VIDYAPEETH

BATCH CODE – 12-AJ251MA

- Subject Name- Physics
- Chapter Name- Work , Power & Energy

Lecture No.- 01

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Today's Targets

1. Work , Power & Energy
2.
3.
4.

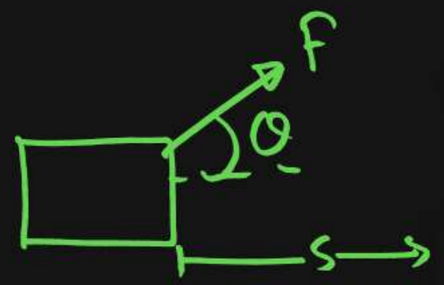
Work :- It is said to be done by a force when the force produces a displacement in the body .

→ It is the dot product of the applied force and the displacement .

$$W = \vec{F} \cdot \vec{S}$$

$$W = |\vec{F}||\vec{S}|\cos\theta$$

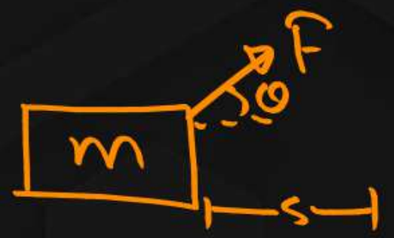
- θ → angle b/w $\vec{F}$ & $\vec{S}$
- Scalar Quantity
- S.I. Unit :- N-m or Kgm^2s^{-2} or joule (J)
- Dimension :- $[ML^2T^{-2}]$
- $1\ J = 10^7\ erg$



$W_{(F)} = FS\cos\theta$

Positive work

$0 \leq \theta < 90$



$W = FS\cos\theta$ → +ve

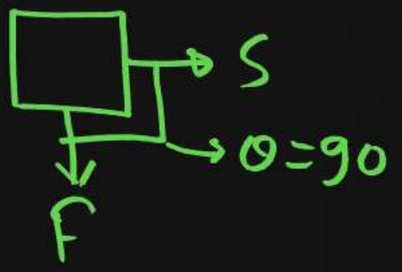
Negative work

$90 < \theta \leq 180$

$W = FS\cos\theta$ → -ve

Zero work

$\theta = 90$

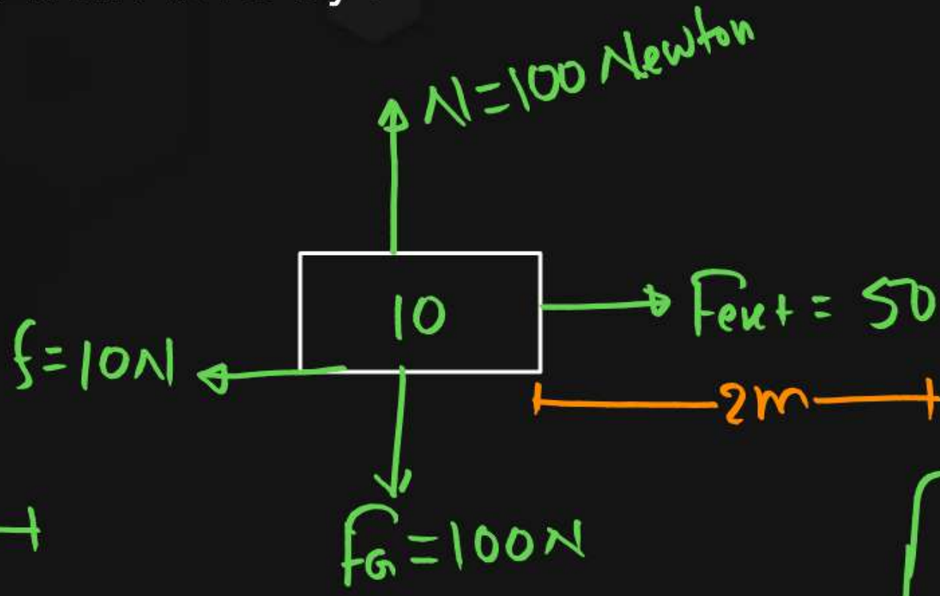


$W_c = FS\cos 90$

$W = 0$

Que. If block is displaced by 2 m ; Find work done by :

(1) Gravity
(2) External force
(3) Normal
(4) friction



① $W_G = f_G \times S \times \cos\theta$
$= 100 \times 2 \times \cos 90$
$W_G = 0$

② $W_{ext} = F_{ext} \times S \times \cos\theta$
$= 50 \times 2 \cos 0$
$W_{ext} = 100\,J$

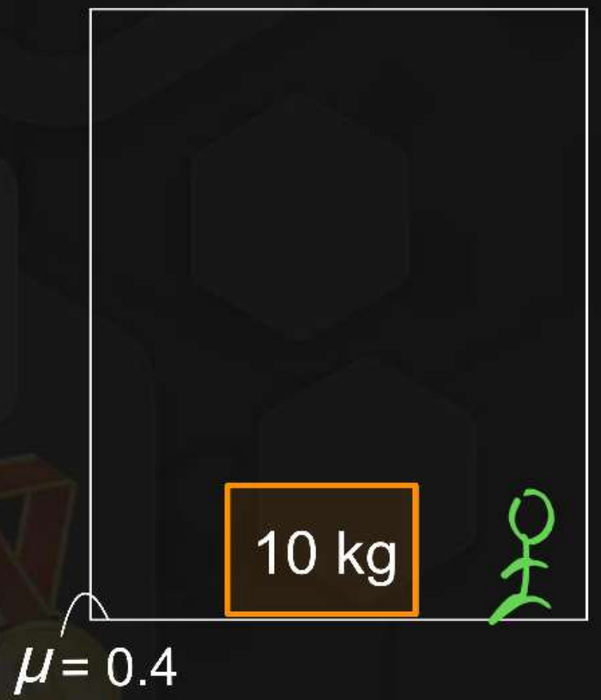
③ $W_N = N \times S \times \cos\theta$
$= 100 \times 2 \times \cos 90$
$W_N = 0$

④ $W_f = f \times S \times \cos\theta$
$= 10 \times 2 \times \cos 180$
$W_f = -20\,J$

Que. Acceleration of elevator $\vec{a} = 2\hat{i} + 2\hat{j}$

u = 0

Find work done by : Gravity , Normal & friction in 2 sec



$u = 0$
$a_x = 2\ m/s^2$
$t = 2\ sec$
$S_x = 0 + \frac{1}{2} \times 2 \times 4$
$S_x = 4\ m$

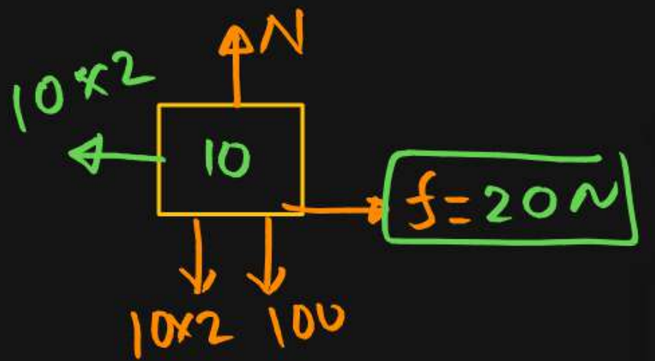
$u = 0$
$a_y = 2\ m/s^2$
$t = 2\ sec$
$S_y = \frac{1}{2} \times 2 \times 4$
$S_y = 4\ m$

$\vec{S} = 4\hat{i} + 4\hat{j}$

$\vec{F_G} = -100\hat{j}$

$f = 20\hat{i}$

$\vec{N} = 120\hat{j}$



$N = 20 + 100$

$N = 120\ New$

$F_G = 100\ N$

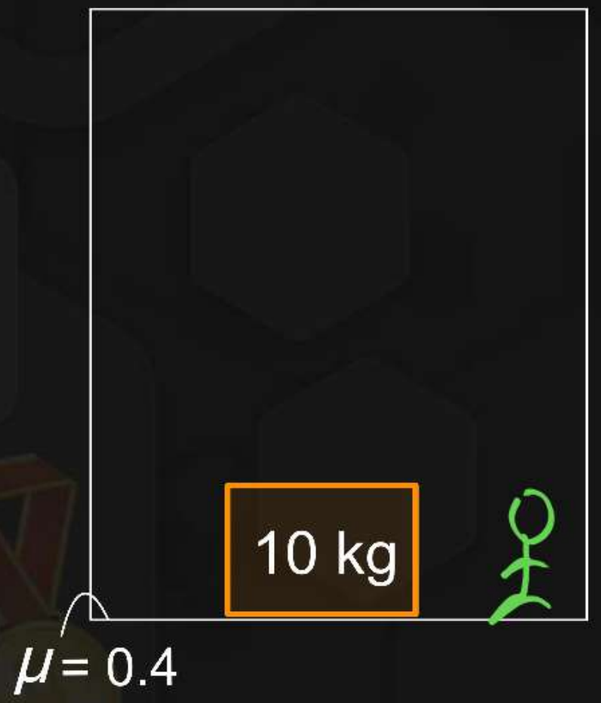
$f_{s(m)} = 0.4(120) = 48\ N$

$f = 20\ N$

Que. Acceleration of elevator $\vec{a} = 2\hat{i} + 2\hat{j}$

$u = 0$

Find work done by : Gravity , Normal & friction in 2 sec



$u = 0$

$a_x = 2\ m/s^2$

$t = 2\ sec$

$S_x = 0 + \frac{1}{2} \times 2 \times 4$

$S_x = 4\ m$

$\vec{S} = 4\hat{i} + 4\hat{j}$

$\vec{F_G} = -100\hat{j}$

$f = 20\hat{i}$

$\vec{N} = 120\hat{j}$

$\vec{S} = 4\hat{i} + 4\hat{j}$

$\vec{F_G} = -100\hat{j}$

$|W_G| = -400\ J$

$\vec{f} = 20\hat{i}$

$W_f = 80\ J$

$\vec{N} = 120\hat{j}$

$W_N = 480\ J$

Que

$\vec{A} = 2\hat{i} + 3\hat{j}$

$\vec{B} = 3\hat{i} + 4\hat{j}$

$\vec{A} \cdot \vec{B} = (2\hat{i} + 3\hat{j}) \cdot (3\hat{i} + 4\hat{j})$

$= 18$

$\hat{i} \cdot \hat{i} = 1$
$\hat{j} \cdot \hat{j} = 1$
$\hat{k} \cdot \hat{k} = 1$ $\rightarrow$

$\vec{F} = 2\hat{i} - \hat{j} + 3\hat{k}$

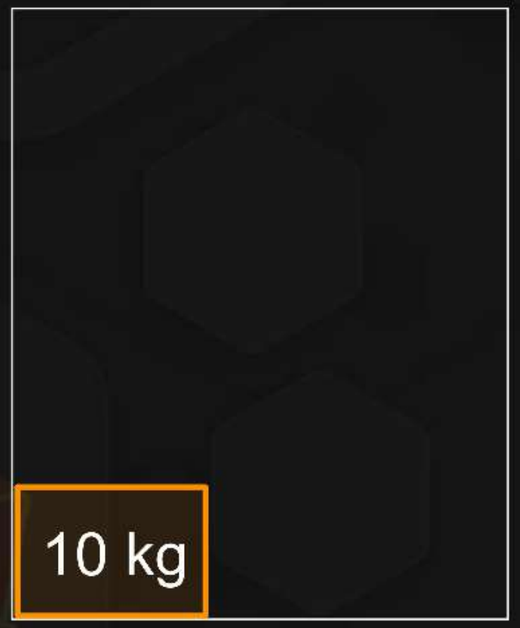
$\vec{v} = 3\hat{i} - 2\hat{j} - 2\hat{k}$

$\vec{F} \cdot \vec{v} = 6 + 2 - 6 = 2$

Que. Acceleration of elevator $\vec{a} = 1\,\hat{i} + 2\,\hat{j}$

$u = 0$

Find work done by : Gravity , Normal in 2 sec



Smooth

Que. Acceleration of elevator $\vec{a} = 1\,\hat{i} + 2\,\hat{j}$

$u = 0$

Find work done by : Gravity & Tension in 4 sec

Que. A constant force $\vec{F} = (3\hat{i} + 2\hat{j} + 2\hat{k})$ N acts on a particle displacing from $\vec{r}_1 = (\hat{i} - 3\hat{j} + 5\hat{k})$ to $\vec{r}_2 = (5\hat{i} + 3\hat{j} + 8\hat{k})$. Find work done by the force.

$\vec{S} = \vec{r}_2 - \vec{r}_1$

$\vec{S} = (5-1)\hat{i} + [3-(-3)]\hat{j} + [8-5]\hat{k}$

$\boxed{\vec{S} = 4\hat{i} + 6\hat{j} + 3\hat{k}}$

$\boxed{\vec{F} = 3\hat{i} + 2\hat{j} + 2\hat{k}}$

$W = \vec{F} \cdot \vec{S} = (3\hat{i} + 2\hat{j} + 2\hat{k}) \cdot (4\hat{i} + 6\hat{j} + 3\hat{k})$

$= 12 + 12 + 6$

$\boxed{= 30\,J}$

Que. A constant force $\vec{F}= (5\hat{i} - 2\hat{j} + 4\hat{k})$ N acts on a particle displacing from (1,-1,2) to (2,2,0) . Find the total work done by the force .

Que. A particle is shifted from origin to (1, 2 , -3) under the action of three forces act simultaneously . $\vec{F}_1 = (2\hat{i} + 3\hat{j} - \hat{k})$ N , $\vec{F}_2 = (\hat{i} - 2\hat{j} + 2\hat{k})$ N and $\vec{F}_3 = (\hat{i} + \hat{j} - 3\hat{k})$ N. Find net work done on particle dues to these forces .

Thank You...

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★★★★★

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