Power.

Power of a body is defined as the rate at which the body can do the work.

Average power $(P_{av.}) = \frac{\Delta W}{\Delta t} = \frac{W}{t}$

Instantaneous power $(P_{inst.}) = \frac{dW}{dt} = \frac{\vec{F}.d\vec{s}}{dt}$ [As $dW = \vec{F}.d\vec{s}$]

$P_{inst} = \vec{F}.\vec{v}$ [As $\vec{v} = \frac{d\vec{s}}{dt}$]

i.e. power is equal to the scalar product of force with velocity.

Important points

(1) Dimension: $[P] = [F][v] = [MLT^{-2}][LT^{-1}]$

$\therefore \quad [P] = [ML^2T^{-3}]$

(2) Units: Watt or Joule/sec [S.I.]

Erg/sec [C.G.S.]

Practical units: Kilowatt (kW), Megawatt (MW) and Horse power (hp)

Relations between different units : $1\,watt = 1\,Joule/\sec = 10^7\,erg/\sec$

$1hp = 746\,Watt$

$1\,MW = 10^6\,Watt$

$1\,kW = 10^3\,Watt$

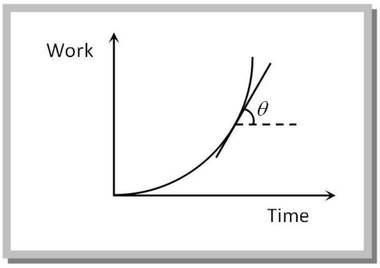
(3) If work done by the two bodies is same then power $\propto \frac{1}{\text{time}}$

i.e. the body which perform the given work in lesser time possess more power and vice-versa.

(4) As power = work/time, any unit of power multiplied by a unit of time gives unit of work (or energy) and not power, i.e. Kilowatt-hour or watt-day are units of work or energy.

$1\,KWh = 10^3\,\frac{J}{sec} \times (60 \times 60\,sec) = 3.6 \times 10^6\,Joule$

(5) The slope of work time curve gives the instantaneous power. As P = dW/dt = tanθ



(6) Area under power time curve gives the work done as $P = \frac{dW}{dt}$

$\therefore \; W = \int P\,dt$

$\therefore$ W = Area under P-t curve