Thurs: Discussion /quiz

Ex: 201, 204, 205, 217, 218, ~~221~~, 223, 224

Thurs: Seminar 12:30 - 1:30 WS 203

Energy conservation

The work - kinetic energy theorem can be adapted to special situations such as that where gravity is the only force doing non-zero work.

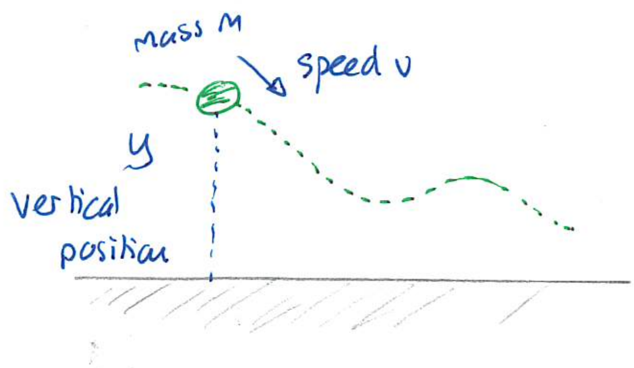
If gravity is the only force that does non-zero work on a system then the total energy

$$E = K + U_{grav}$$

is constant as the object moves / system evolves. Here

$$K = \frac{1}{2} m v^2 \quad \text{(kinetic energy)}$$

$$U_{grav} = mgy \quad \text{(gravitational potential energy}$$



This is an example of the conservation of energy. Comparable statements are that between any initial and final points

$$\Delta E = 0 \iff \Delta K + \Delta U_{grav} = 0$$

$$\Updownarrow \qquad\qquad\qquad \Updownarrow$$

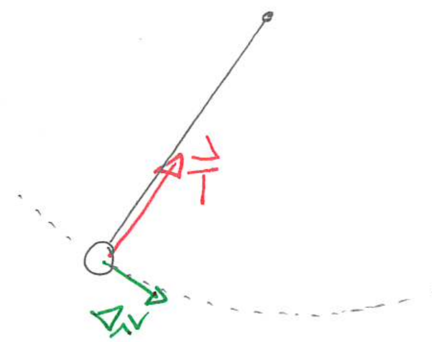
$$E_f = E_i \iff K_f + U_{grav\,f} = K_i + U_{grav\,i}$$

Warm Up!

Quiz1 30% ~ 50% } 10% - 70%

Demo: Loop the loop

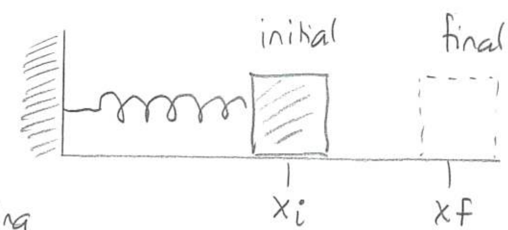
Energy conservation can be applied to any object that swings in a circle on a string. Here the work done by tension is zero, since the tension is always perpendicular to the instantaneous displacement



Warm Up2

Elastic potential energy

Consider a mass that can slide horizontally attached to a spring. Suppose that $x=0$ is the point where the spring is in equilibrium. Then if there is no friction



$$\Delta K = W_{net} = W_{spring} \Rightarrow K_f - K_i = -\frac{1}{2}kx_f^2 + \frac{1}{2}kx_i^2$$

$$\Rightarrow K_f + \frac{1}{2}kx_f^2 = K_i + \frac{1}{2}kx_i^2$$

Thus we define

The elastic potential energy of a spring is

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

where x is the distance by which the spring is stretched or compressed.

Then defining $E = K + U_{spring}$ will result in a new version of energy conservation.

If the only forces that do non-zero work are gravity and spring forces then the total energy

$$E = K + U_{grav} + U_{spring}$$ Conservation of energy

stays constant throughout the motion.