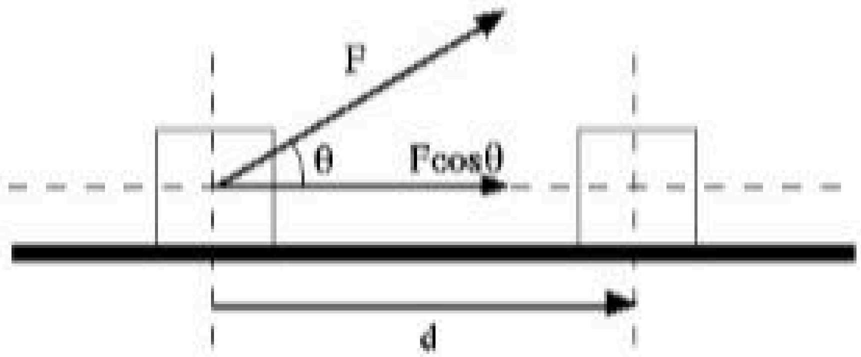
Work Energy and Power

(i) $W = \vec{F} \cdot \vec{d} = F \times d \cos\theta$



If displacement is $\perp$ to applied force

$\Rightarrow \theta = 90^\circ \Rightarrow W = F \times d \cos 90^\circ = 0$

so , in following cases work done is 0.

(a) Circular motion

(b) Planetary motion

(c) Motion of electrons around nucleus

Since centripetel force is always $\perp$ to displacement

(ii) Rate of doing work = Power, $P = \frac{\Delta w}{\Delta t} = \vec{F} \cdot \vec{v}$

(iii) K.E. $= \frac{1}{2} mv^2$

(iv) Gravitational P.E. = mgh, referring PE = 0 at earth surface

$= -\frac{GMm}{r}$ referring PE = 0 at infinity

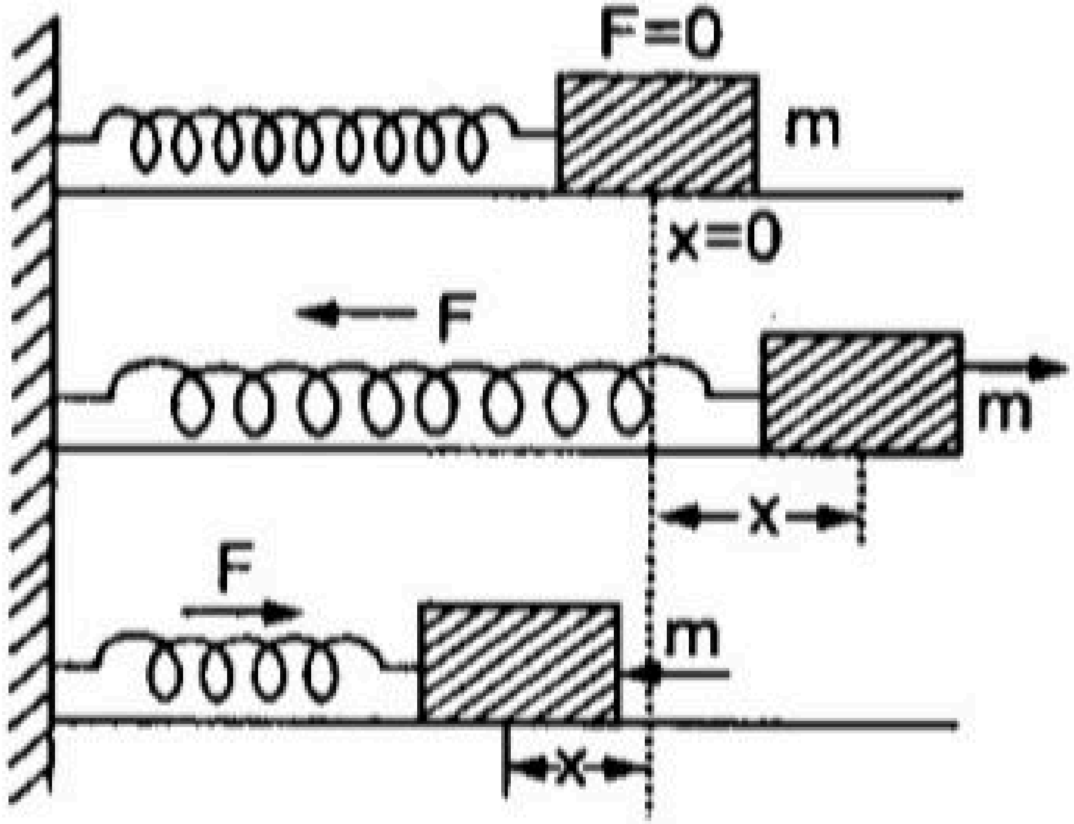
(v) Relation between kinetic energy & momentum.

K.E., $E = \frac{P^2}{2m}$ or $P = \sqrt{2mE}$

(vi) **K.E.** never be (-ve) but **P.E.** may be (-ve) or (+ve)

(vii) **P.E.** stored in a spring compressed through the distance x

$$\boxed{\mathbf{PE} = \frac{1}{2} k x^2}$$



(viii) Work energy theorem :- work done by the resultant force on a particle is equal to the change in its K.E.

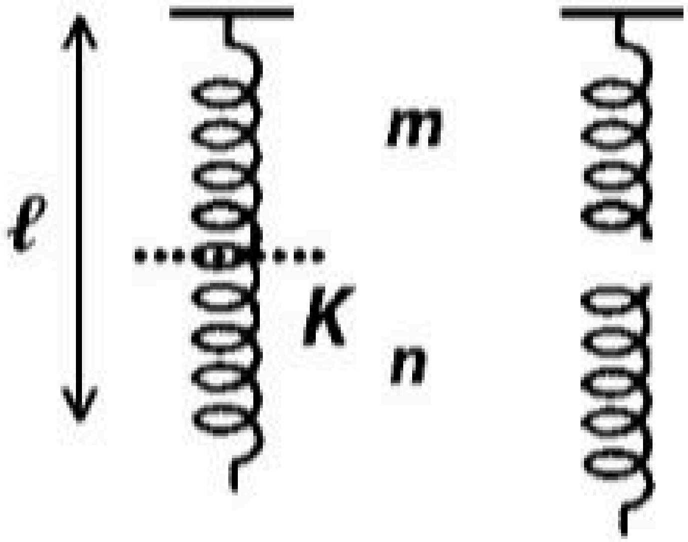
$$W_{F_{net}} = \Delta k = k_f - k_i$$

$$= \frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2$$

Where $v_1 =$ **Initial velocity**

$v_2 =$ **Final velocity**

Spring constant when a spring is cut in ratio $m : n$



$$K_1 = \left(\frac{m+n}{m}\right) K \qquad \ell_1 = \left(\frac{m}{m+n}\right) \ell$$

$$K_2 = \left(\frac{m+n}{n}\right) K \qquad \ell_2 = \left(\frac{n}{m+n}\right) \ell$$

If $\vec{F} = F_x\hat{i} + F_y\hat{j}$

Then condition for this force to be conservative.

$$\frac{\partial F_x}{\partial y} = \frac{\partial F_y}{\partial x}$$

If derivative of F_x keeping x constant = derivative of F_y keeping y constant

Conservative Force	Non-conservative Force
1) Work done by this force is indepedent of path	Depends on path
2) In a round trip work done by conservative force is zero	Not zero
3) when this force does work on a system. then sum of **K.E. + P.E.** remain constant *i.e.* mechanical energy is conserved.	when this force does work then mechanical energy is not conserved
Example:- Gravitational force , Electrostatic force , Normal force . Force applied by spring	**Example:-** Viscous force , frictional force