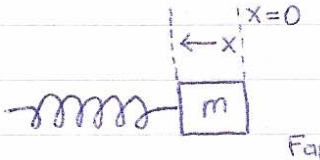
Spring Force

Hooke's Law: $F = -kx$

- restoring force, opp. dir. of x
- spring constant, dependent on: how spring was formed, material, thickness of wire, etc.



F varies w/ x : work is the area under the curve

Linear spring is simple : $A = \frac{1}{2}bh \rightarrow W = \frac{1}{2}x_{max}F_{max} = \frac{1}{2}kx^2$

PE in a Spring: $PE_s = \frac{1}{2}kx^2$

Elastic PE related to work reqd to compress spring from equil. position

Work = PE ; $KE_{i,f} = 0$

Spring + Gravity : $W_{nc} = (KE_f - KE_i) + (PE_{gf} - PE_{gi}) + (PE_{sf} - PE_{si})$

(gravitational PE; elastic PE assoc. w/ spring)

PE: total PE of energy of system

Conservation of Energy: $(KE + PE_g + PE_s)_i = (KE + PE_g + PE_s)_f$

$PE_g = mgh$; $PE_s = \frac{1}{2}kx^2$

$E_s = PE_g$

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

Nonconservative Forces

$W_{nc} = [(KE_f) - (KE_i)] + [(PE_i) - (PE_f)]$

or

$W_{nc} = [(KE_f) + (PE_f)] \neq [(KE_i) + (PE_i)]$

The energy can either cross a boundary or the energy is transformed into a form of non-mechanical energy such as thermal energy

friction or direct collisions

Transferring Energy

By work – applying F creates Δx

Heat: The process of transferring heat by collisions b/w molecules

IE: sound, H_2O, seismic, electricity

Mechanical Waves: disturbance propagates thru a medium

Grand Statement: Conservation of Energy

We can neither create nor destroy energy

If the total E_{system} doesn't remain constant, the energy boundary must've been crossed

Applies to the entire universe

Power

The rate at which energy transfer takes place

$\bar{P} = \frac{work}{\Delta t} = \frac{F\Delta x}{\Delta t} = F\bar{v}$

SI Units: watts, $W = J/s = \frac{kg \cdot m^2}{s^3}$

Motors (US): $1hp = \frac{(550 ft)(lb)}{(1 lb)}$ $550 ft \cdot lb/sec = 746 W$