Work, Energy and Power

Work

Work is said to be done if, on applying a force on an object, it gets displaced from its position.

$W = F \times s$ (Force, displacement) $\quad W = Fs\cos\theta$

SI unit of work - joule

CGS unit of work - erg

Relation bet. 'Joule' and erg

1 joule = 1 newton x 1 metre

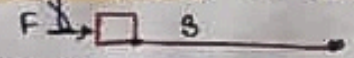
1 joule = 10^5 dynes x 100 cm

1 joule = 10^7 dyne x cm

1 joule = 10^7 erg

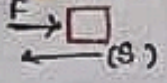
Positive Work

When a force acts on a body and the body moves in direction of force



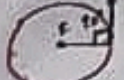
Negative Work

When a force acts on a body and the body moves in the direction opposite to the force



Zero Work

When a force acts on a body and the body moves in the direction perpendicular



Power

The rate of doing work or the rate at which energy is spent is called power

$P = \frac{W}{t}$ (W: work done, t: seconds)

SI unit of Power - watt

CGS unit of Power - erg per second (erg s^{-1})

Relation bet. Power, Force and Velocity

$W = F \times s \qquad P = \frac{W}{t}$

So, $P = \frac{F \times s}{t} \qquad P = F \times \left[\frac{s}{t}\right]$

$P = F \times v$ ∴ Power = Force x Velocity

Factors on which Power of a source depends

- The amount of work done by the force
- The time spent in doing the work

ENERGY

The capacity of a body to do work is called energy.

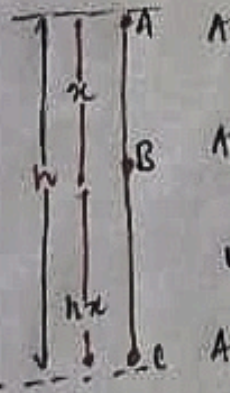
SI unit - joule CGS unit - erg

Mechanical Energy

The energy possed by a body by virtue of its state of motion or position.

- **Potential Energy** — Due to its position or configuration
  - **Gravitational potential energy** — Body has placed at some height above earth surface. it has capacity to do work. $U = mgh$
  - **Elastic potential energy** — By virtue of its deformed state. change in it size & shape
- **Kinetic Energy** — body by virtue of its of motion. $K = \frac{1}{2}mv^2$

Law of Conservation of Mechanical Energy



At point A $K = 0 \quad U = mgh$

$K + U = 0 + mgh = mgh$

At point B $K = \frac{1}{2}mv^2 \quad \frac{1}{2}m \times 2gx$

$v^2 = u^2 + 2as \quad v^2 = 0 + 2gx = 2gx$

$U = mg(h-x) \quad mgx + mg(h-x) = mgh$

At point C $v^2 = u^2 + 2as$

$v^2 = 0 + 2gh \quad v^2 = 2gh$

$K = \frac{1}{2}mv^2 \quad K = \frac{1}{2}m \times 2gh$

$K = mgh$