INTERMEDIATE

Work, Power, Energy

Hand Notes For JEE Mains, Advance, NEET UG, Class 11 & 12 etc…

Hand Notes

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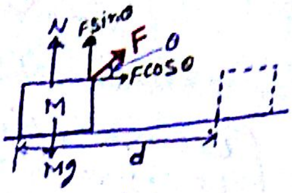
'WORK. POWER. ENERY'

WORK (W)

|I| → If force const.

$W = (F\cos\theta)d = \vec{F}\cdot\vec{d}$ *

$\vec{d}$ = displacement.
θ = Angle b/w Force & disp.



$\vec{F} = F_x\hat{i} + F_y\hat{j} + F_z\hat{k}$, $\vec{d} = x\hat{i} + y\hat{j} + z\hat{k}$ *

$W = \vec{F}\cdot\vec{d} = F_x x + F_y y + F_z z$

$\vec{F} = F_x\hat{i} + F_y\hat{j} + F_z\hat{k}$

* Initial position vector
$\vec{r}_i = x_1\hat{i} + y_1\hat{j} + z_1\hat{k}$
* Final position vector
$\vec{r}_f = x_2\hat{i} + y_2\hat{j} + z_2\hat{k}$

* Disp. vector
$\vec{d} = \vec{r}_f - \vec{r}_i = (x_2 - x_1)\hat{i} + (y_2 - y_1)\hat{j} + (z_2 - z_1)\hat{k}$

$W = \vec{F}\cdot\vec{d} = F_x(x_2 - x_1) + F_y(y_2 - y_1) + F_z(z_2 - z_1)$

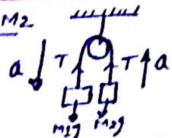
$\vec{F_1}, \vec{F_2} - - - \vec{F_N}$
$W = W_1 + W_2 + - - - W_N$
$W = \vec{F_1}\cdot\vec{d_1} + \vec{F}\cdot\vec{d_2} + - - - \vec{F_N}\cdot\vec{d_N}$

$W = Fd\cos\theta$

- $W = \oplus ve$, $0° < \theta < 90°$
- $W = \ominus ve$, $90° < \theta < 180°$
- $W = 0$: $\theta = 90$ or $F = 0$ or $d = 0$

Eg → * Work done by centripetal force in circular path.
* Work done on charge particle in presence of uniform magnetic field.
* Work done by collie.
* Work done by tension force in a simple pendulum.

Ex → $M_1 > M_2$



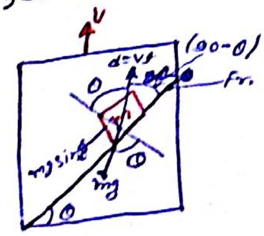
* Work done by Gravitational Force on Mass –
$M_1 = W_1 = (M_1 g)d\cos 0° = \oplus ve$
$M_2 = W_2 = (M_2 g)d\cos 180° = \ominus ve$

* Work done by tension force on mass.
$M_1 = W_1 = T\cdot d\cos 180° = \ominus ve$
$M_2 = W_2 = T\cdot d\cos 0° = \oplus ve$.

Particle of Mass 'M' placed on Incline plane wich is move upward with const velocity. If mass 'M' Remain at Rest w.r.t incline plane. Work done by Gravitational force on mass 'M' after time 't'.

* Work done by Friction force
$W = F_r(vt)\cos(90 - \theta)$
* If body cont at Rest
$F_L > mg\sin\theta$
$W = (mg\,vt)\sin^2\theta$

* Work done by Gravitational force
$W = (Fg)(vt)\cos 180°$
$= (mg)(vt)(-1)$
$W_g = -(mg\,vt)$

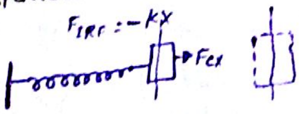


II → If Force is variable.

$\vec{F} = F_x\hat{i} + F_y\hat{j} + F_z\hat{k}$] (x_1, y_1, z_1)
$\vec{dr} = dx\hat{i} + F_y\hat{j} + dz\hat{k}$] (x_2, y_2, z_2)

$W = \vec{F}\cdot\vec{dr} = \int_{x_1}^{x_2} F_x\,dx + \int_{y_1}^{y_2} F_y\,dy + \int_{z_1}^{z_2} F_z\,dz$ *

Internal Resolving force of spring is change w.r.t distance as Relation $F = -kx$. Work done by the applied force to displace the spring x_1 to x_2.



$F_{ex} = -F_{IRF} = -(-kx)$
$F_x = kx$

* Force compression, extended.
$W = \frac{1}{2}(x_2^2 - x_1^2)$ *

$x_1 = 0$, $x_2 = x$
$W = \frac{1}{2}kx^2$ *

Work Done From Force, Disp Curve

* Area inclosed b/w Force disp. curve & disp. axis Represent work done by by the force.

$W = \int_{x_1}^{x_2} F\cdot dx$ = Area inclosed b/w "F-x" curve & x-axis. *