# VIDYAPEETH

## BATCH CODE – 12-AJ251MA

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

Lecture No.- 02

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# Today's Targets

1. Work , Power & Energy
2. Work done in different situations
3. _____
4. _____

FRICTION → Ex → 1

Ex → 2

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 .

$$\vec{S} = (2-1)\hat{i} + (2-(-1))\hat{j} + (0-2)\hat{k}$$

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

$$\vec{F} = 5\hat{i} - 2\hat{j} + 4\hat{k}$$

$$W = \vec{F} \cdot \vec{S} = 5 - 6 - 8$$

$$= -9\,J$$

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 .

$\vec{F}_{net} = 4\hat{i} + 2\hat{j} - 2\hat{k}$

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

$W = 4 + 4 + 6 = 14\,J$

Que. At t= 0 , particle is at origin & moves on $y = 4x^2$ . Find the work done by a force $\vec{F} = 4\hat{i} + 6\hat{j} + 8\hat{k}$ when y coordinate of particle become 16 .

$y = 16$

$y = 4x^2$

$16 = 4x^2$

$x^2 = 4$

$\boxed{x = \pm 2}$

$S_1 = (2, 16)$

$S_2 = (-2, 16)$

$\vec{S}_1 = 2\hat{i} + 16\hat{j}$

$\vec{S}_2 = -2\hat{i} + 16\hat{j}$

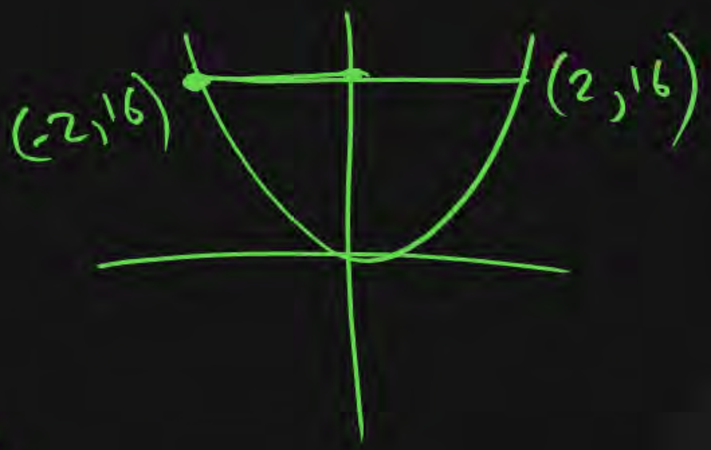
$\vec{F} = 4\hat{i} + 6\hat{j} + 8\hat{k}$

$W_1 = \vec{F} \cdot \vec{S}_1 = (4\hat{i} + 6\hat{j} + 8\hat{k}) \cdot (2\hat{i} + 16\hat{j})$

$= 8 + 96 = 104\ J$

$W_2 = \vec{F} \cdot \vec{S}_2 = (4\hat{i} + 6\hat{j} + 8\hat{k}) \cdot (-2\hat{i} + 16\hat{j})$

$= -8 + 96 = 88\ J$



Que. **Find net workdone by friction in each block in first 3 sec .**
**( $\vec{u} = 0$ )**


5 kg → $f = 0.1(5)(10) = 5N$

$a = \frac{5}{5} = 1 m/s^2$

$f = 5N$ ← 10 → 50 N

$a = \frac{45}{10}$

$a = 4.5 m/s^2$

→ 5 → $a = 1 m/s^2$, $f = 5N$

$S = ut + \frac{1}{2}at^2$

$S = 0 + \frac{1}{2} \times 1 \times 9 = 4.5$

$W = (5)(4.5)\cos 0 = 22.5 J$

→ $f = 5N$ ← 10 → $a = 4.5$

$S = \frac{1}{2}at^2 = \frac{1}{2} \times 4.5 \times 9$

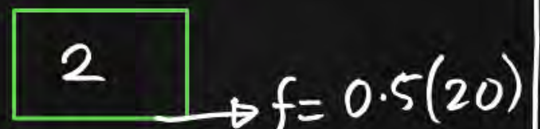
$= 20.25 m$

$W_f = (5)(20.25)\cos 180$

$= -101.25 J$

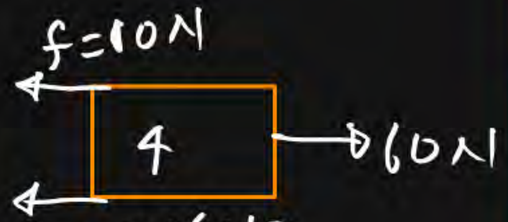
Que.

**Find net workdone by friction in each block in first 2 sec .**
**( $\vec{u} = 0$ )**


$f = 10\ N$

$a = \frac{10}{2} = 5\ m/s^2$

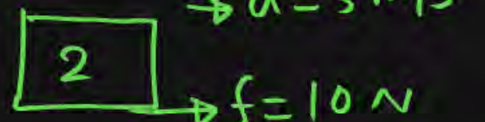



$= 12\ N$

$a = \frac{60-22}{4}$

$a = 9.5\ m/s^2$

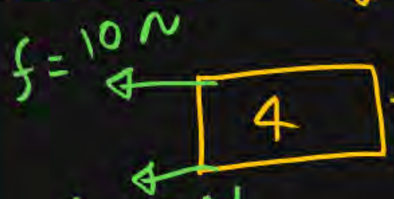
→ for 2 kg block




$S = 0 + \frac{1}{2} \times 5 \times 4 = 10\ m$

$W_f = (10)(10)\cos 0 = 100\ J$

→ for 4 kg



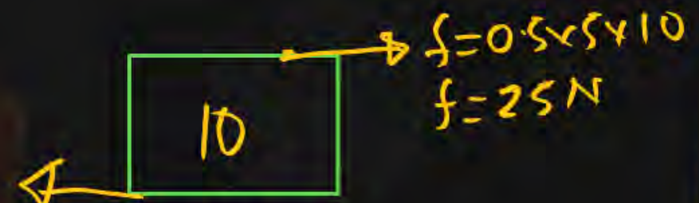

$f_{net} = 22\ N$

$S = 0 + \frac{1}{2} \times 9.5 \times 4$

$S = 19\ m$

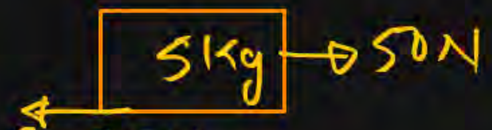
$W = (22)(19)\cos 180 = -418\ J.$

Que. **Find net workdone by friction in each block in first 4 sec .**
**( $\vec{u} = 0$ )**

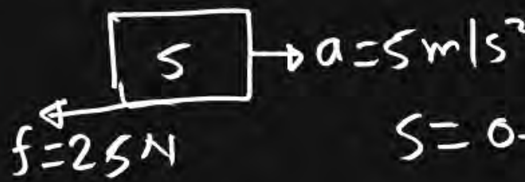

$f_g = 0.1 \times 15 \times 10$
$= 15N$

$a = \frac{10}{10} = 1 m/s^2$ ✓




$a = 5 m/s^2$

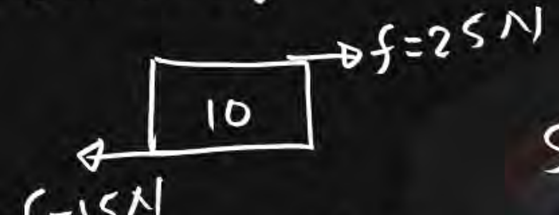
⊖ for 5 kg




$S = 0 + \frac{1}{2} \times 5 \times 16 = 40 m$

$W_f = (25)(40)\cos 180$
$= -1000 J$

⊖ for 10 kg

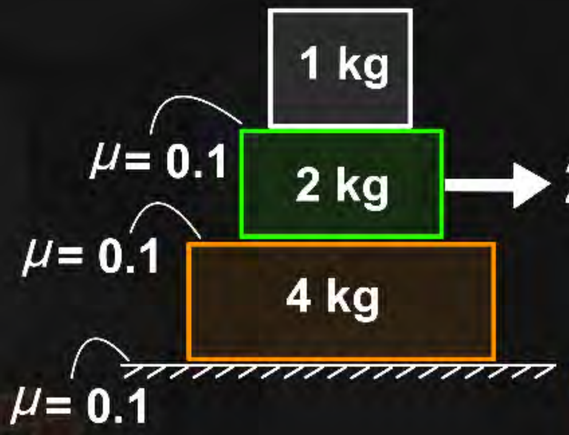



$f_{net} = 10N$

$S = 0 + \frac{1}{2} \times 1 \times 16$
$S = 8 m$

$W_f = (10)(8)\cos 0^\circ = 80 J$

Que. **Find net workdone by friction in each block in first 2 sec .**
**( $\vec{u} = 0$ )**




1 → $f = 0.1(1)(10)$

$a = 1 m/s^2$ ✓

4 → $f = 0.1(3)(10)$

$f = 3N$

$f_m = 0.1(7)(10)$

$= 7$

$f = 3N$

$f = 3N$

$a = 0$ ✓

2 → 20 N

$f = 1N$

$f = 3N$

$a = 8 m/s^2$ ✓

**(A) for 1 kg**

1 → $a = 1 m/s^2$

$f = 1N$

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

$s = 2 m$

$W_f = (1)(2)\cos 0^\circ = 2J$

**(B) for 2 kg**

$f = 1N$

2 → $a = 8 m/s^2$

$f = 3N$

$f_{net} = 4N$

$s = 0 + \frac{1}{2} \times 8 \times 4$

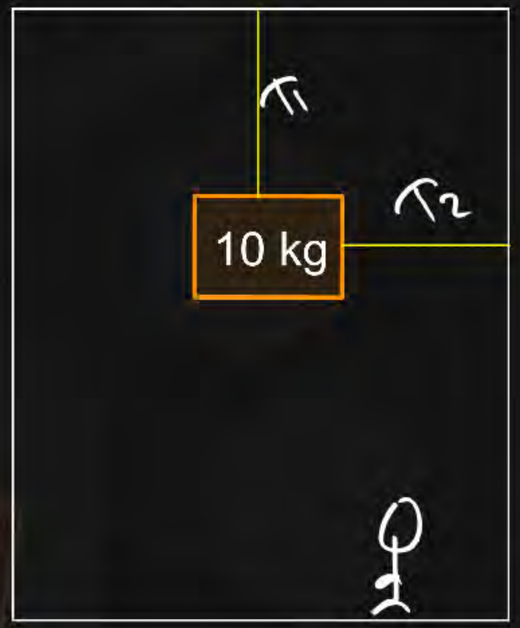
$s = 16$ ✓

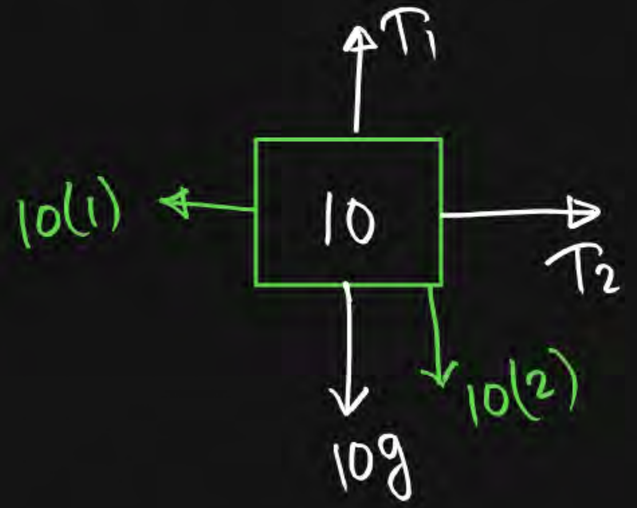
$W = (4)(16)\cos 180^\circ = -64J$

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

$\vec{u} = 0$

Find work done by : Gravity & Tension in 4 sec




$T_1 = 100 + 20 = 120\,N$

$\boxed{\vec{T}_1 = 120\hat{j}}$

$T_2 = 10\,N$

$\boxed{\vec{T}_2 = 10\hat{i}}$

| $a_x = 1$ | $a_y = 2$ |
|---|---|
| $u = 0$ | $u = 0$ |
| $t = 4\,sec$ | $t = 4$ |
| $S_x = \frac{1}{2} \times 1 \times 16$ | $S_y = \frac{1}{2} \times 2 \times 16$ |
| $S_x = 8\,m$ | $S_y = 16\,m$ |

$\boxed{\vec{S} = 8\hat{i} + 16\hat{j}}$

$32$
$16$

$W_{T_1} = \vec{T}_1 \cdot \vec{S}$
$= (120\hat{j}) \cdot (8\hat{i} + 16\hat{j})$
$= 1920\,J$

$W_{T_2} = \vec{T}_2 \cdot \vec{S}$
$= (10\hat{i}) \cdot (8\hat{i} + 16\hat{j})$
$= 80\,J$

$W_g = (-100\hat{j}) \cdot (8\hat{i} + 16\hat{j})$

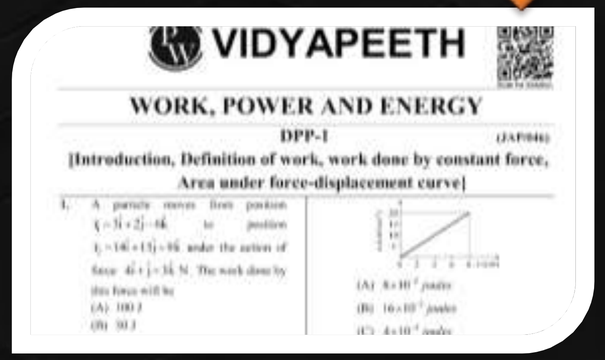
Que. Acceleration of elevator $\vec{a} = 1\,\hat{i} + 2\,\hat{j}$

$u = 0$

Find work done by : Gravity , Normal in 2 sec


Smooth

# Solve the DPP


VIDYAPEETH

WORK, POWER AND ENERGY

DPP-1

[Introduction, Definition of work, work done by constant force, Area under force-displacement curve]

1. A particle moves from position $(-3\hat{i}+2\hat{j}-6\hat{k})$ to position $(14\hat{i}+15\hat{j}+8\hat{k})$ under the action of force $(4\hat{i}+\hat{j}-3\hat{k})$ N. The work done by this force will be
(A) 100 J
(B) 50 J



(A) $8\times10^{-2}$ joules
(B) $16\times10^{-2}$ joules
(C) $4\times10^{-2}$ joules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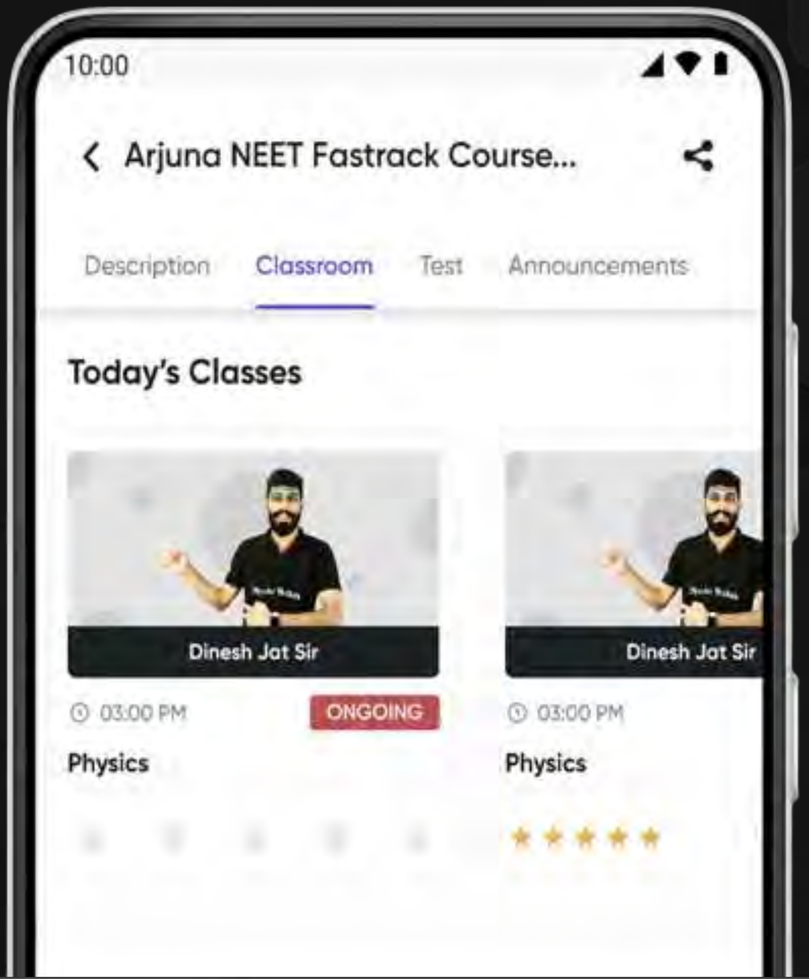


*Thank You!!!!*

*Baccho...*

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