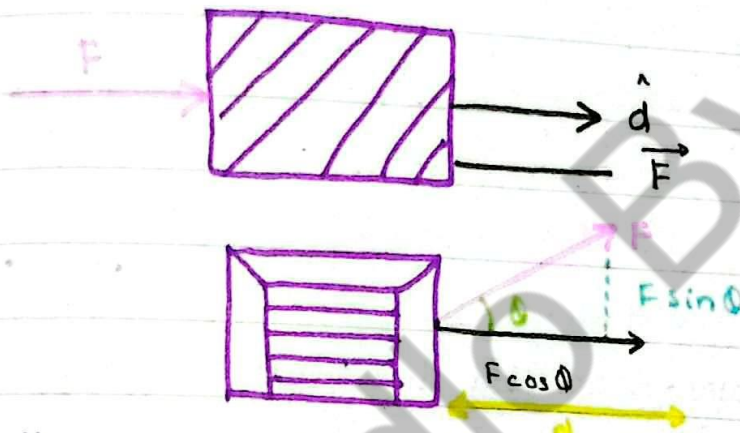


• WORK :-

" When we apply force on an object and the object move in the direction of force so it is work done.

S.I UNIT :- Joule (J)



In this case when force is acting on it upward then the block of wood will move forward. The acting component in this case is $F \cos \theta$ (x) component.

$$W = \vec{F}_x \cdot \vec{d}$$

$$W = F \cos \theta \cdot d$$

$$W = Fd \cos \theta$$

• Cases of work done on the basis of Angle :-

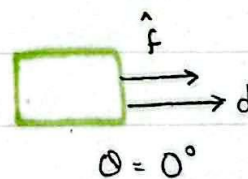
(i)

At 0°

Since, $W = \vec{F} \cdot \vec{d}$

$$W = \cos \theta Fd$$

$$W = (1) Fd$$

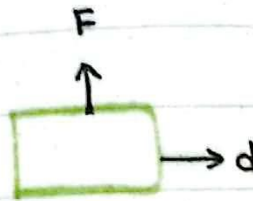


$$W = Fd$$

E.g :- Car

Thus at 0° the work done will be positive and maximum.

(ii) At 90°



$$W = Fd \cos 0$$

$$W = Fd \cos (90)$$

$$W = Fd \cdot 0$$

$$W = 0$$

Thus, at 90° The value of work done will be zero

(Q) The work done by the Satellite on Earth is?

$0 = 90^\circ$ The work done will be zero

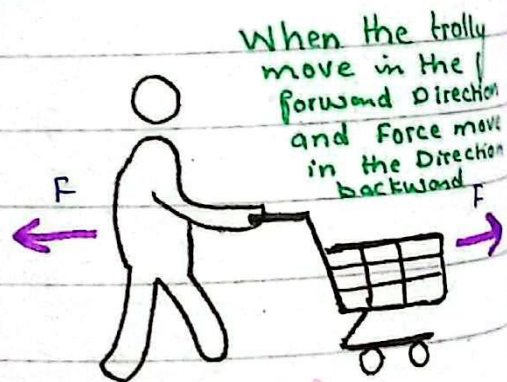
(iii) At 180°

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

$$W = Fd \cos 0$$

$$W = Fd (\cos)(180)$$

$$W = -Fd$$



$$\cos 180^\circ = -1$$

Thus, we conclude that when the force and force and displacement is 180°

or Antiparrallel thus the value of
work done will be 0

(iv) At $d = 0$

$$W = Fd \cos \theta$$

$$W = F(0) \cos \theta$$

$$W = 0$$

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WORK DONE from Force - Displacement Graph :-

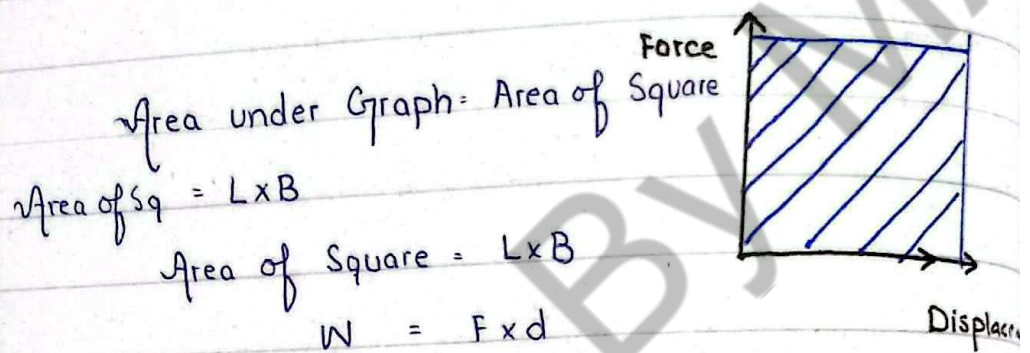
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(1) Constant Force :-

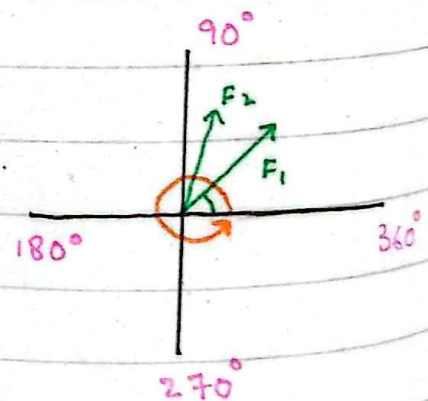
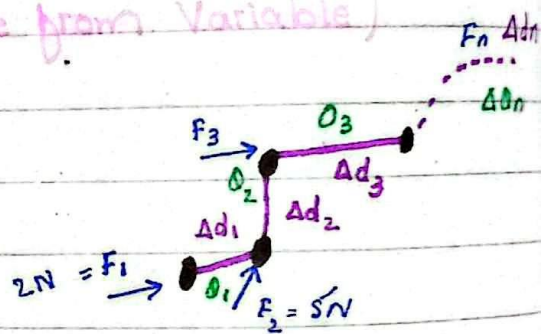
(work done from constant)

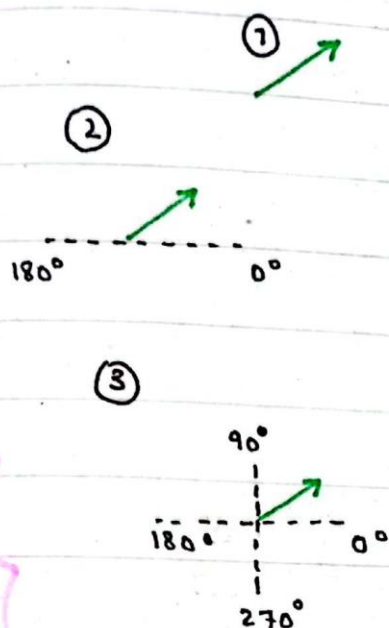


(2) Variable Force

(work done from variable)

If the value/magnitude of force is changing in each segment then, the that will be a variable force.





Life Hack

When we want to find angle (θ) of any body that we have to draw a straight line at its x-axis and horizontal line in its y-axis through their tail.

$$W = F \times \Delta d \cos \theta$$

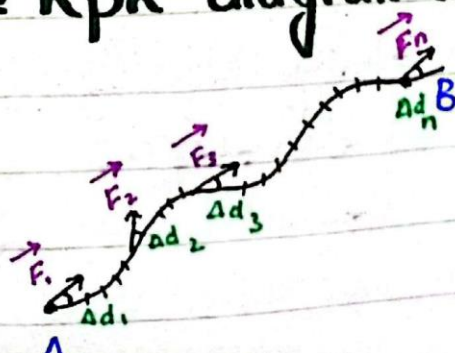
Now calculating Total work done by variable form.

$$W_r = W_1 + W_2 + W_3 + \dots + W_n$$

$$W_r = F_1 \Delta d \cos \theta_1 + F_2 \Delta d \cos \theta_2 + \dots + F_n \Delta d \cos \theta_n$$

$$W_r = \sum_{i=1}^n F_i \cos \theta_i \cdot \Delta d_i$$

—: Kpk diagram:—



LECTURER # 48

CONSERVATIVE AND NON-CONSERVATIVE FIELDS :-

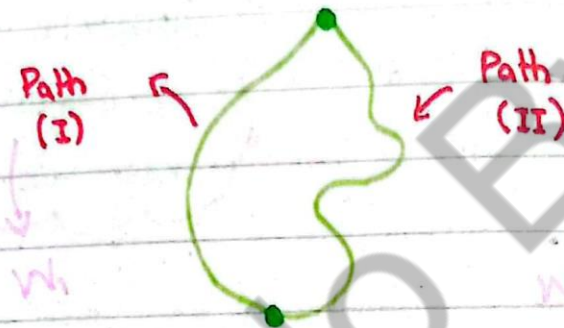
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CONSERVATIVE :-

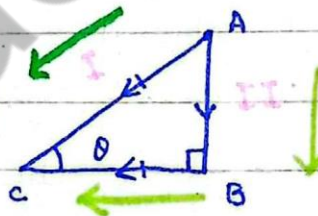
=> (1) work done is independent of Path taken



When in electric field work done is not depend upon Path called Conservation.

Kpk

$$\Rightarrow W_1 = W_2$$

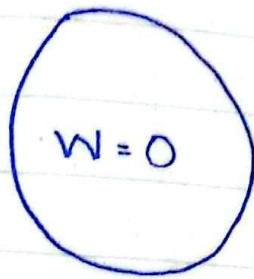


$$W_{A \rightarrow B} + W_{B \rightarrow C} = W_{A \rightarrow C}$$

PKM2 :-

Under the action of Gravity Magnetic or Electric field if an object move from one point to another point But follows different path but there is no change in work

(2) Work done in a closed loop is Zero

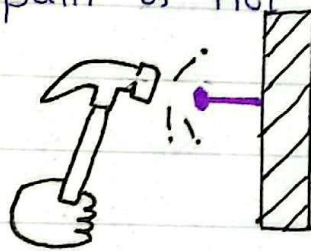


Example:-

Gravitational and electric fields are example of conservation force.

NON-CONSERVATION FIELDS :-

=> The field in which work done depend upon the path followed or the work done along a closed path is not zero



For Example:-

(1) Take a hammer and a nail and insert it inside the wall. Initially the work done is zero minimum but after some time due to change in magnitude and path the work done will be change. Because the nail path change due to force and friction.

(2) Air Resistance

When we jump from plane. Firstly our velocity is zero. As our velocity increase our path change. Air Resistance in the form work will also increase.

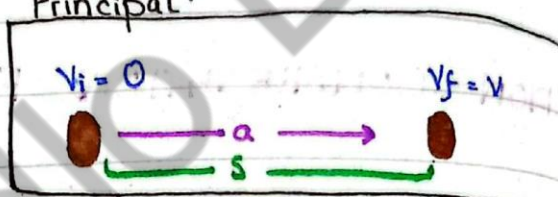
LECTURE # 49

5.3 KINETIC ENERGY :-

The energy possessed by a body due to its motion is called kinetic energy.

According to work-energy Principal.

$$W = E_k$$



Work done depend upon work done they both are directly proportional

$$W = E_k = FS \quad \text{--- (i)}$$

Since force =

$$F = ma \quad \text{--- (ii)}$$

Since from Third equation of motion

$$2as = v_f^2 - v_i^2$$

$$S = \frac{v_f^2 - v_i^2}{2a}$$

$$S = \frac{v^2 - 0}{2a}$$

Change in Speed = change in Kinetic Energy = work done

$$S = \frac{v^2}{2a} \quad \text{--- (iii)}$$

now putting eq (ii) and (iii) in eq (i) then

$$E_k = m \cdot a \left(\frac{v^2}{2a} \right)$$

$$E_k = \frac{1}{2} m v^2$$

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LECTURER # 49

WORK ENERGY PRINCIPAL

⇒ The net work done on an object is equal to change in the object kinetic Energy.

$$W_{\text{net}} = K \cdot E_f - K \cdot E_i = \Delta K \cdot E$$

NOTE :-

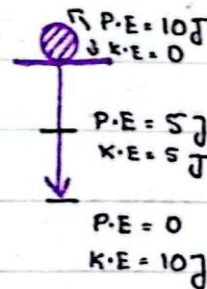
without equation of motion we can't calculate the motion of any object.

⇒ It is also valid for potential energy.

⇒ Change in potential Energy is exactly equal to the negative of change in kinetic Energy.

$$W = \uparrow \Delta K = -\Delta U \downarrow$$

$$W_{\text{net}} = \Delta K + \Delta U$$



$$W_{\text{net}} = \text{Total Energy}$$

$$W_{\text{net}} = \Delta K \cdot E + \Delta P \cdot E$$

WORK - ENERGY THEOREM IN RESISTIVE MEDIUM

$$W_{\text{net}} = \Delta K \cdot E + W_{\text{resistive}}$$

$$W_{\text{net}} = \Delta K \cdot E = W_{\text{resistive}}$$

$$W_{\text{resistive}} = W_{\text{net}} - \Delta K \cdot E$$

Example:-

Take a hammer and a nail. When you put it inside the wall, the wall can act as a resistive force. It also does its work by opposing the nail to enter in it.

SLO BASED QIA:-

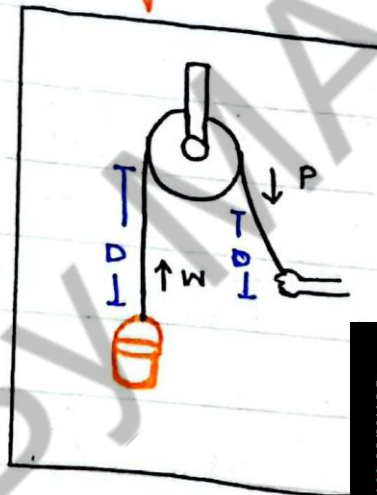
Q How work done is related with change in energy?

Implications of Energy losses in Practical Devices and Efficiency:-

INPUT:-

The energy supplies to a mechanical machine is called Input

$$\text{Input} = p \times d$$



Output:-

The work done by a mechanical machine is called output

$$\text{Output} = W \times D$$

Efficiency

The Efficiency is the ratio of work output to the work input,

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}}$$

Ideal machine:-

The input will be equal to output, this means that no energy is wasted

and all energy is converted into useful work.

$$\text{output} = \text{Input}$$

$$\text{Efficiency} = 1$$

Efficiency has no units

Percentage Efficiency:-

When we multiply efficiency with 100% so we can get Percentage Efficiency.

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}} \times 100$$

E.g:-

$$\text{Efficiency} = \frac{60}{40} \times 100$$

$$\text{Efficiency} = 150\%$$

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