$$m\left(\frac{dv}{dt}\right) = -F \quad ....(i)$$

$$\text{or} \qquad mv\frac{dv}{dx} = -F \quad ....(ii)$$

Work done by the body is

$$W = \int_P^Q F.dx$$

$$= -\int_P^Q mvdv = -\left[\frac{1}{2}mv^2\right]_P^Q$$

$$= \frac{1}{2}mv_Q^2 - \frac{1}{2}mv_P^2$$

$$= \frac{1}{2}mv_P^2 \qquad (\because v_Q = 0, \text{the body comes to a stop})$$

Work energy theorem

The total amount of work done on a body by all the forces acting on it is equal to the change in its kinetic energy.

$$K_f - K_i = W_{Total} \quad ....(10)$$

A. For constant force

Let there is a block of mass m moving initially with a velocity u. Let a force $\vec{F}$ acts on it and moves it by a displacement S.

The acceleration of the block under the force $\vec{F}$ is, a = F /m

$$\because \quad v^2 = u^2 + 2as$$

$$\because \quad v^2 - u^2 = 2 \times F/m \times s$$

$$\text{or} \quad mv^2 - mv^2 = 2F.s$$

$$\tfrac{1}{2} mv^2 - \tfrac{1}{2} mv^2 = F.S$$

$$\text{or} \quad K_f - K_i = W$$

B. For variable force :