Date:

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SEMESTER : 2nd

ENGINEERING MECHANICS

Date: _____

QUESTION # 5

WORK :-

The product of force & displacement is called work.

A force is said to do positive work if (when applied) the force has a component in the direction 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 the application of the force.

Example :-

A baseball pitcher does positive work on the ball by applying a force to it over the distance it moves while in his grip.

Daily life :- A man carrying book is doing work

Common symbols : W

SI unit : Joule.

Other units : Foot - Pound, Erg.

In SI base units : $1kg \cdot m^2 \cdot s^{-2}$.

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Derivations from other equations.

$W = F \cdot S$

$W = T\theta$

Dimension : ML^2T^{-2}.

Example:

When a ball is held above the ground & then droped the work done by the gravitational force on the ball as it falls is equal to the weight of the ball. multiplied by the distance to the ground. When the force is constant and the angle between the force and displacement S is θ then the work done is given by $W = Fs\cos\theta$

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Energy:

Energy is the capacity of doing work.

=> It may exist in potential kinetic energy, termal, electrical, chemical or other various forms.

=> Energy is nor create- nor destroy but it can be converted from one form to another.

After it has been transferred energy is always designated to its nature or other various forms.

Examples:

(1) Watching television

(2) Washing clothes.

(3) working from home on your laptop.

(5)

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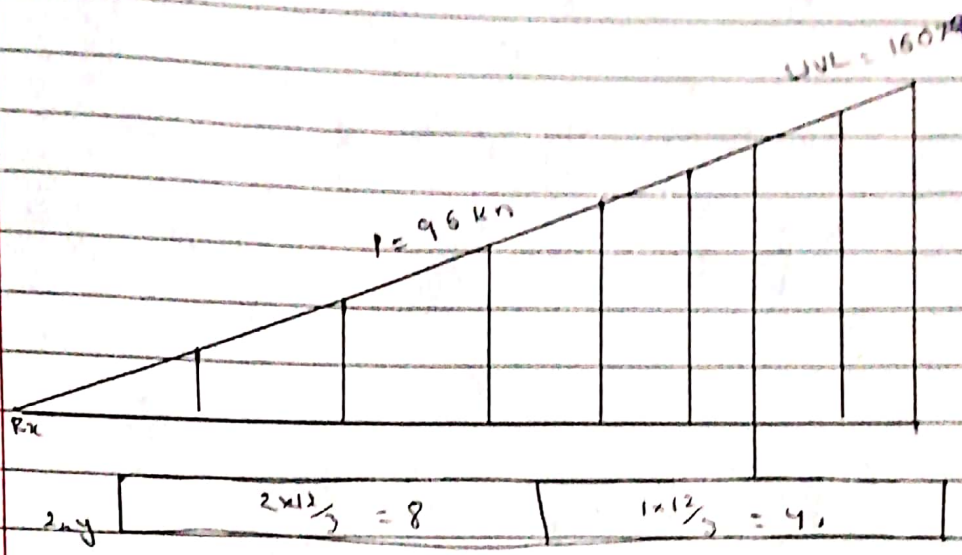
Answer 3:



UVL = 16079/1000 = 16.079.

UVL resultant $\frac{16 \times kN/m \times 12}{2}$

= 96 kN

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

$R_{1x} = 0$

$\Sigma q_v = 0$

$\Sigma F_x = 0$.

$R_{1y} + R_{2y} = 96\,kN = 0$ eq 2.

$(R_2 \times 12) - (96 \times 8) = 0$ eq III

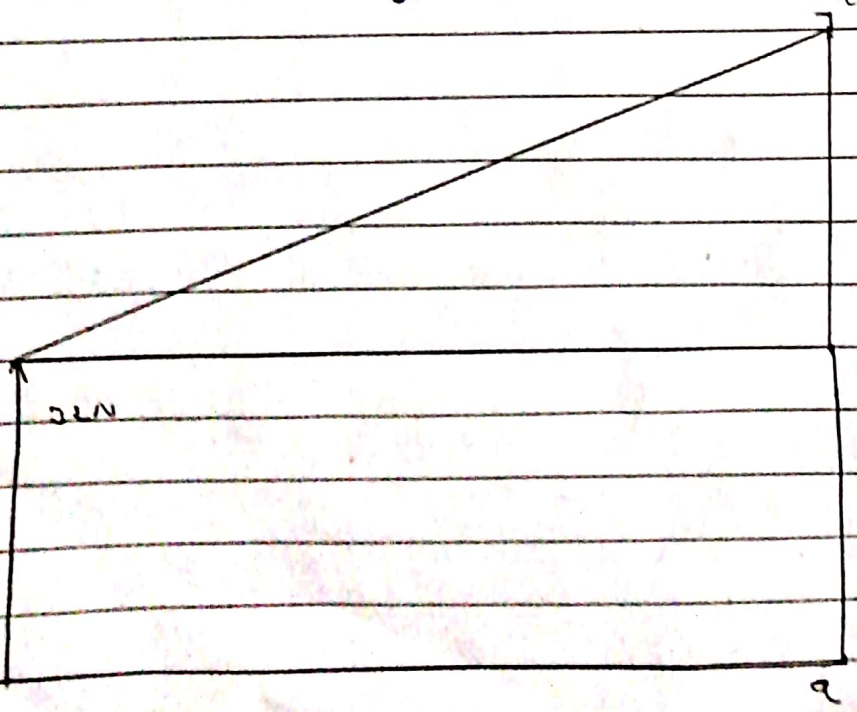
$R_{2y} = 96 \times 8/12 = 64\,kN$

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

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

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

$\{R_{1x} = 0 , R_{1y} = 32\,kN , R_2 = 96\,kN\}$



from law of similar triangle

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$\frac{16\ KN/m}{12} = \frac{w\ KN/m}{n\ m}$

$w = \left[\frac{10\ KN}{12}\right]\ KN/m$

Summition

$\Sigma y = 0$

$-V_{aa} - P_1 + 32\ KN$

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

$V_{aa} = 31 - \frac{16x^2}{24} \rightarrow eq(1)$

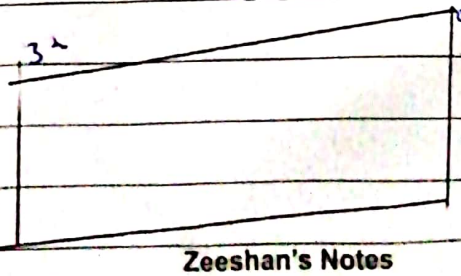
at $x = 0$ $\quad eq(1) = 96$

the point at which similar forces are negative

$0 = \frac{16x^2}{12} + 12 - \frac{16x^2}{24} = 32$

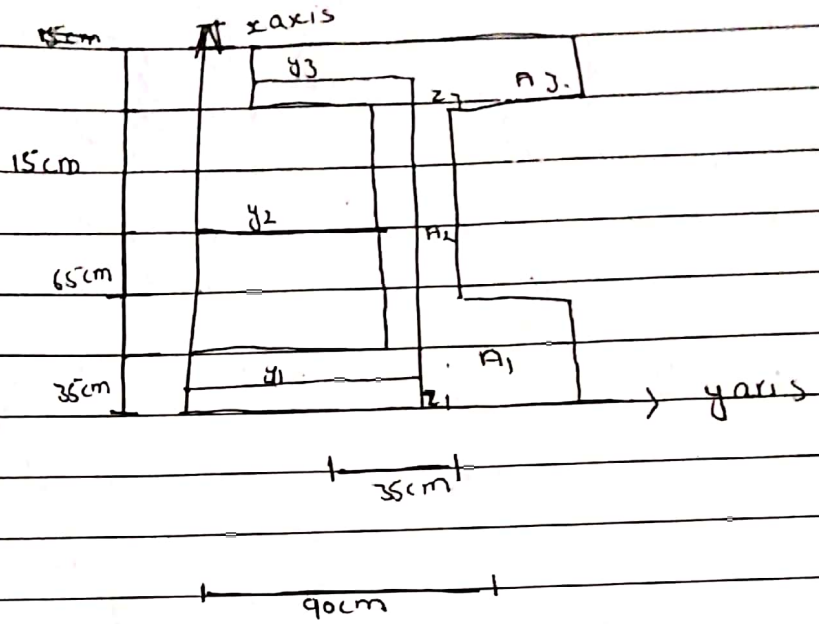
$\sqrt{x^2} = \frac{\sqrt{12 \times 24}}{16} \quad x = \sqrt{48}$

$x = 6.92$



Hence the share force is positive.

Q4. a) Find the centriod of the given shape.



Sol: Establishing the quardinate system.

↓ Dividing the composite area into differd simple areas.

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

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

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

finding centre point of each from the origin.

$y_1 = 0.9/2 = 0.45m$

$y_2 = 0.9/2 = 0.45m$

$y_3 = 0.9/2 = 0.45m.$

$z_1 = 0.35/2 = 0.175m$

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

$z_3 = 0.35 + 0.65 + 0.15/2 = 0.075m$

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

$$= \frac{(0.315 \times 0.45) + (0.2275 \times 0.45m) + (0.0975 \times 0.}{0.315 + 0.2275 + 0.0975}$$

$$= \frac{0.1417 + 0.10237 + 0.04387}{0.43525}$$

$$= \frac{0.28794}{0.43525}$$

$y_c = 0.6615m$

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

$$z_c = \frac{(0.315 \times 0.175) + (0.2275 \times 0.675) + (0.0975 \times 0.}{0.43525}$$

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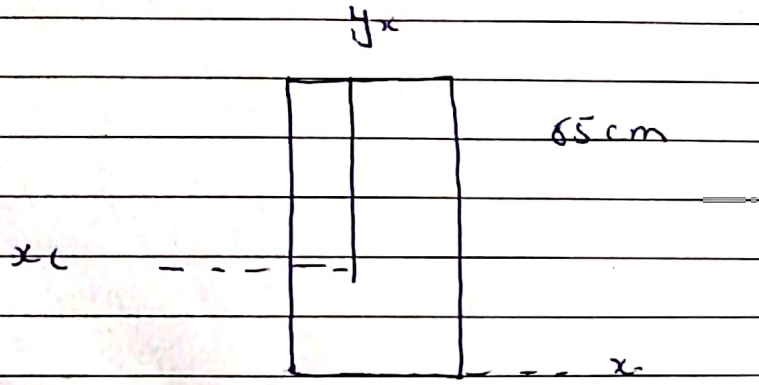
$= \frac{0.3134945}{0.43525}$

$z_c = 0.7202\,m$

(b)

Moment of inertia

(65cm x 35cm)



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

$I = 800,989.58\ cm^4$

Radius of gyration,

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

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

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

Section modulus:-

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

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

$$S = 26645.83\,cm^3$$

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Q no 2

Share fore diagram

$P_1 = 100 + 16079 = 16179\,KN$

$UDL = 150 + 16079 = 16229\,KN$

UDL Point load $= 16229 \times 6$

$= 97374$

FBD

$\Sigma F_x = 0 \Rightarrow A_x = 0$

$\Sigma F_y = 0 \Rightarrow A_y + B_y$

$= 16179 + 97374$

$= 113553 \quad -(1)$

$(\circlearrowleft + \Sigma M_A = 0 \Rightarrow (B_y \times 12) - (16179 \times 3) - (97374 \times 10$

$B_y \times 12 = 48537 + 876366$

$B_y = \frac{924903}{12}$

$= 77075.25\,KN$

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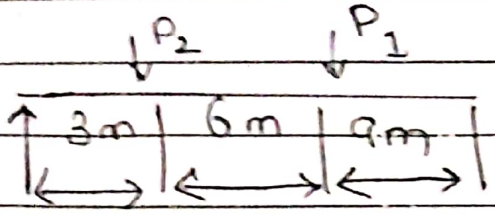
Put in eq(i)

$$A_y + B_y = 1135$$

$$A_y = 113553 - 77075.25$$

$$= 36477.75 \text{ KN.}$$

Q:1 Find the support reaction show all your calculation.



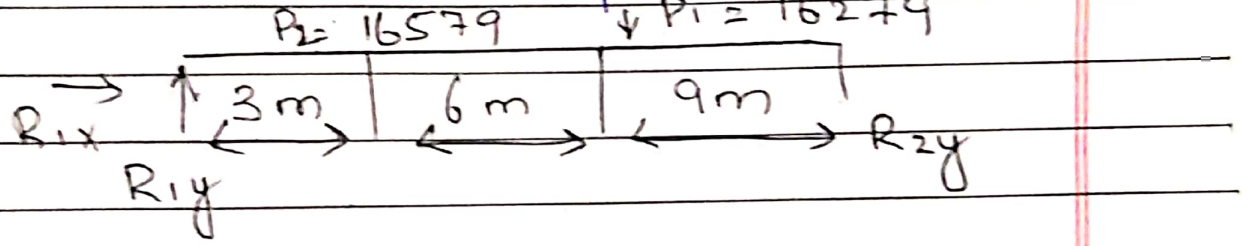
SOLUTION :-

$P_1 = 200 + 16079$

$P_1 = 16279$

$P_2 = 500 + 16079$

$P_2 = 16579$



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

$R_{1y} + R_{2y} = 16279 - 16579 = 0$ $\quad \Sigma F_y = 0$

$R_{1y} + R_{2y} = 16279 + 16579$

$R_{1y} + R_{2y} = 32858$ eq(i)

$$R_{1y} = \left[(16279 \times 9) + (16579 \times 15) \right] / 18$$

$$R_{1y} = \frac{146511 + 248685}{18}$$

$R_{1y} = 21955.33$ eq (2)

Put eq (2) in eq (1)

$R_{1y} + R_{2y} = 32858$

$21955.3 + R_{2y} = 32858$

$R_{2y} = 32858 - 21955.3$

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$R_{2y} = 10902.7$

$R_{1y} = 21955.3N$ $R_1 \times 20N$

$R_{2y} = 10902.7$

Q - 2 Digram