Work :- If an external force acting on a particle having position vector $\vec{r}$. It through a displacement $d\vec{s} = d\vec{r}$.

$$dW = \vec{F}\cdot d\vec{s}$$

Power :- Power of an agent is defined as the time rate of doing work.

$$P = \frac{dW}{dt}$$

$$P = F\cdot\frac{dS}{dt} = F\cdot\vec{V}.$$

Energy :- Energy of a particle is its capacity of doing work. It is the measure of the amount of work that a body can do.

Kinetic energy :- It is the type of energy prosessed by a particle by virtue of its motion.

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

Conservative Force :- A Force is said to be Conservative, if the work done by it in moving a particle from one point to another in space depands only on the position. (inital to final) of these points and not on the actual path following by the particle.

$$W_{pa} = \int_p^a \vec{F}\cdot d\vec{s} = \int_p^a \vec{F}\cdot d\vec{s} = \int_p^a \vec{F}\cdot d\vec{s}$$

$$\oint \vec{F}\cdot d\vec{s} = 0$$

2.

Non-Conservative Force :- A Force is said to be non-Conservative, if the work done by it on a particle that moves between two points. Depands upon the path followed by the particle.

Conservative Theorem of linear momentum of a particle :-

If total force acting on a particle is zero, then the linear momentum $(\vec{p})$ is Constant (or Conserved).

- Acc. to newton's second law of motion.

$$\vec{F} = \frac{d\vec{p}}{dt}$$

$$\vec{F} = 0 \qquad \frac{d\vec{p}}{dt} = 0$$

Integrating we get

$$\vec{p} = \text{Constant}$$

Conservation theorm for the angular momentum of particle :-

If the total torque $\vec{\tau}$ acting on a particle is zero, then the angular momentum $(\vec{l})$ is Conserved angular momentum.

$$\vec{l} = \vec{r}\times\vec{p}$$

The moment of the total force $\vec{F}$ or torque $\vec{\tau}$ on particle

$$\tau = \vec{r}\times\vec{F}$$

$$= \vec{r}\times\frac{d\vec{p}}{dt}$$

$$= \vec{r}\times\frac{d}{dt}(mv)$$

Taking total time derivative

$$\frac{d}{dt}(\vec{r}\times\vec{p}) = \vec{r}\times\frac{d\vec{p}}{dt} + \frac{d\vec{r}}{dt}\times\vec{p}$$

$$= \vec{r} \times \frac{d}{dt}(m\vec{v}) + \vec{v} \times m\vec{v}$$

Now, the second term expression

$$\vec{v} \times m\vec{v} = 0$$

$$\frac{d}{dt}(\vec{r} \times \vec{p}) = \vec{r} \times \frac{d}{dt}(m\vec{v})$$

$$\tau = \frac{d}{dt}(\vec{r} \times \vec{p})$$

$$\tau = \frac{d}{dt}(\vec{l})$$

Thus, the time rate of change of angular momentum of a particle is equal to the vector torque acting on it.

$$\frac{dl}{dt} = 0$$

Integrating we get

$$\vec{l} = \text{Constant}.$$

Conservation theorem of energy of a particle :->

This theorem state that if the force acting on the particle are conservative, then the total energy of a particle, which is the sum of ~~a the~~ its kinetic energy T and potential energy V is constant or conserved or T or V = constant.

$$dW = \vec{F} \cdot \vec{ds}$$

The total work W_{12} done by the external force $\vec{F}$.

$$W_{12} = \int_1^2 dW = \int_1^2 \vec{F} \cdot \vec{ds}$$

$$= \int_1^2 \frac{d\vec{P}}{dt} \cdot \frac{\vec{ds}}{dt} \, dt$$

Moment of inertia of the shell

3

$$= \frac{2}{3}(\text{mass of the shell}) \times (\text{radius})^2$$

$$= \frac{2}{3}\left[\frac{3M}{R^3} x^2 dx\right] \times x^2 = \frac{2M}{R^3} x^4 dx$$

The moment of inertia of the sphere about a diameter.

$$= \frac{2M}{R^3} \int_0^R x^4 dx = \frac{2M}{R^3}\left[\frac{x^5}{5}\right]_0^5 = \frac{2M}{R^3}\left[\frac{R^5}{5}\right]$$

$$= \frac{2}{5} MR^2$$