Power

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The rate of doing work is called Power. Accordingly, we can talk about instantaneous power and average power.

$$P_{inst.} = \frac{dw}{dt}$$

$$P_{avg} = \frac{\Delta w}{\Delta t}$$

$$P = \frac{\vec{F}\cdot d\vec{s}}{dt}$$

$$P_{inst} = \vec{F}\cdot\vec{v}$$

by differentiating work energy theorem, we get, WET in terms of power i.e. Power done by all the forces is equal to rate of change of kinetic energy.

Que:) The position of a particle varies with time as $x = kt^3\hat{i}$.
Find (i) instantaneous power at a general time.
(ii) average power till a general time t. Mass of particle is m.

$$P_{inst.} \Rightarrow \quad a = 6Kt$$

$$v = 3Kt^2$$

$$= ma.v$$

$$= m \times 6kt \times 3kt^2$$

$$= 18K^2mt^3$$

$$P_{avg} = \frac{KE_2 - KE_1}{\Delta t} = \frac{\frac{1}{2}m(v^2-u^2)}{t}$$

$$= \frac{1}{2}\frac{m}{t} \times (9K^2t^4 - 0)$$

$$= \frac{1}{2}\frac{m \times 9K^2t^{\cancel{4}}}{\cancel{t}}$$

$$= \frac{9}{2}K^2t^3m$$

Or

$$P_{inst.} = \frac{dK_E}{dt}$$

$$= 18mK^2t^3$$

Que.) $\vec{r} = A\sin(\omega t)\hat{i} + A\cos(\omega t)\hat{j}$, mass is m

Find instantaneous and avg. power.

Using WET $\quad v = A\cos(\omega t)\hat{i} + A\sin(\omega t)\hat{j}$

$(\vec{v}\cdot\vec{v})\quad v^2 = A^2\cos^2(\omega t)\hat{i} + A^2\sin(\omega t)\hat{j}$

$v^2 = A^2$

$u^2 = A^2$

$\Delta KE = \Delta W = \frac{1}{2}m(v^2-u^2) = 0$

$P_{avg} = 0$

$P_{inst} = 0$