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Dpt = Bsc

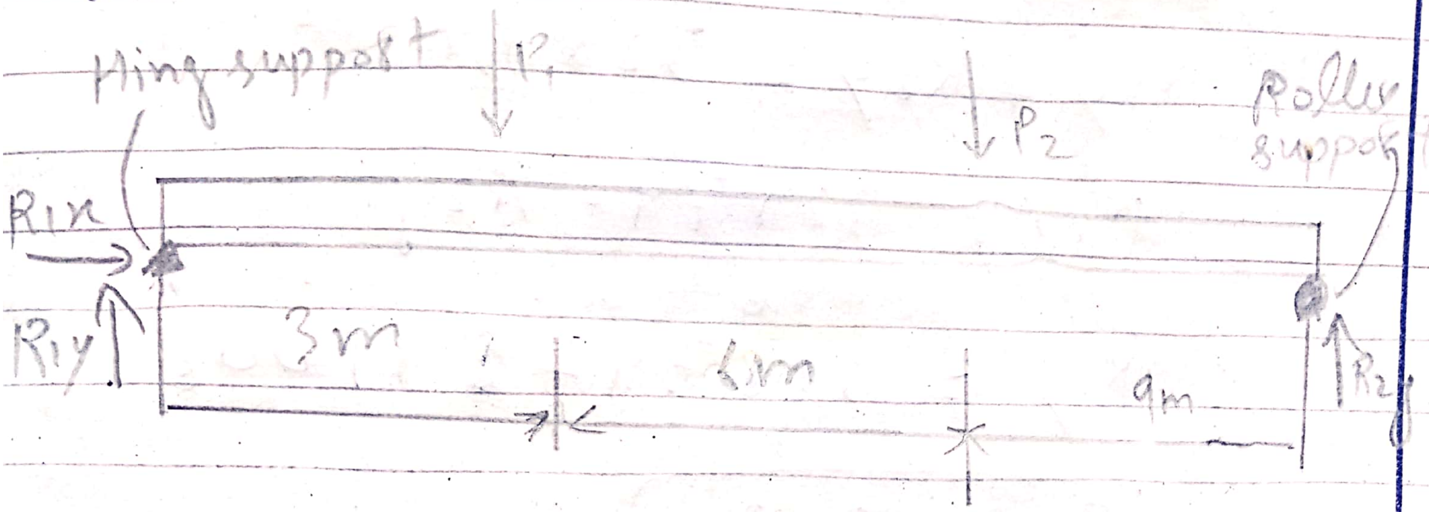
Section = A

Paper = Engineering mechanics.

Submittid to = Sir majid.

Q No 1

Ans :-



$P_1 = 200 + \text{student ID No} =$

$200 + 16087 = 16,287$ KN

$P_2 = 500 + \text{student ID No} =$

$500 + 16087 = 16587$ KN.

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

$R_1y + R_2y - P_1 - P_2 = 0 \qquad \Sigma F_y = 0$

$R_1y + R_2y - 16287 - 16587 =$

$R_1y + R_2y = 32874$ — Eq ①

$(12 \times R_2y) - (16587 \times 9) - (16287 \times 3) = 0$ Eq ③

$R_2y = \dfrac{(16587 \times 9) + (16287 \times 3)}{18} =$

149283 + 48861

$R_{2y} = 11{,}008\,KN$

$R_{1y} + R_{2y} = 32874$

$R_{1y} = 32874 - R_{2y}$

$R_{1y} = 32874 - 11008$

$R_{1y} = 21866\,KN.$

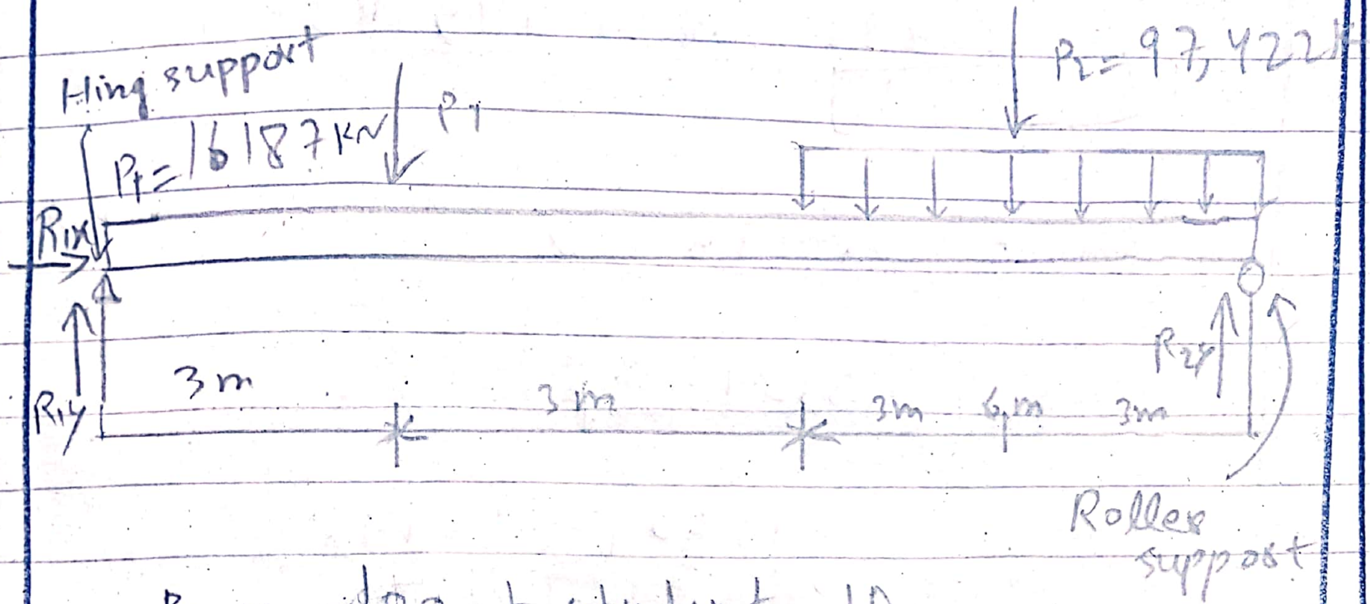
$R_{1x} = 0\,KN$

$R_{1y} = 21888\,KN$

$R_{2y} = 11008\,KN$

Q No 2:-

Ansr



$P_1 = 100 + \text{student ID}$

$P_1 = 100 + 16087 = 16187$

$UDL = 150 + \text{student ID} =$

$150 + 16087 = 16237$

UDL Resultant $= (16237 \text{ KN/m} * 6\text{m})$

$= 97,422$ kN

$R_{1x} = 0$ summation $F_x = 0$

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

$R_{1y} + R_{2y} - 16187 - 97,422 = 0$

$R_{1y} + R_{2y} = 113,609$

$R_{1y} = \cancel{16187} \times$

$$R_{1y} = \frac{(97422 \times 3) + (16187 \times 9)}{12}$$

$$R_{1y} = \frac{292,266 + 145.683}{12}$$

$R_{1y} = 36496$ kN

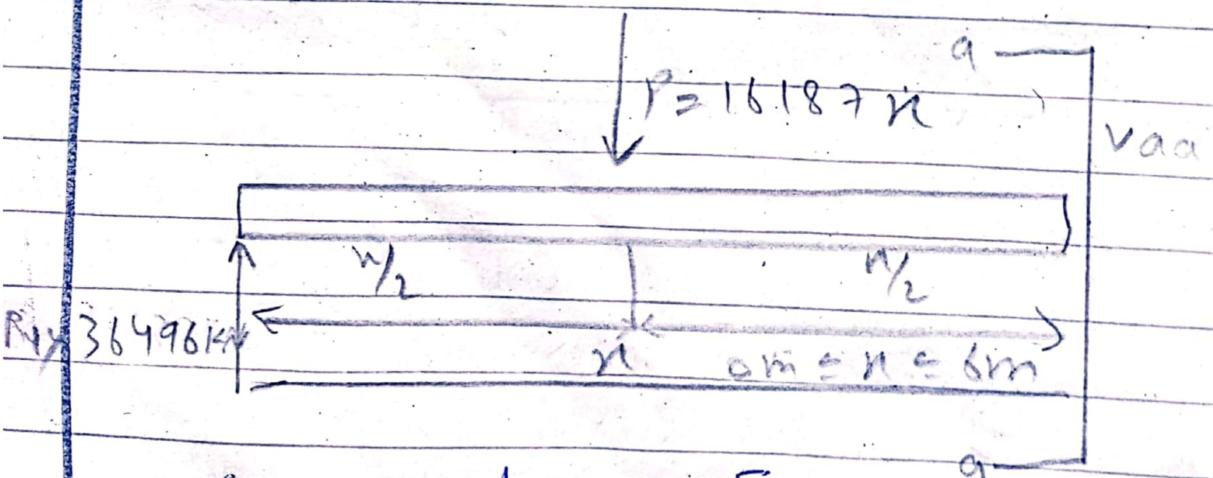
$R_{2y} = 113609 - R_{1y}$

$R_{2y} = 113609 - 36496$

$R_{2y} = 77,113$ kN

$R_{1x} = 0$ kN $\quad R_{1y} = 36496$ kN

$R_{2y} = 77,113$ kN



summation $F_y = 0$

$-V_{aa} - P + 36496$ kN

$V_{aa} = 36496 - 16187x$ — eq (1)

at $x = 3 = -12,065$ Eq (1)

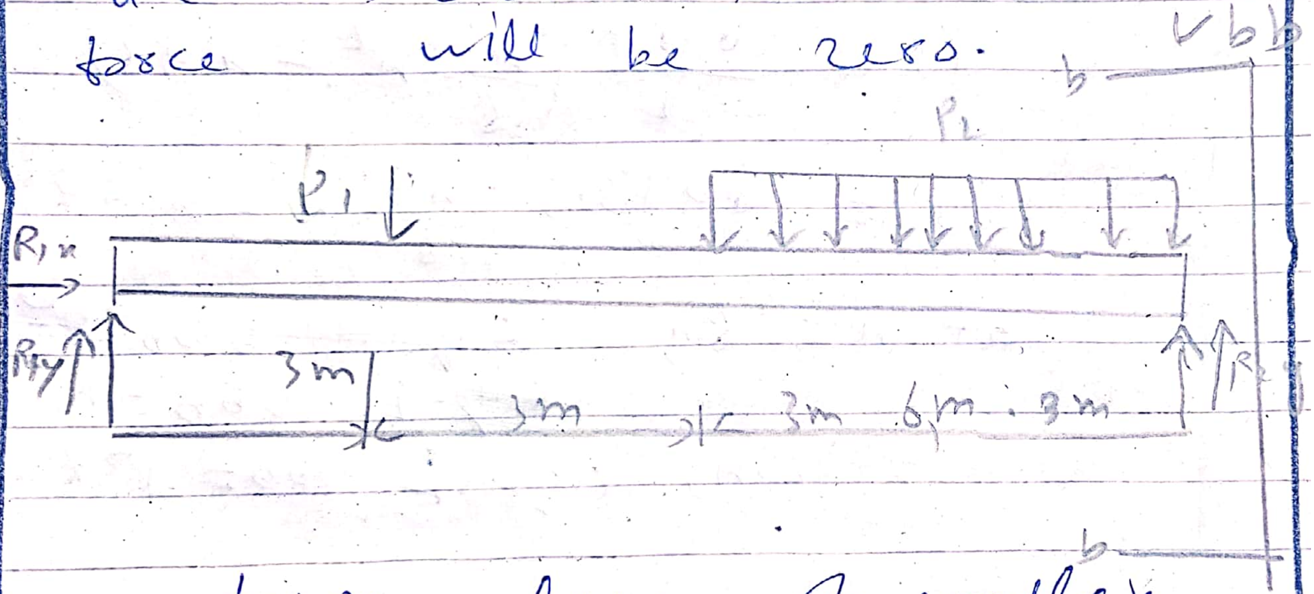
To find the location of shear force put eq - 1 equal to zero

$0 = 36496 - 16187x$

$x = \frac{36496}{16187}$

$x = 2.25\,m$

at $x = 2.25\,m$ the shear force will be zero.



from law of similar triangle

~~w_0 KN/m~~

$\frac{16187\,x}{6\,m} = \frac{w_0\,KN/m}{(x-6)\,m}$

$6\,w_0\,KN = 16187x(x-6)$

$6\,w_0 = 16187x^2 - 97,122$

$w_0 = \frac{16187x^2}{6} - 16187$

$w_o = 16187\left(\frac{x^2}{6} - 1\right)$

To find vbb find P_3.

$P_3 = [w^\circ(x-6)]/2$

$P_3 = 16187\left(\frac{x^2}{6} - 1\right)(x-6)/2$

$P_3 = 16187\left(\frac{x^3}{6} - x^2 - x + 6\right)/2$

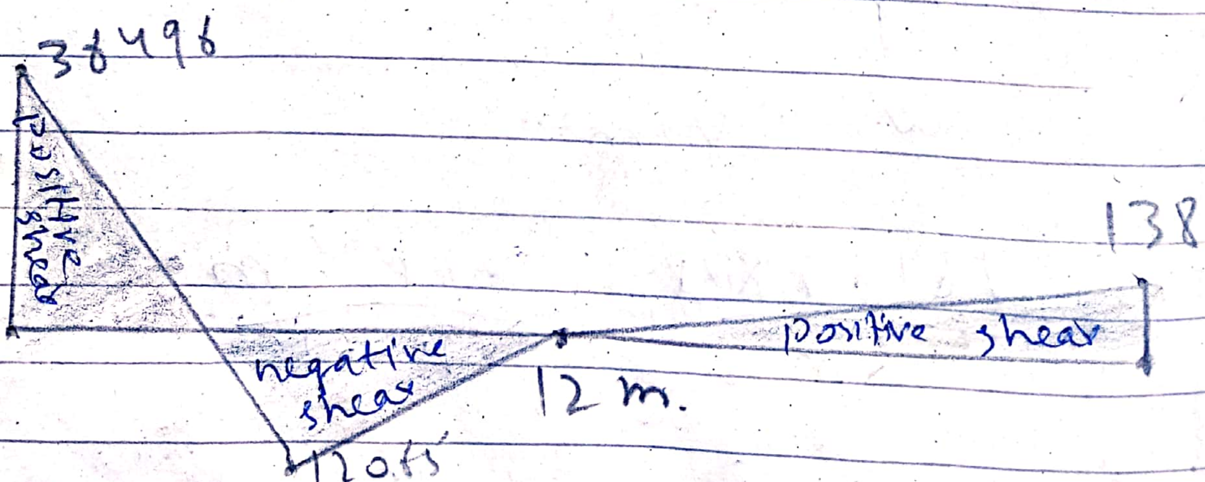
$P_3 = \frac{16187}{2}\left[\frac{x^3}{6} - x^2 - x + 6\right)$

$P_3 = 8093.5\left(\frac{x^3}{6} - x^2 - x + 8\right)$

at $x = 6m$, ~~eq-1 vbb = 8063.5~~ 0

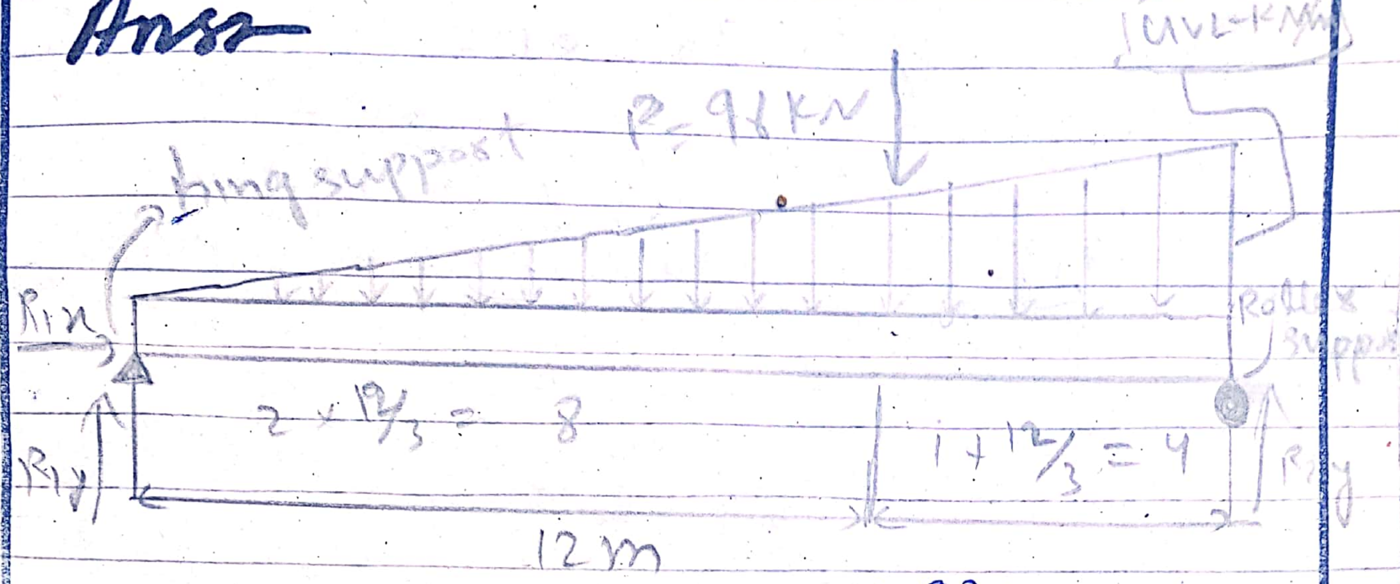
eq-1 vbb = 0

at $x = 12m$, eq-1, vbb = 138



QNo 3

Ans:



UVL = (Student ID/1000) = 16087/1000 = 16.087

UVL Resultant = $\frac{(16 \text{ kN/m} \times 12\text{m})}{2}$

UVL = 96 KN.

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

$R_1x = 0$ — Eq.1 $\Sigma f_x = 0$

$R_1y + R_2y - 96 \text{ KN} = 0$ — Eq 2

$(R_2y \times 12) - (96 \times 8) = 0$ Eq 3

$(12 \times R_2y) = (96 \times 8)$

$R_2y = \frac{96 \times 8}{12} = 64 \text{ kN}$

$R_1y + R_2y = 96 \text{ kN}$

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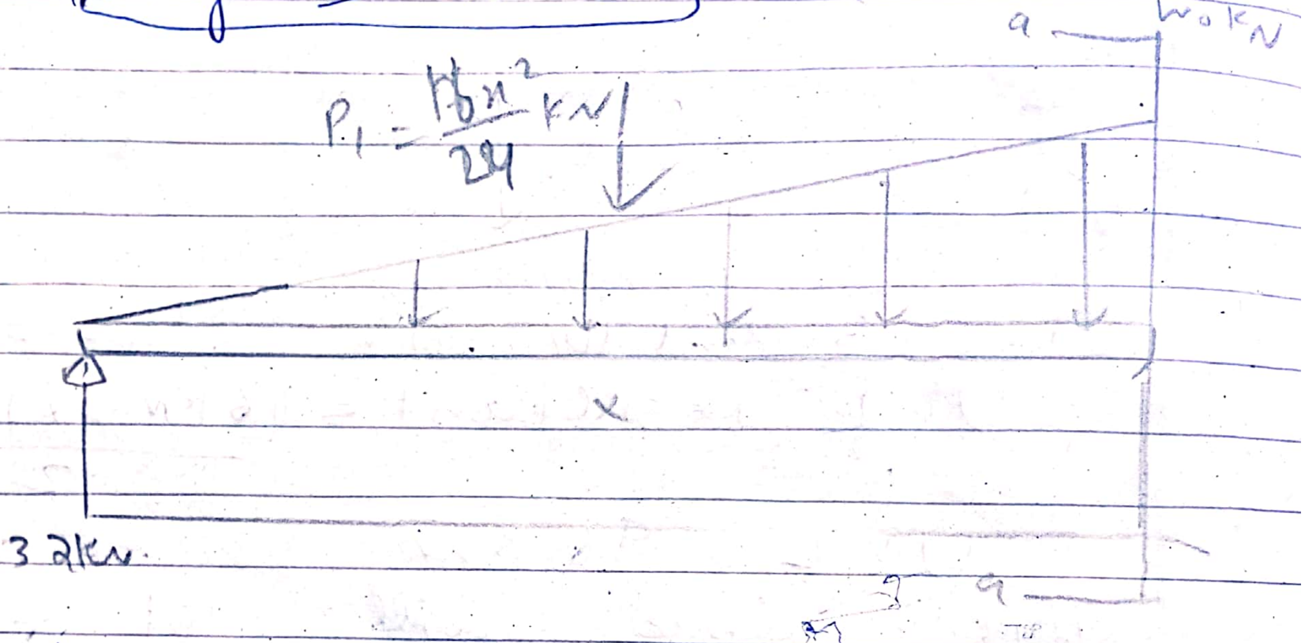
$R_{1y} = 96 - R_{2y}$

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

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

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



from law of similar triangle

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

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

Summation $F_y = 0$

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

$-V_{aa} - \frac{16x^2}{24} + 32 = 0$

$V_{aa} = 32 - \frac{16x^2}{24}$ — Eq (1)

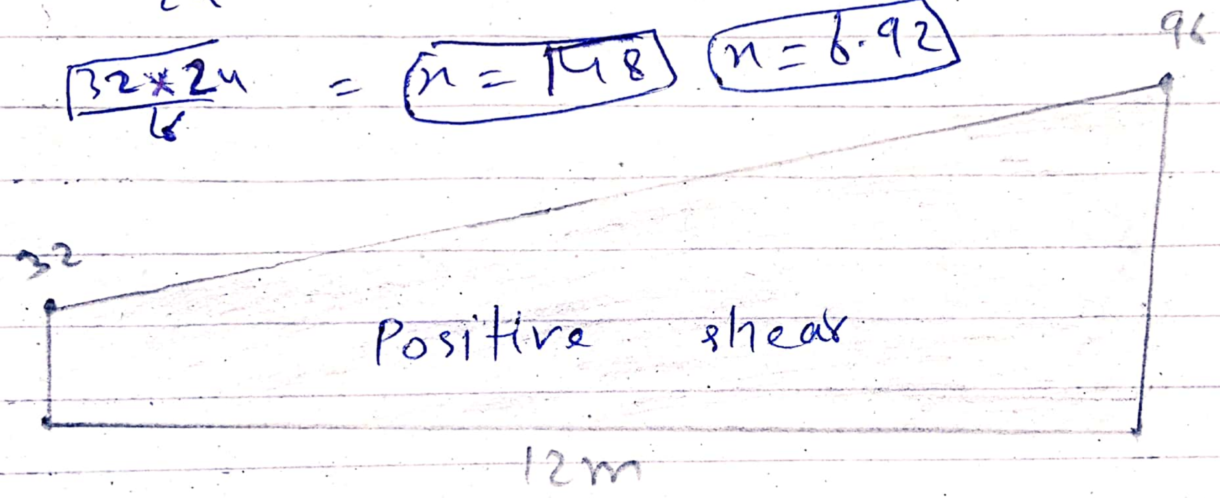
At $x = 0$ Eq① $= 32$

At $x = 12$ Eq(1) $= 96$

the point atn which shear force negative.

$0 = \frac{16x^2}{24} + 32 = \frac{16x^2}{24} = 32$

$x^2 = \frac{32 * 24}{16} = x = \sqrt{48}$ $x = 6.92$

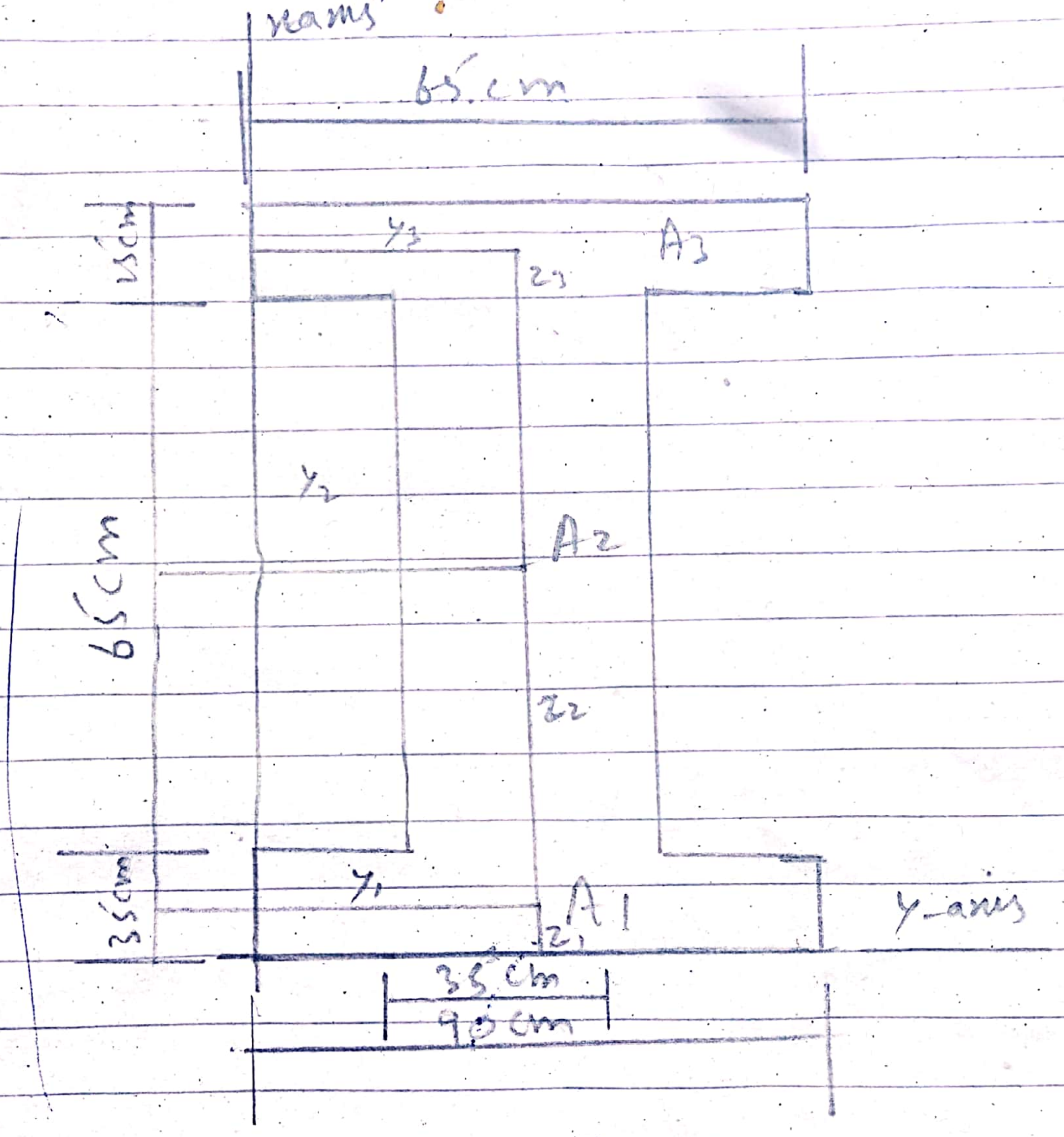


Hence the shear force is positive.

Q No 4

Ans (A) :-

Find the centroid of the given shape.



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

$A_1 = (0.9 + 0.35) = 0.315$

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

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

Find the centre ~~area~~ point of each area from the origin

$y_1 = 0.9/2 = 0.45$

$y_2 = 0.9/2 = 0.45$

$y_3 = 0.9/2 = 0.45$

$z_1 = 0.35/2 = 0.175$

$z_2 = 0.35 + (0.65/2) = 0.675$

$z_3 = 0.35 + 0.65 + (0.15/2) = 1.075$

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

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

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

$$y_c = \frac{0.34875}{0.621}$$

$y_c = 0.45$ ~~m~~ m

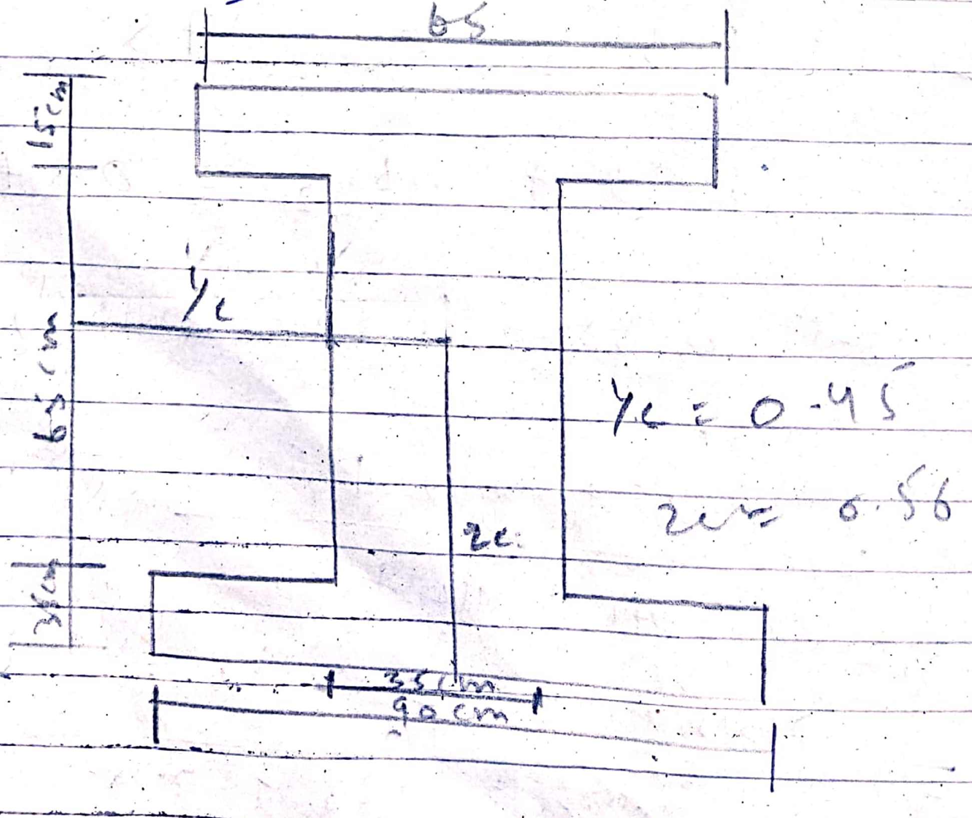
$y_c = 0.45$ m

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

$$z_c = \frac{(0.315 \times 0.175) + (0.28 \times 0.675) + (0.18 \times 1.075)}{(0.315 + 0.28 + 0.18)}$$

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

$z_c = 0.56$ m



Q No 5

Ans:-

Work:-

The application of a force through certain distance is known as work. It is measured in Joules.

work = Force x Distance travelled in direction of force

$$W = F \cdot d$$

If a person gave 600N force to a weight of 100kg then the distance travel by weight in a direction of force is called work. Such as W is the workdone (J). F is the force applied (N) and d is the distance (m).

Work examples

A box is pushed across a floor by a constant force of 100N then the workdone by the force to move the box 5m

$w = f.s$

$w = 100 \times 5 \Rightarrow 500J$

then the workdone is 500J.

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. when calculating the work done by a force at an angle It is useful to break the force ~~broken~~ into components. The tension in the rope can be broken down into a horizontal and a vertical component. The vertical component does not work because the box does not move in that direction so to calculate work done by a force at an angle workdone = force in direction of movement × distance moved

$w = Fs\cos\theta$

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A toy car is pulled along by a piece of string which is at 30° to the horizontal. ~~Then~~ If the tension in the string is 10 N and it is pulled along 5m then the work done is $Fs\cos\theta$.

$w = 10 \times 5 \times \cos(30) \Rightarrow 43.3 J$

Energy :-

Energy is the measure of the ability of an object or a system to perform work. Its unit is Joule and is denoted by J.

There are many types of energy such as.

- Kinetic energy
- elastic energy.
- Nuclear energy.
- Gravitational energy
- chemical energy.

1 Joule is the MKS unit of energy equal to the force of one Newton acting through one meter.

1 Joule(J) = 1 N.m.

- **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 stretched or compressed.

- **chemical energy-**

Energy stored in chemical bonds.

- **Nuclear energy-**

Energy stored in nuclei.

- **Heat energy-**

Hot energy have more

energy than their cold counter-parts.

Energy transferr

When work is done energy is transferred. that energy might be.

- gravitational energy-
e.g when an objects changes height with in a gravitational field.
- Kinetic energy: e.g when an object changes speed.
- light energy e.g when light bulb is switched on.
- heat and sound - when a car brakes sharply.

conservation of energy:

The law of conservation of energy states that ~~energy~~

Energy cannot be created nor destroyed. It can ~~be~~ only be changed from one form into another form.

In other words the total energy of a system remain constant.

Examples

When a man jumpers, the gravitional potential energy is changed into kinetic energy as he comes down, and then stored as elastic potential energy as the rope stretches. It also includes watching television, washing clothes heating and lighting the home, ~~talki~~ taking a shower, working from home on your laptop or computer running appliances and cooking. etc. Burning a wooden match releases about one Btu or 1055 Joules

P.T.O.

(a match is about 0.3g).
So this is > 3000 J/g
nearly 1 cal/g.
Burning coals releases about 20 kJ per gram of chemical energy or roughly 5 cal/g.
Burning gasoline yields about 39 kJ per gram or just over 9 cal/g.

Power:-
Power is the rate at which work is done or the rate at which energy is transferred.
power = workdone / time taken

$$P = W/t$$

where
Power is measured in watts (W)
~~workdone~~ workdone or energy transferred is measured in joules (J)
time is measured in second.

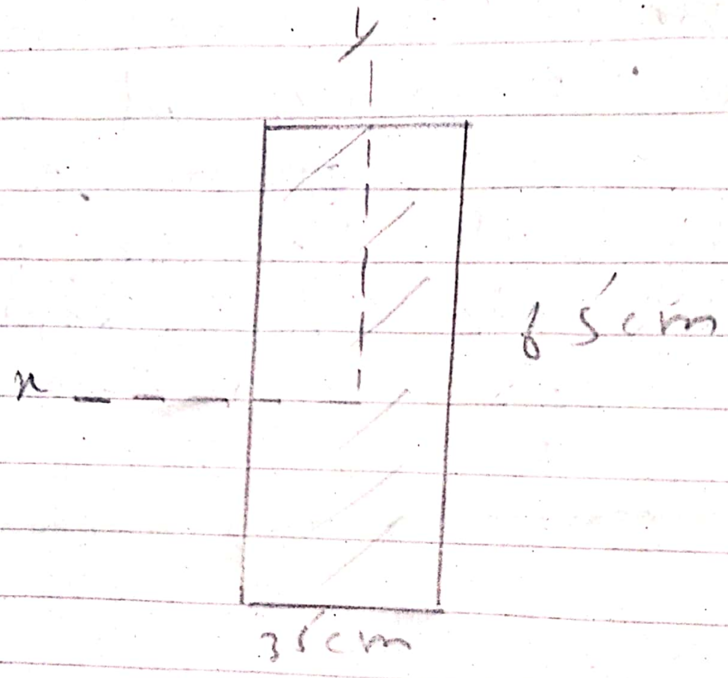
Examples:-
The power rating

Indicates the rate at which that machine can do work upon other objects. Thus, the power of a machine is the work/time ratio for that particular machine. A car engine is an example of a machine that is given a power rating. the power rating relates to how rapidly the car can accelerate car.

Q NO 4

ANS:- (b)

Movement inertia for (65cm x 35cm)



$$I = \frac{bh^3}{12} = \frac{(35)(65)^3}{12}$$

$$I = 800,989.58\ cm^4$$

Redius of gyration:-

$$r_x = \frac{h}{\sqrt{12}} = \frac{65}{\sqrt{12}} = 18.76cm$$

$$r_y = \frac{b}{\sqrt{12}} \quad \frac{35}{\sqrt{12}} = 10.1cm$$

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$$r_x = \frac{h}{\sqrt{3}} = \frac{65}{\sqrt{3}} = 37.5 \text{ cm}$$

Section modulus:-

$$S = \frac{bh^2}{6}$$

$$S = \frac{35 \times 65^2}{6}$$

$$S = 24645.83 \text{ cm}^3$$