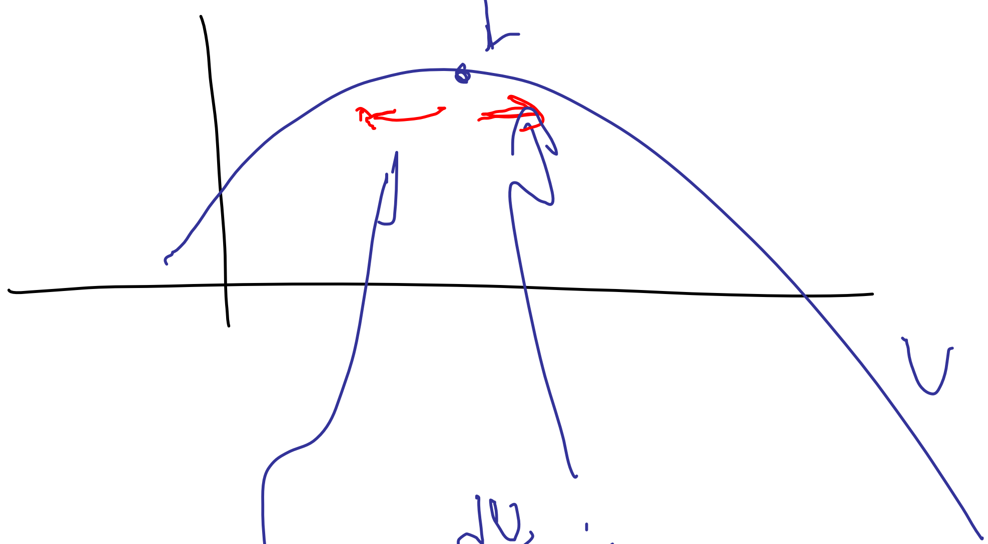
Equilibrium: $F = 0$ No force

Stable equilibrium.

Wander to right $\frac{dU}{dx}$ pos Force is neg

Wander to left $\frac{dU}{dx}$ neg Force is pos.

Force = 0 Equilibri



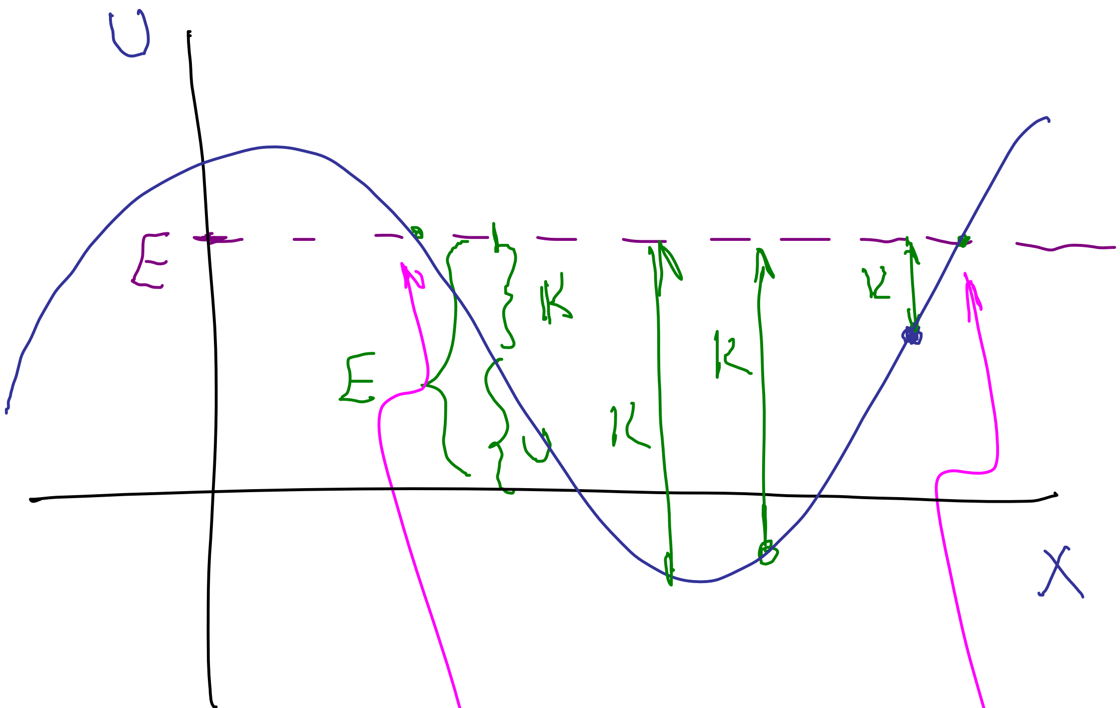
$\frac{dU}{dx}$ is neg

F is pos

$\frac{dU}{dx}$ is pos

F is neg

Unstable equilibrium.



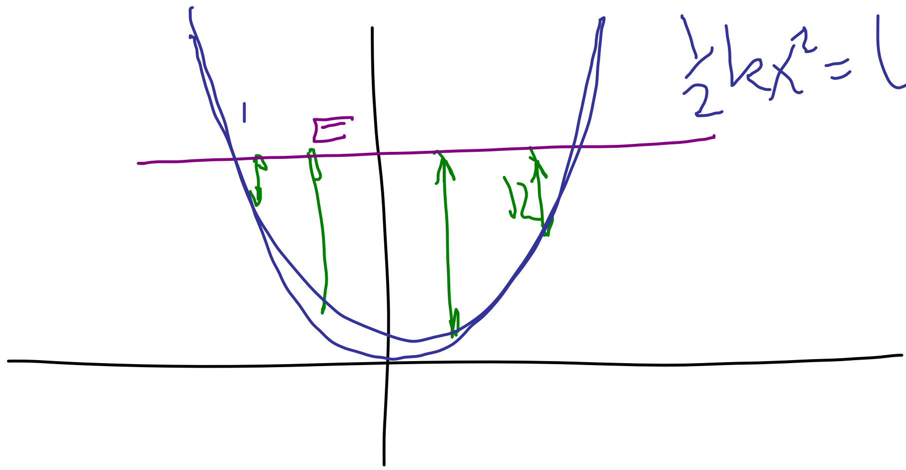
$K = 0$
Particle it turns around

Turning points

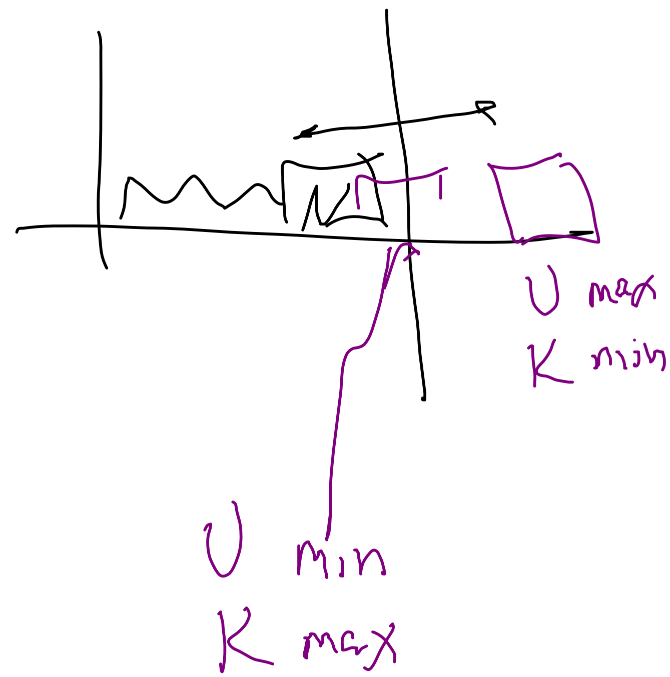
$$E = U + K$$

$$K = E - U$$

K is "distance" between E and U.



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



Read this in Book

Momentum!