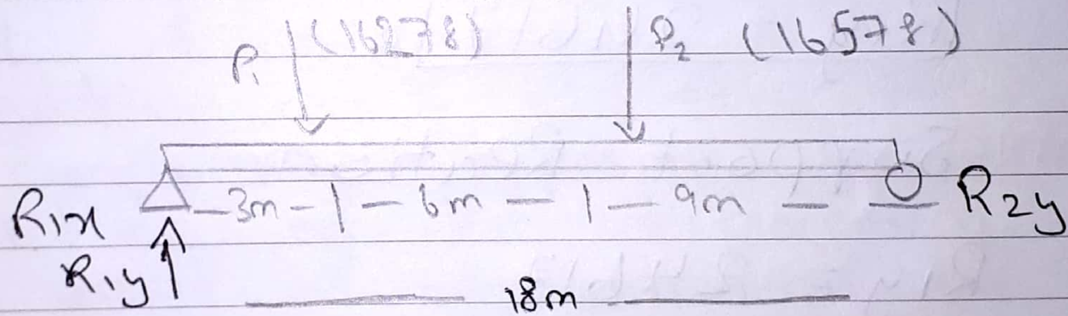
Final Term.

Date:

Name : Muhammad Fahad
Section : A
ID : 16078
Teacher : Majid naeem
Subject : Engineering Mechanics
Department : BSc Civil Engr
semester 2nd

Q1) Find the support reactions, show all your calculation.
$(P_1 = 200 + 16078)\ (P_2 = 500 + 16078)$



Solr

Find all the support reactions.

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

$R_{1y} + R_{2y} - 16278 - 16578 = 0 \rightarrow (i) \quad \Sigma F_y = 0$

$(R_{2y} \times 18) - (16278 \times 3) - (16578 \times 6) = 0$

$18R_{2y} - 48834 - 99468 = 0$

Scanned with CamScanner

$18R_{2y} - 148302 = 0$

$$\frac{18R_{2y}}{18} = \frac{148302}{18}$$

$\boxed{R_{2y} = 8239}$ put in ①

$R_{1y} + 8239 - 16278 - 16578 = 0$

$R_{1y} - 24617 = 0$

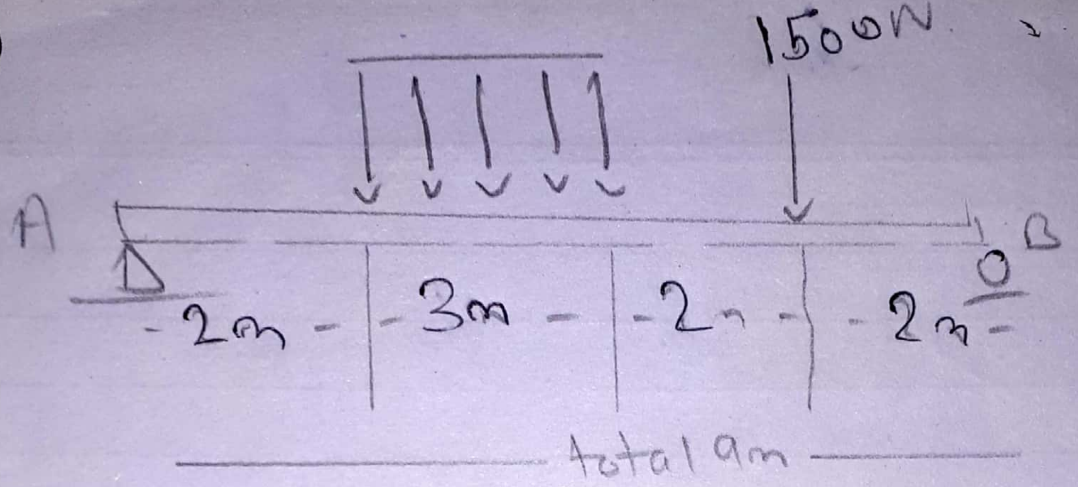
$\boxed{R_{1y} = 24617}$

Support Reation

$R_{1y} = 24617$

$R_{2y} = 8239$

Q2)



Soln

Resultant $P = (800 \times 3) = 2400$ at (3.5) from A

$R_{1x} = 0$

$R_{1y} + R_{2y} - 2400 - 1500 = 0 \rightarrow (1)$

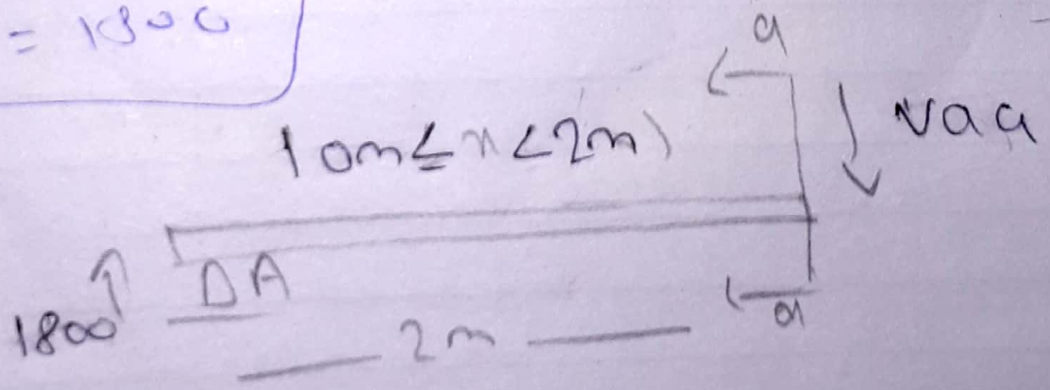
$(R_{2y} \times 9) - (2400 \times 3.5) - (1500 \times 7) = 0$

$\frac{\cancel{9} R_{2y}}{\cancel{9}} = \frac{18900}{9}$

$\boxed{R_{2y} = 2100}$ put in (1)

$R_{1y} + 2100 - 2400 - 1500 = 0$

$\boxed{R_{1y} = 1800}$

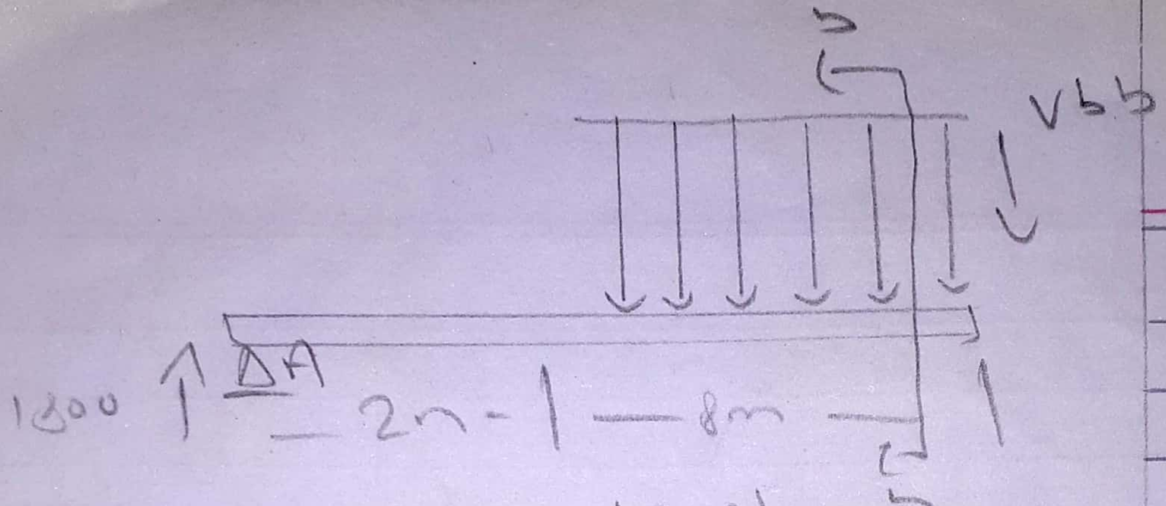


$-V_{aa} + 1800 = 0$

$V_{aa} = 1800 \rightarrow (1)$

at $x = 0$ $V_{aa} = +1800$

$x = 2$ $V_{aa} = + 1800$



$P = 800(x-2) = 800x - 1600$

$-Vbb - 800x + 1600 + 1800 = 0$

$Vbb = 3400 - 800x \quad -(2)$

at $x = 2m$, $Vbb = +1800$

$x = 5m$, $Vbb = -600$

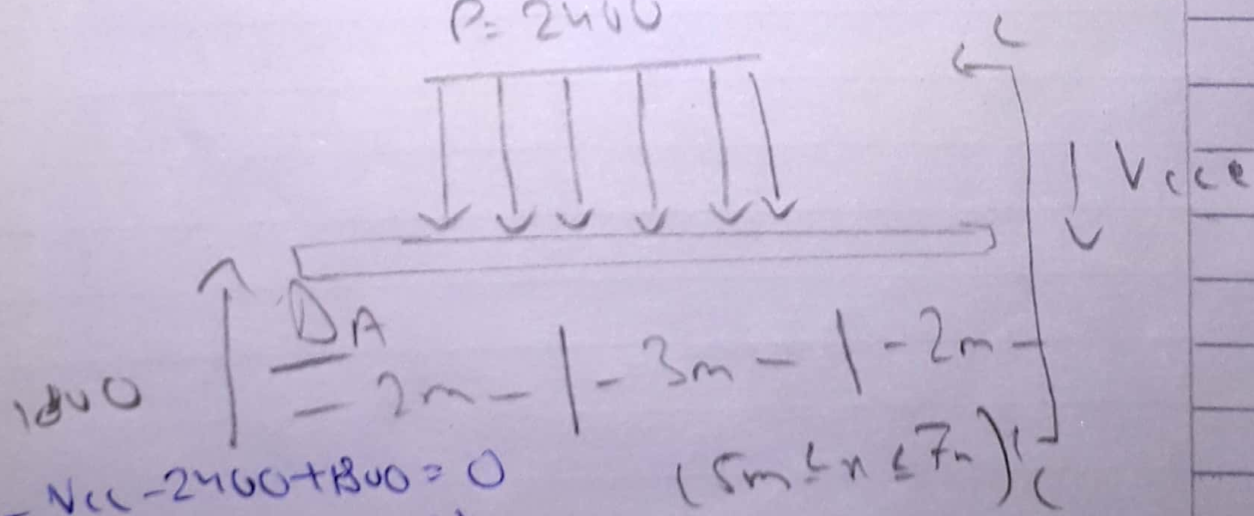
eq (2) = 0 to find zero shear

$0 = 3400 - 800x$.

$\frac{\cancel{800}x}{\cancel{800}} = \frac{3400}{800}$

$\boxed{x = 4.25\ mm}$ at this point $Vbb = 0$

$P = 2400$



$-Vcc - 2400 + 1800 = 0$

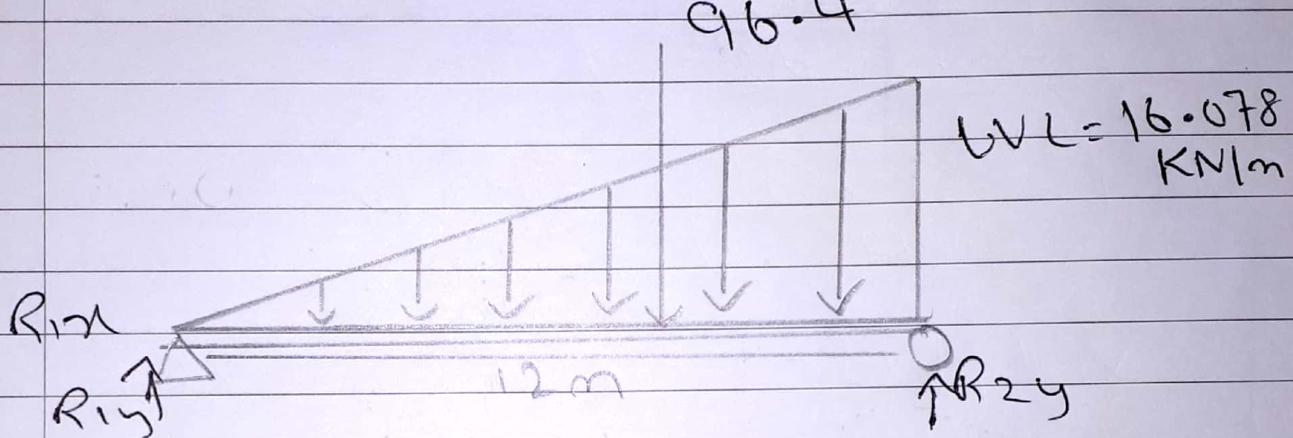
$Vcc = -600 \quad (3)$

at $x = 5m$, $Vcc = -600$

$x = 7m$, $Vcc = -600$

Date:

Q3) Draw neat shear force diagram and bending moment diagram. Show all calculation.



Solv

Resultant for UVL

$$P = \frac{(16.078 \times 12)}{2} = 96.4 \text{ KN/m}$$

$$\text{distance from low side} = \left(\frac{2}{3} \times 12\right) = 8 \text{ m}$$

$$\text{distance from high side} = \left(\frac{1}{3} \times 12\right) = 4 \text{ m}$$

$$R_1x = 0.$$

$$R_1y + R_2y - 96.4 = 0 \longrightarrow (1)$$

$$(R_2y \times 12) - 96.4 = 0$$

$$\frac{\cancel{12} R_2y}{\cancel{12}} = \frac{96.4}{12}$$

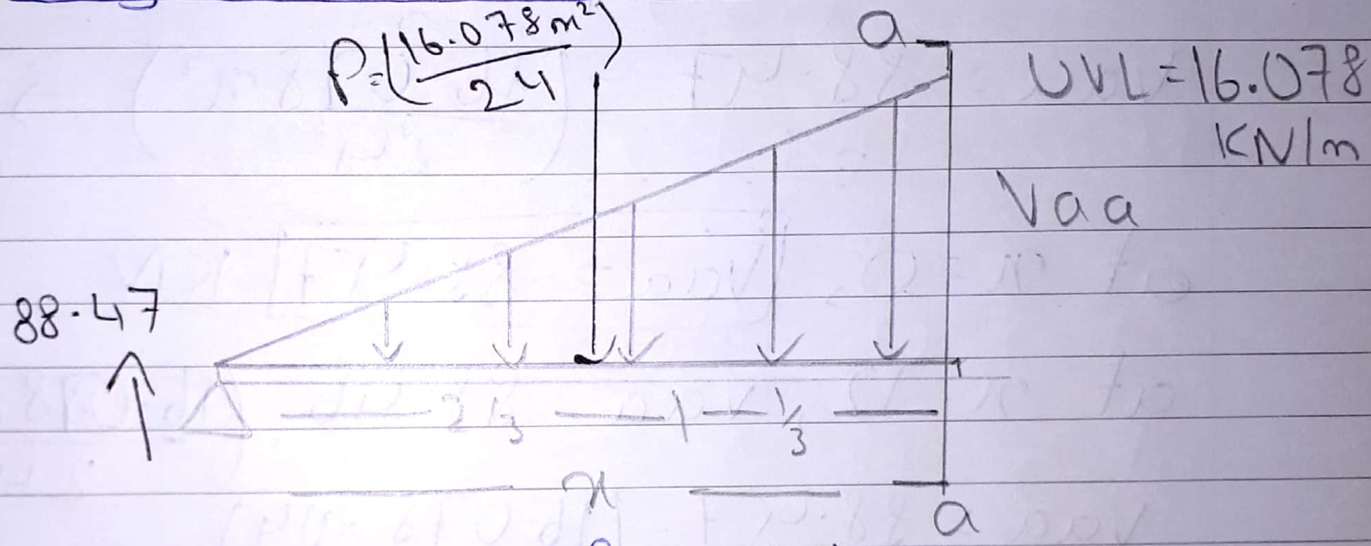
Scanned with CamScanner

Date:

$\boxed{R_{2y} = 8.03}$ put in (1)

$R_{1y} + 8.03 - 96.4 = 0.$

$\boxed{R_{1y} = \cancel{88.47}\ 88.47\ KN}$



From law of similar triangles

$$\frac{16.078}{12} = \frac{W_0\ KN/m}{x}$$

$$W_0 = \left[\frac{16.078x}{12}\right] KN/m$$

Resultant $P = [W_0 \times x]/2$

$$P = \frac{16.078x^2}{24}$$

Now

Date:

$$-V_{aa} - \left(\frac{16.078\,x^2}{24}\right) + 88.47 = 0$$

$$V_{aa} = 88.47 - \left(\frac{16.078\,x^2}{24}\right) \rightarrow (1)$$

at $x = 0$, $\boxed{V_{aa} = 88.47}$ KN

at $x = 12$, $V_{aa} = 88.46 - \left(\frac{16.078 \times (12)^2}{24}\right)$

$$V_{aa} = 88.47 - \left(\frac{16.078 \times 144}{24}\right)$$

$\boxed{V_{aa} = -8.00}$ KN

To find at which point shear = 0

eq (i) = 0

$$0 = 88.47 - \left(\frac{16.078\,x^2}{24}\right)$$

$$\frac{16.078\,x^2}{24} = 88.47$$

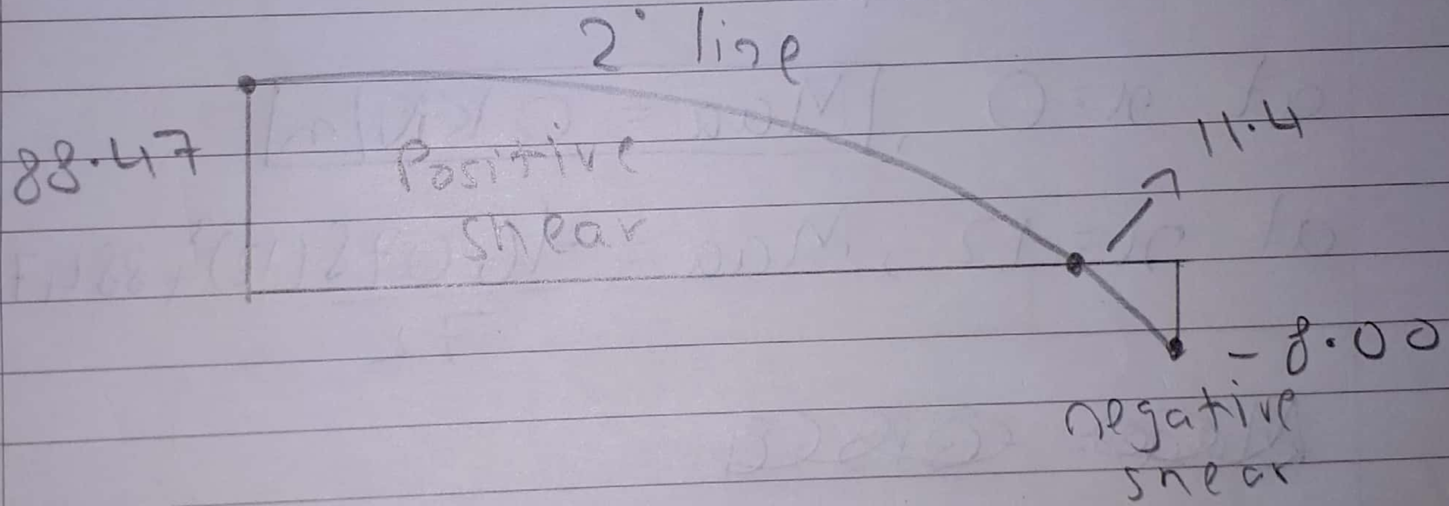
Date:

$$x^2 = \frac{2123.04}{16.078}$$

$$\sqrt{x^2} = \sqrt{132.046}$$

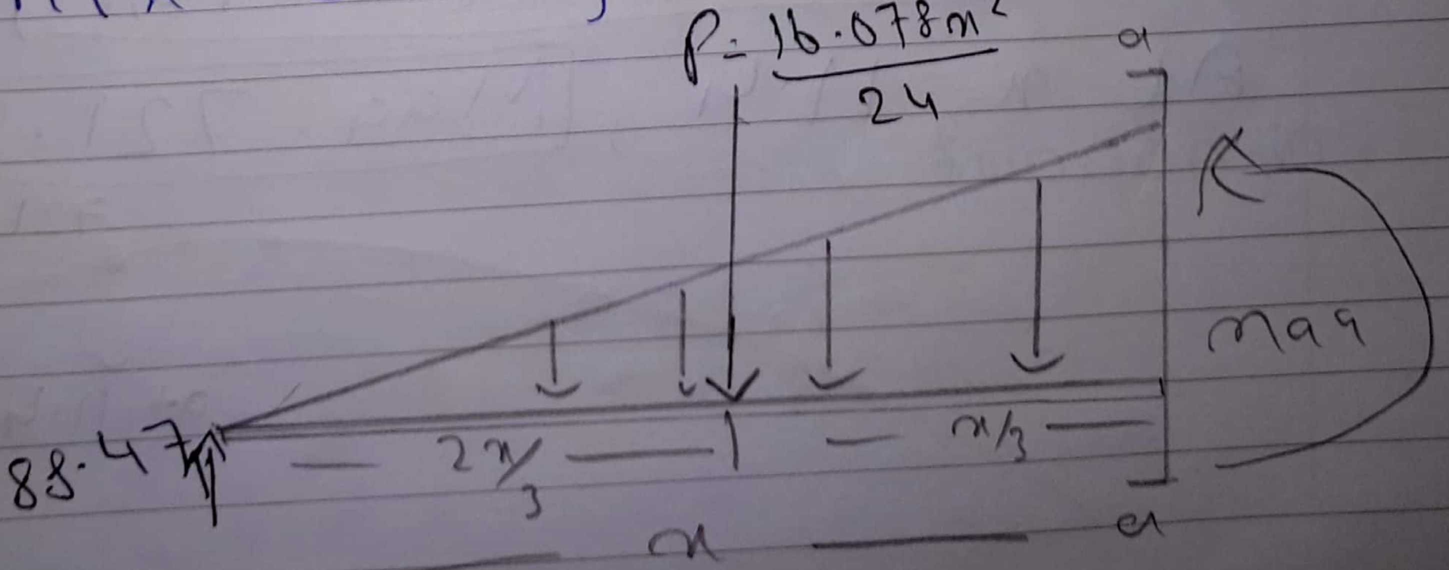
$\boxed{x = 11.4}$ at this point Vaa=0

Shear force diagram



Now for bending moments.

$R_{1x} = 0$ $R_{1y} = 88.47$ $R_{2y} = 8.00$



$$Maa + P(x/3) - 88.47x = 0.$$

$$Maa = -\left(\frac{x}{3}\right) P + 88.47x$$

$$Maa = -\left(\frac{x}{3}\right)\left(\frac{16.078x^2}{24}\right) + 88.47x$$

$$Maa = \frac{-16.078x^3}{72} + 88.47x \longrightarrow (1)$$

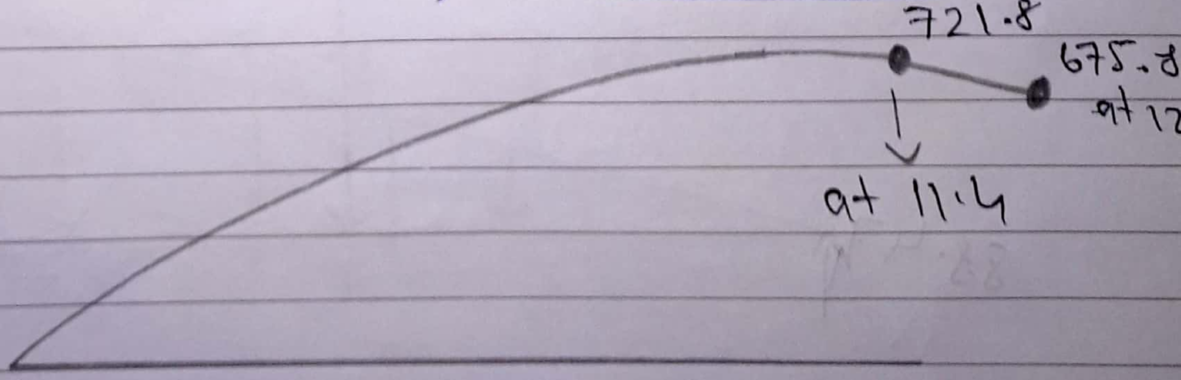
at $x = 0$, $\boxed{Maa = 0 \, KN/m}$

at $x = 12$, $Maa = \frac{-16.078(12)^3}{72} + 88.47(12)$

$$Maa = -385.8 + 1061.64$$

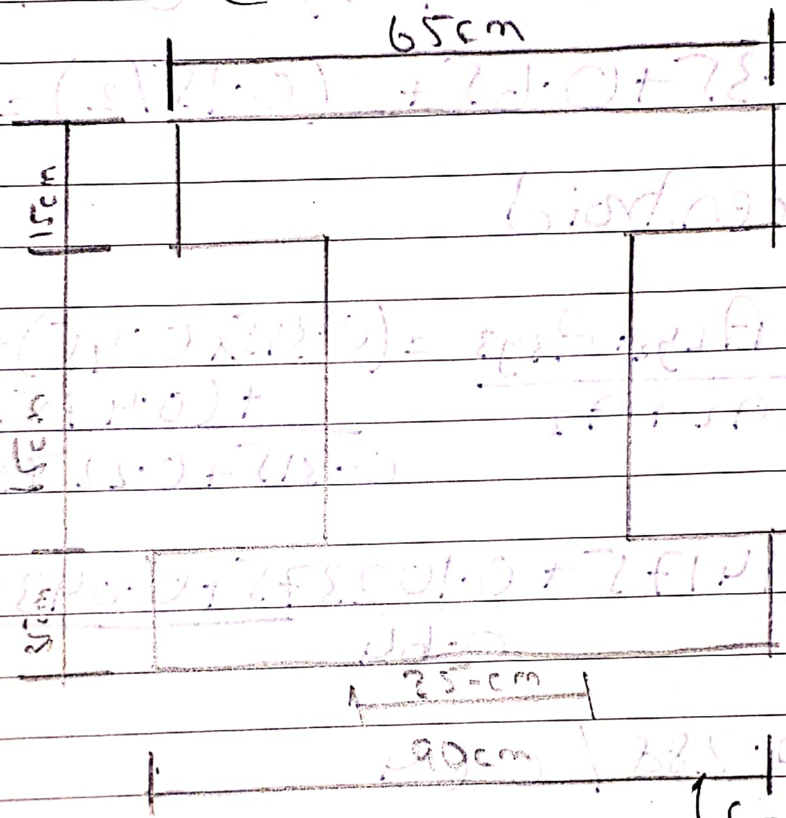
$$\boxed{Maa = 675.84 \, KN/m}$$

At $x = 11.4$, $\boxed{Maa = 721.9}$



Date:

(4) a) Find the centroid of the given shape, show all your calculations.



(Converted in meters)

Areas.

$A_1 = (0.9 \times 0.35) = 0.315\ m^2$

$A_2 = (0.35 \times 0.65) = 0.2275\ m^2$

$A_3 = (0.15 \times 0.65) = 0.0975\ m^2$

Now centre points from origin

$y_1 = 0.9/2 = 0.45\,m$

$y_2 = 0.9/2 = 0.45\,m$

$y_3 = 0.9/2 = 0.45\,m$

Scanned with CamScanner

Date:

$Z_1 = (0.35/2) = 0.175\ m$

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

$Z_3 = 0.35 + 0.65 + (0.15/2) = 1.075\ m$

Now centroid

$$yc = \frac{A_1y_1 + A_2y_2 + A_3y_3}{A_1 + A_2 + A_3} = \frac{(0.315 \times 0.45) + (0.2275 \times 0.45) + (0.975 \times 0.45)}{0.315 + 0.2275 + 0.0975}$$

$$yc = \frac{0.14175 + 0.102375 + 0.043875}{0.64}$$

$yc = 0.288 / 0.64$

$yc = 0.45\ m$

Now

$$Zc = \frac{A_1z_1 + A_2z_2 + A_3z_3}{A_1 + A_2 + A_3} =$$

$$\frac{(0.315 \times 0.175) + (0.2275 \times 0.675) + (0.975 \times 1.0)}{0.64}$$

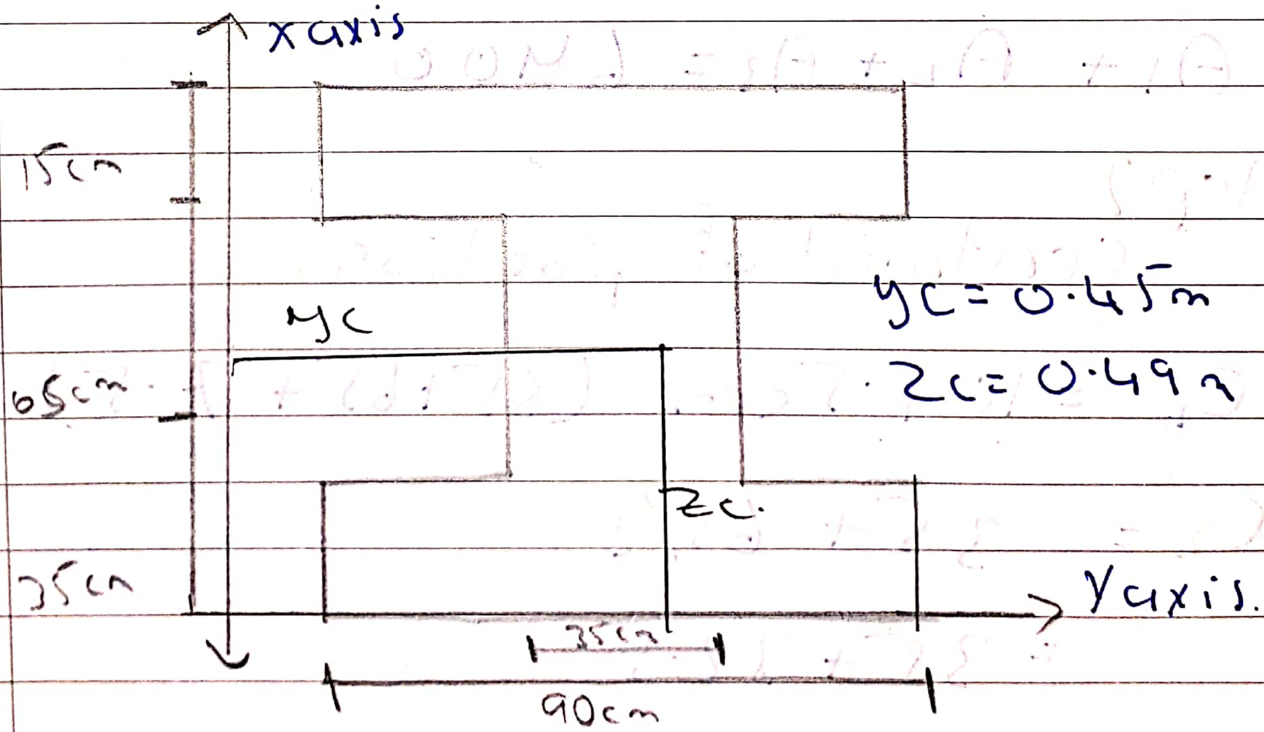
Scanned with CamScanner

Date:

$$Z_c = \frac{0.0551125 + 0.1535625 + 0.1048125}{0.64}$$

$$Z_c = 0.313/0.64$$

$$\boxed{Z_c = 0.49\ m}$$



$y_c = 0.45m$

$Z_c = 0.49m$

Date:

(4B) Areas.

area 1

$65 \times 15 = 975\ cm^2$

area 2.

$65 \times 35 = 2275\ cm^2$

area 3.

$35 \times 90 = 3150\ cm^2$

$A_1 + A_2 + A_3 = 6400$

step 2.

centroid of portions

$C_1 = 107.5\ cm\ (35 + 65 + 7.5)$

$C_2 = 35 + 65/2$

$= 35 + 32.5$

$= 67.5\ cm$

$C_3 = 35/2 = 17.5\ cm$

Step 3

Date:

Moment of areas

$M_1 = 975 \times 107.5$

$= 104812.5$

$M_2 = 2275 \times 67.5$

$= 153562.5$ cm

$M_3 = 17.5 \times 3150$

$55.125.$

Summation of moment of area

$M_1 + M_2 + M_3 = 313,500$

$$\bar{y} = \frac{\Sigma A'y'}{\Sigma A'}$$

$$= \frac{313,500}{6400}$$

$\bar{y} = 48.98.$ is centroid from x-axis.

Date:

Q5) Explain work, energy and power in details along with practical examples from daily life.

Work:-

The product of force and displacement. A force is said to do positive work if (when applied) the force has a component in the direction of the displacement of the point of application. A force does negative work if the force has a component opposite to the direction of the displacement at the point of application of the force.

For example

When a ball is held above the ground and then dropped, the work done by the gravitational force on the ball as it falls is equal to the weight of the ball (a force) multiplied by distance to the ground (displacement) s is θ, then the work done is given by

$$W = Fs\ \cos\theta$$

Scanned with CamScanner

Date:

Work transfer energy from one place to another or one form to another

SI Unit:

The SI Unit of work is the Joule (J). which is defined as the work expended by a force of one newton through a displacement of one meter.

Newton-meter (N·m) is sometime used as the measuring unit of work.

Mathematical Equation

Work is the result of force on a poin that follows a curve X with the velocity v, at each instant. The small amount of Work is calculated as

$$\delta W = F \cdot ds = F\ v dt$$

wher $F \cdot v$ is the power over instant dt.

$$W = \int_{t_1}^{t_2} F \cdot v \, dt = \int_{t_1}^{t_2} F \cdot \frac{ds}{dt} dt = \int_C F \cdot d$$

where C is the trajectory from $x(t_1)$ to $x(t_2)$.

If the force is always directed along this line and the magnitude of the force is F, then this integral simplifies to

$$W = \int_C F \, ds$$

where s is displacement along the line. F is constant addition to beign directed along the line, then the integral simplifies further to

$$W = \int_C F ds = F \int_C ds = Fs$$

where s the displacement of the point along the line

Date:

$$W = \int_c F \cdot ds = Fs\cos\theta$$

Daily life examples

1) Pushing a car horizontally from rest
2) Shooting a bullet (the powder does the work)
3) Walking up stairs.
4 Sawing a log.
5) A horse pulling a plow through the feild.

6)

Energy :-

Eneregy is the quantitative property that must be transferred to an object in order to perform work on, or to heat. Energy is a ~~conservation~~ ~~a~~ ~~conserved~~ ~~property~~ conserved quantity: the law of conservation of energy states that energy can be converted in form, but not created or destroyed.

Date:

The SI Unit.

The SI Unit. of energy is the "joule" which is energy transfered to. an object by the work of moving it a distance of 1 meter aganist a force 1 newton

Forms of energy

1) Kinetic Energy (Moving Body)
2) Potential Energy (object Position)
3) Elastic energy (stretching Solid objecti)
4) Chemical energy (fuel burns)
5) radiant energy (carried by light)
6) Thermal Energy (objet temperature)

Mathematically

$$W = \int_C F \cdot ds.$$

This says the work (W) is equal to the line integral of the force F along a path C.

Daily life examples.

1) Heating & cooling Our Homes
2) lighting office building, school, hospital etc.
3) Driving cars and moving freight.
4) Manufacturing the products we rely on in our daily lives.
5) Watching television, washing clothes, doing cooking etc.

Power

The amount of energy transfferred or converted per unit time.

OR

Power is the rate with respect to time at which work is done; it is the time derivative of work:

$$P = \frac{dW}{dt}$$

where P is power, W is work and t is the time.

If a constant force F is applied throughout a distance x, the work done is defined as

$W = F \cdot x$. In this case power can be written as.

$$P = \frac{dW}{dt} = \frac{d}{dt}(F \cdot x) = F \cdot \frac{dx}{dt} = F \cdot V$$

Form the fundamental theorem of calculus, we know that.

$$P = \frac{dW}{dt} = \frac{d}{dt}\int_{\Delta t} F \cdot v \cdot dt = F \cdot V.$$ Hence

the formula is valid for any general situation.

Unit:

The SI Unit of power is "watt (W)". which is equal to one joule per second.
other units are the followings.

1) ergs (erg/s)
2) foot - pound, (Per minute)
3) dBm (logarithm measure 1 milliwatt)
4) BTU (BTU/h)

Formula

$$\text{Power} = \frac{\text{Work}}{\text{Time}} = \frac{\text{Force} + \text{Displacement}}{\text{Time}}$$

$$\text{Power} = \text{Force} + \frac{\text{Displacement}}{\text{time}}$$

$$\boxed{\text{Power} = \text{Force} = \text{Velocity}}$$

Daily Uses example

1) Walking.
2) Driving a car ~~using~~ while using a phone.
3) All the technolgies that we use in our daily life
4) charging our phone or playing video games.