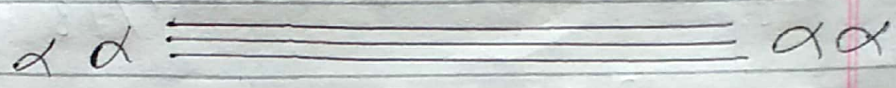
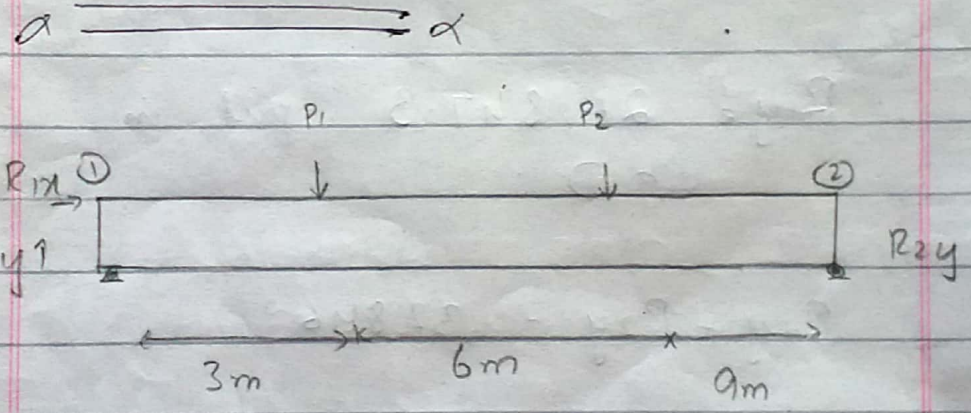
⇒ Name: Arif ullah
⇒ Id : 16073
⇒ Section: A
⇒ Paper : Eng: Mechanics Final Paper:
⇒ Teacher: Sir - Majid Naeem (sb)
⇒ Submitted: Sir - Majid Naeem(sb)



Answer # 01:



$P_1 = 200 + \text{sto I.D}$
$= 200 + 16073$
$= 16273$

$P_2 = 500 + \text{sto ID}$
$= 500 + 16073$
$= 16573$

Sol: $R_{1x} = 0$ $\quad \Sigma F_x = 0$

Now

$R_{1y} + R_{2y} - P_1 - P_2 = 0$ $\quad \Sigma F_y = 0$

$R_{1y} + R_{2y} - 16273 - 16573 = 0$

$$R_{1y} + R_{2y} - 32846 = 0$$

$$\boxed{R_{1y} + R_{2y} = 32846} \quad -①$$

$$R_{1y} = [(16573 \times 9) + (16273 \times 15)] / 18 \quad \because \Sigma m_1 = 0$$

$$R_{1y} = (149,157 + 244095) / 18$$

$$R_{1y} = 393,252 / 18$$

$$R_{1y} = 21,847.3 \text{ , put in eq ①.}$$

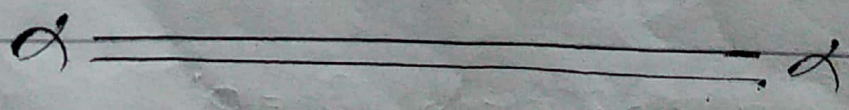
$$R_{1y} + R_{2y} = 32846$$

$$R_{1y} = -R_{2y} + 32846$$

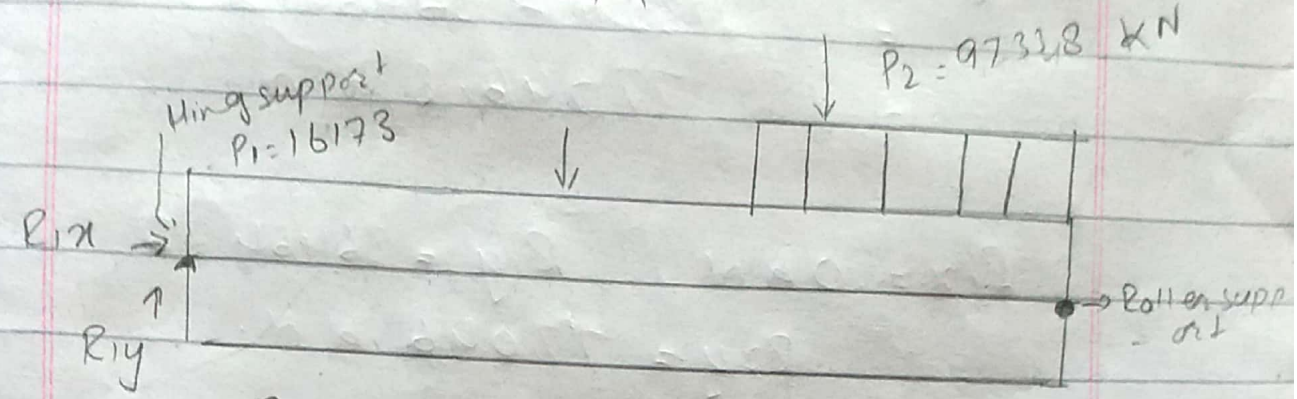
$$R_{1y} = 32846 - 21847.3$$

$$R_{2y} = 10,998.7.$$

$$\{R_{1x} = 0 \text{ , } R_{1y} = 21847.3 \text{ , } R_{2y} = 10998.7\}$$



Answer :- 02 :-



P_1 = 100 + student ID

= 100 + 16073 = 16173

UDL = 150 + student ID

= 150 + 16073 = 16223

UDL Resultant = (16223 kN/m * 6m) = 97338 kN

$R_{1x} = 0$ $\quad \Sigma F_x = 0$

$R_{1y} + R_{2y} - P_1 - P_2 = 0$

$R_{1y} + R_{2y} - 16173 - 97338 = 0$

$R_{1y} + R_{2y} = +113,511$

$R_{1y} = (97338 \times 3) + (16173 \times 9) / 12$

$= 292014 + 145557 / 12$

$= 437571 / 12$

$= 36464.2$ kN

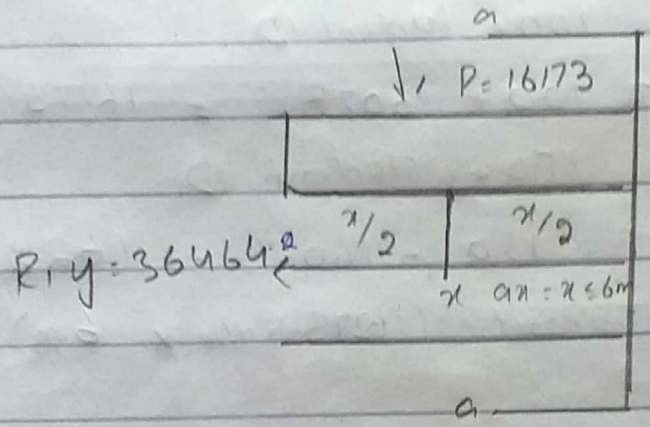
R_{2y} = 113511 − R_{1y}

= 113511 − 36464.2

= 77046.8 KN

R_{1x} = 0 KN, R_{1y} = 36464.2

R_{2y} = 77046 KN.



Summation Fy = 0

− vaa − P + 36464.2 KN

vaa = 36464.2 − 16173 eq①

To find the location of shear force let eq① equal to zero.

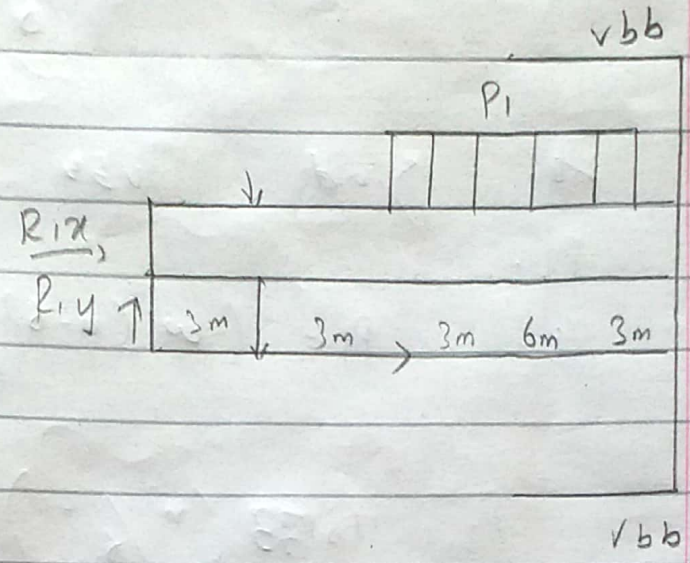
0 = 36464.2 − 16173 x

$x = \frac{3646.2}{16173}$

x = 2.25 m

at x = 2.25 the shear

will be zero.



From law of similar triangle

$$\frac{16173}{6m} = \frac{w \cdot kn\,m}{(n-6)\,m}$$

$$6w \cdot kn = 16173n(n-6)$$

$$6w \cdot kn = 16173n^2 - 97038$$

$$w_0 = \frac{16173n^2 - 16173}{6}$$

$$w_0 = 16173\left(\frac{x^2}{6} - 1\right)$$

to find v_b find P_3.

$$P_3 = \left(w \cdot (x-6)\right)/2$$

$$P_3 = 16173\left(\frac{x^2}{6} - 1\right)(x-6)/2$$

$$= 16173\left(\frac{x^3}{6} - x^2 - x + 6\right)/2$$

$$P_3 = \frac{16173}{2}\left(\frac{x^3}{6} - x^2 - x + 6\right)$$

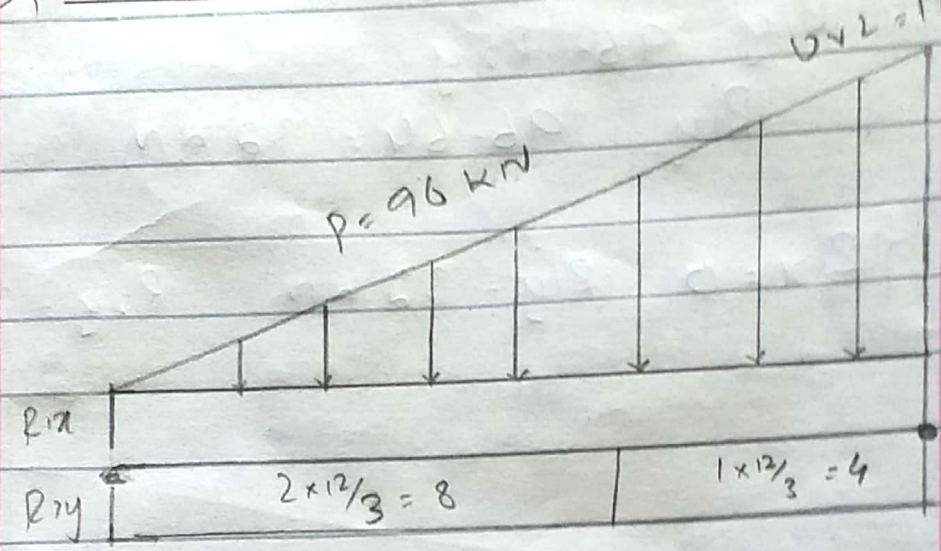
$$P_3 = 8086.5\left(\frac{x^3}{6} - x^2 - x + 6\right)$$

at $x = 6m$

at $x = 12$, eq ①

$$v_b = 158.$$

⇒ Answer : 3 :-



$OVL = \text{Student}/1000 = 16073/1000 = 16.073$

$OVL\ Resultant = \left(\frac{16\ kN/m \times 12}{2}\right)$

$= 96\ kN$

This load will act 1/3 of length from the maximum side

$R_{1x} = 0$ - Eq-0 $\quad \Sigma F_x = 0$

$R_y = R_{2y} - 96\ kN = 0$ - Eq (2)

$(R_{2y} \times 12) - (96 \times 8) = 0$ Eq (1)

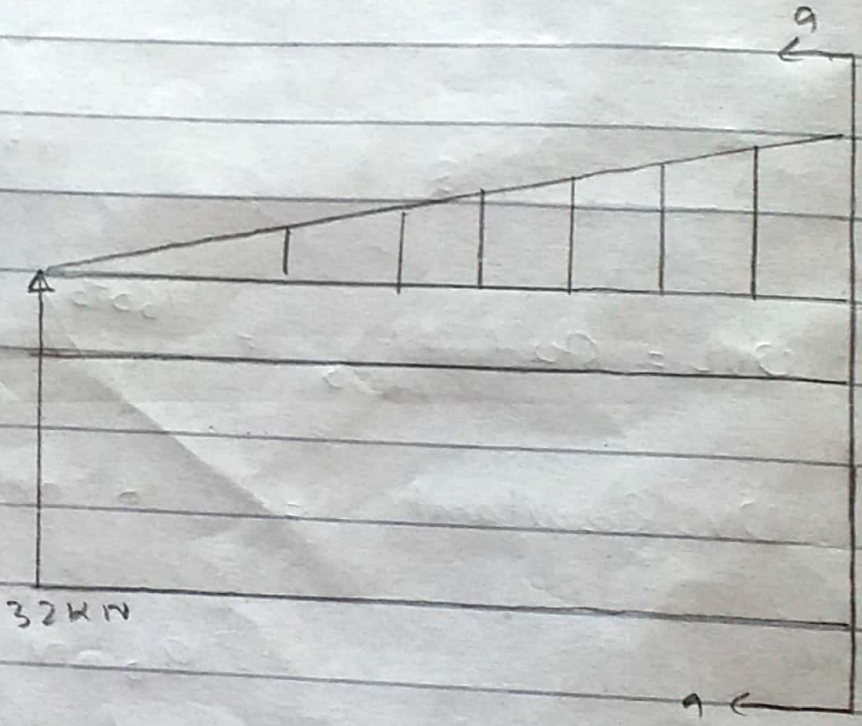
$R_{2y} = 96 \times 8/12 = 64\ kN$

$R_{1y} + R_{2y} = 96\,kN$

$R_{1y} = 96 - R_{2y}$

$R_{1y} = 96 - 64 = 32\,kN$

$\{R_{1x} = 0 \quad R_{1y} = 32\,kN \quad R_{2y} = 96\,kN\}$



From law of similar triangle

$$\frac{16\,kN/m}{12m} = \frac{w.kN/m}{x-m}$$

$$w = \left[\frac{16\,kN}{12}\right] kN/m$$

Summation $Fy = 0$

$-V_{aa} - P_1 + 32kN$

$-V_{aa} - \frac{16n^2}{24} + 32$

$V_{aa} = 32 - 16n^2/24$ - Eq ①

at $x = 0$ Eq ① $= 32$.

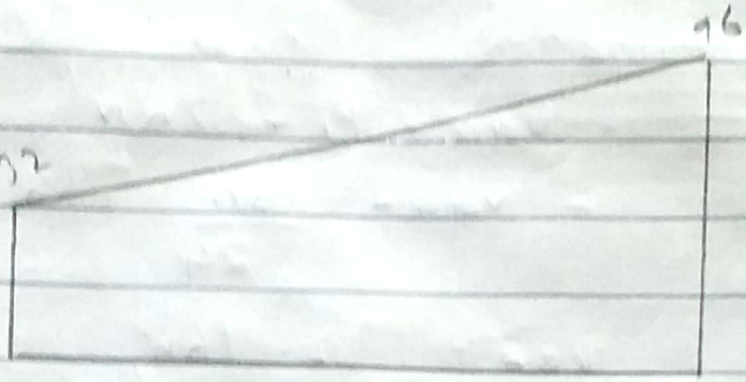
At $x = 12$ Eq ① $= 96$.

the point at which shear force are negative

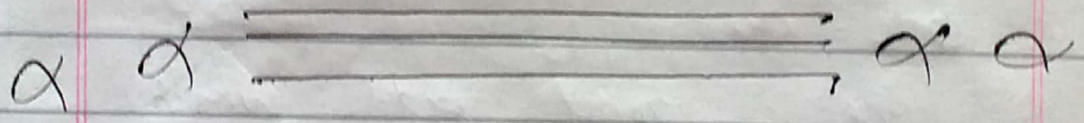
$0 = 16n^2/12 + 32 = 16n^2/24 = 32$.

$\sqrt{n^2} = \sqrt{\frac{32 \times 24}{16}}$ $n = \sqrt{48}$

$n = 6.92$

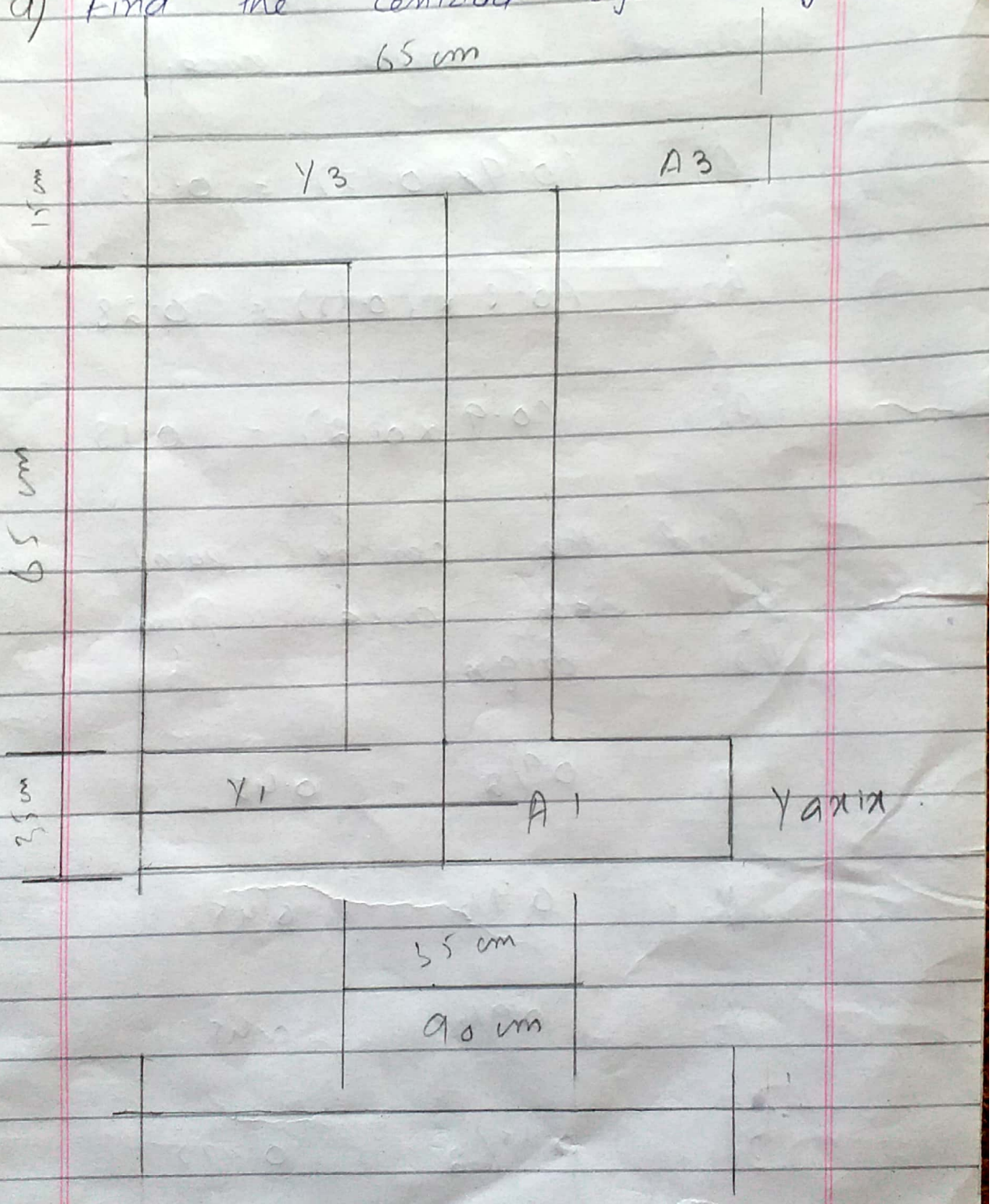


Hence the shear force as positive.



⇒ {Answer :- 04 3}

a) Find the centroid of the given



First we have to established the cordinate system. Divide the composite area into different simple area.

$A_1 = (0.9 * 0.35) = 0.315$

$A_2 = (0.8 \times (0.35) = 0.28$

$A_3 = (0.9 \times 0.2) = 0.18$

Find the centre point of each area from the origin.

$Y_1 = 0.9/2 = 0.45$

$Y_2 = 0.9/2 = 0.45$

$Y_3 = 0.9/3 = 0.45$

$Z_1 = 0.35/2 = 0.175$

$Z_2 = 0.35 + (0.65/2) = 0.675$

$$z_3 = 0.35 + 0.65 + \left(0.15/_{2}\right) = 1.075$$

$$y_c = \frac{A_1 y_1 + A_2 y_2 + A_3 y_3}{A_1 + A_2 + A_3}$$

$$y_c = \frac{(0.315 \times 0.45) + (0.28 \times 0.45) + (0.18 \times 0.45)}{0.315 + 0.28 + 0.18}$$

$$y_c = \frac{0.14175 + 0.126 + 0.081}{0.775}$$

$$y_c = 0.34875 /_{0.775}$$

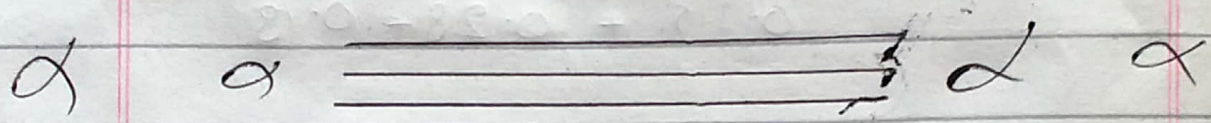
$$y_c = 0.45\,m$$

$$z_c = \frac{A_1 z_1 + A_2 z_2 + A_3 z_3}{A_1 + A_2 + A_3}$$

$$z_c = \frac{(0.315 \times 0.175) + (0.28 \times 0.675) + (0.18 \times 1.675)}{0.315 + 0.28 + 0.18}$$

$$Z_c = \frac{0.055125 + 0.189 + 0.1935}{0.775}$$

$$Z_c = 0.56m$$



⇒ Answer: 05:

⇒ Work:

The application of a force through certain distance is known as work.

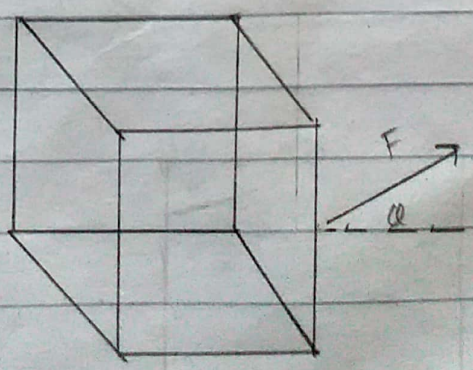
It can be measured in Joules (J).

- Mathematically form:

$$W = F \cdot d$$

⇒ Work done by a force at an angle θ:

The same box is now dragged by a rope, which is raised at an angle θ to the horizontal.

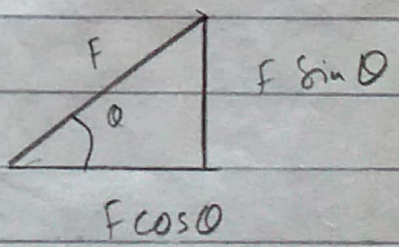


This time, the box moves in a different direction to the direction of the applied force. How does this affect the work done? Can you think any suggestions?.

⇒ Calculating work done at an angle θ:-

When calculating the work done by a force acting at an angle, it is use full to break the force into components.

The tension in the rope can be broken down into a horizontal and a vertical component.



So to calculate work done by a force at an angle:
work done = Force in direction of movement x distance covered

$$W = F \cos\theta.$$

⇒ Example :- 01:-

A box is pushed accosss a floor by a constant force of 100N. What is the work done by the force to move the box 5m?

Sol:-

F = 100N

S = 5m

Required

W = ?

as we know that

$$W = FS$$

$$W = 100 \times 5$$

$$W = 500J.$$

⇒ Example :- 02:-

A toy car is pulled along by a piece of

string is at 30° to the horizontal. Calculate the work done is pulling the toy if the tension in the string is 10N. and it is pulled along 5m.

Sol:- F = 10N

S = 5M

θ = 30°

Req:

W = ?

W = F S Cos θ

W = 10N × 5m × Cos 30°

{W = 43.3 J}.

⇒ Energy:

Energy is the measures of the ability of an object or a system to perform work. The Unit of Energy is Joule. It is denoted by J.

⇒ Types of Energy: There are many types of Energy:

- Kinetic energy: Energy of an object due to its speed.
- Gravitational Potential energy: Energy of an object due to position in a gravitational field.
- Elastic Potential Energy: Energy stored when an object is streched or compressed.
- Chemical energy: Energy stored in a chemical bonds.
- Nuclear Energy: Energy stored in nuclei.

- **Heat Energy:-**
  Hot things have more energy than their cold counterparts.

⇒ **Energy Transfer:-**
When work is done, energy is transferred, That energy might be:

- **Gravitational Potential energy:-**
  When an objects changes height with in a gravitational field.

- **Kinetic energy:-**
  when an object changes speed.

- **Light energy:-**
  when a light bulb is switch switch on.

- **Heat and Sound:-**
  when a

brakes sharply.

⇒ Conservation of Energy:

Energy can't be created, or destroyed but it can only be changed from one form to another form.

⇒ Power:-

Power is the rate at which work is done, or the rate at which energy is transferred.

⇒ Mathematically:-

$$P = w/t$$

Power is measured in watts. The work done or energy is transferred is measured in Joules. While the time is measured in seconds. (s).

⇒ Example:

A crane lifts a load of 1500kg to a height of a 25m at a steady rate. In a time of 2 min. What is the power of the crane.

Sol: $P = W/t$

$P = 367875/120$

$P = 3066\ W$

$\therefore W$ = energy = ΔE_p

$\Delta E_p = mg\Delta h$

$= 1500 \times 9.8 \times 25$

$= W = 367875\ J$

The End