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Section: B

Paper : Engineering Mechanics

Semester: 2nd.

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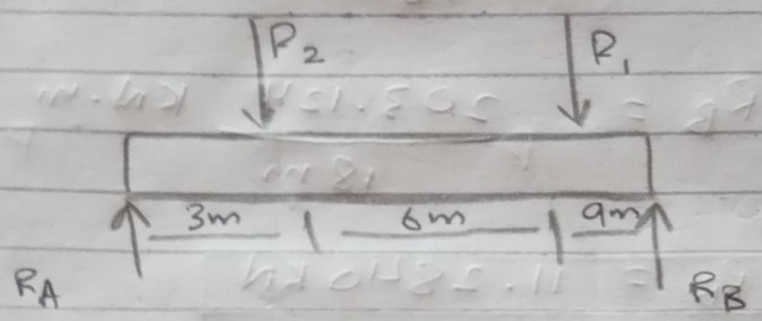
Q:1



$P_1 = 200 + \text{Student id}$

$P_2 = 500 + \text{Studenid}$

Student id = 16652

$P_1 = 200 + 16652$

$= 16852\ KN$

$P_2 = 500 + 16652$

$= 17.152\ KN$

$R_A = ?$

$R_B = ?$

Clockwise torque = +ve

Anticlockwise torque = -ve

$\Sigma M_A = 0$

$\Rightarrow 17.152\ KN \times 3 + 16.852 \times 9 - R_B \times 18$

$16.852 \times 9 + 17.152 \times 3 = 18 R_B$

$151.668 + 51.456 = 18 R_B$

$203.124 = 18 R_B$

$$R_B = \frac{203.124\ KN.m}{18m}$$

$$R_B = \frac{203.124\ KN.m}{18m}$$

$$\boxed{R_B = 11.2846\ KN}$$

NOW FOR R_A

$\Sigma M_B = 0$ (-ve)

$$R_A * 18 - 15(17.152) - 9(16.852) = 0$$

$$18R_A = 257.28\ KNm + 151.668$$

$$18R_A = 408.948\ KNm$$

$$R_A = \frac{408.948\ KNm}{18m}$$

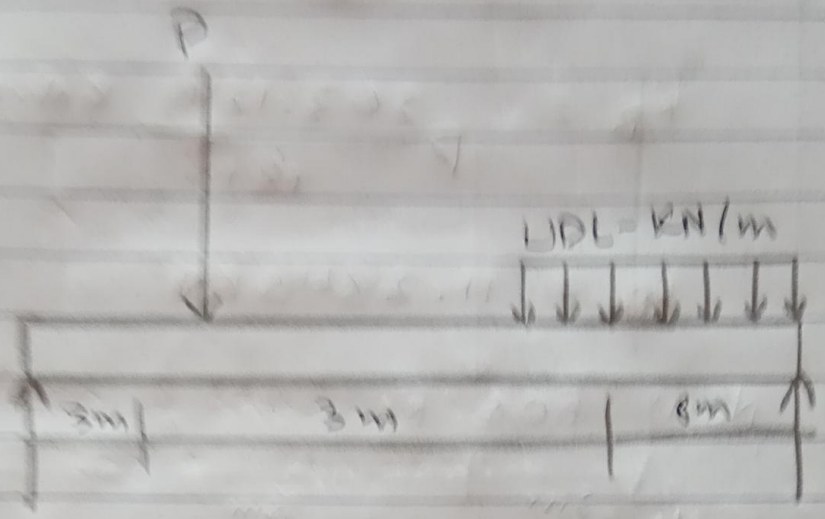
$$R_A = \frac{408.948\ KNm}{18m}$$

$$\boxed{R_A = 22.71933\ KN}$$

$$R_A + R_B = P_1 + P_2$$

$$22.71933 + 11.2846 = 16.852 + 17.152$$

$$\boxed{34.00393 = 34.004}$$



P = 100 + student I.d

UDL = 150 + student I.D

Student I.D = 16852

P = 100 + 16852

= 16.952 N = 16.952 KN

UDL = 150 + 16852

= 16802 = 16.802 KN/m

Now the uniform distributed load can replaced by a single load by a simple calculation.

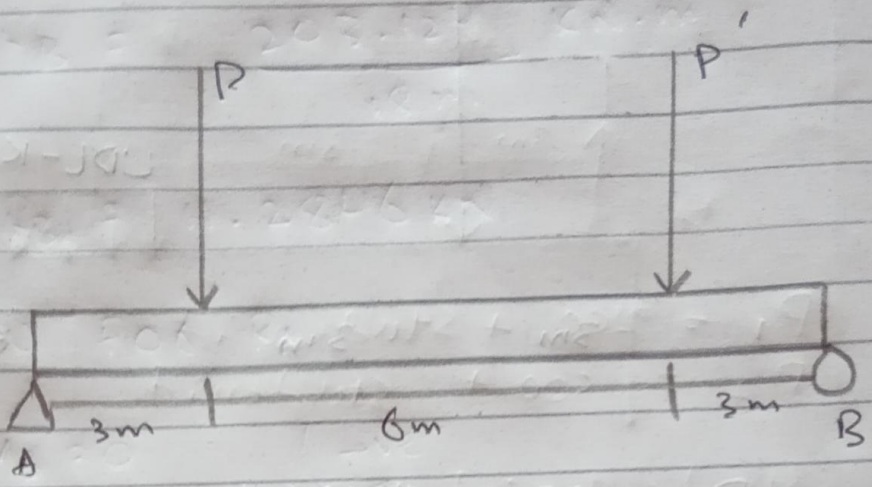
= UDL = 16.802 KN/m

The distance at which load is distributed = 6m

So

point load = 16.802 $\frac{KN}{m}$ x 6m

Point load = 100.812 KN



Now Find Reaction at supports A & B.

R_A = ?
R_B = ?

clockwise = torque = +ve
Anti clock torque = -ve

$\Sigma M_A = 0$

$16.752 \times 3 + 100.812 \times 9 - R_B \times 12 = 0$

$50.256 KNm + 907.308 KNm - R_B \times 12 = 0$

$50.256 KNm + 907.308 KNm = 12 R_B$

$12 R_B = 50.256 KNm + 907.308 KNm$

$12 R_B = 957.564 KNm$

$R_B = \frac{957.564 KNm}{12m}$

$$R_B = 79.797 \text{ KN}$$

$\Sigma M_B = 0$

clockwise torque = +ve
Anticlockwise torque = -ve

$$12R_A - 16.752 \times 9 - 100.812 \times 3 = 0$$

$$12R_A = 150.768 + 302.436$$

$$12R_A = 453.204 \text{ KNm}$$

$$R_A = \frac{453.204 \text{ KNm}}{12 \text{ m}}$$

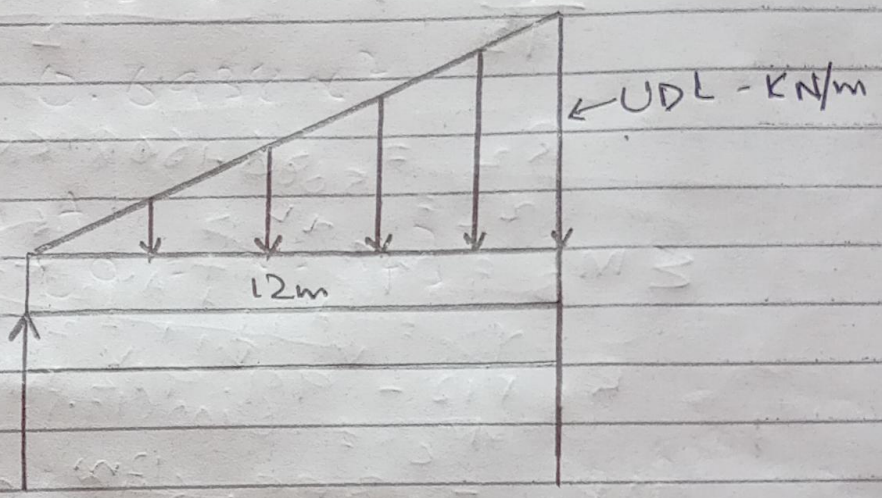
$$R_A = 37.767 \text{ KN}$$

$$R_A + R_B \pm P_1 + P_2$$

$$37.767 + 79.797 = 16.752 + 100.812$$

$$117.564 = 117.564$$

Q 3:

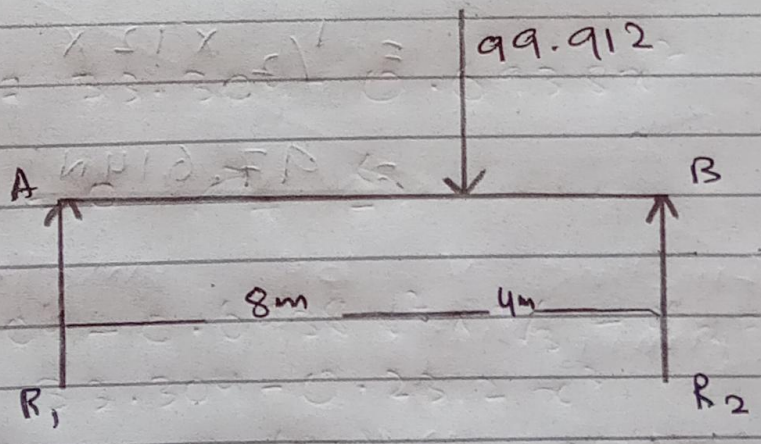


UDL = 16652/1000

UDL = 16.652 KN/m

$w_o = \frac{16.652 \times 12}{2}$

$= 99.912$



$\Sigma M_A = 0$ (+ ↻ −)

$-R_2 \times 12 + 99.912 \times 8 = 0$

$-R_2 \times 12 + 799.296 = 0$

$12R_2 = 799.296$

$\frac{R_2}{12} = \frac{799.296}{12}$

$R_2 = 66.608\ KN$

$\Sigma M_B = 0 \quad (+\circlearrowleft \ -\circlearrowright)$

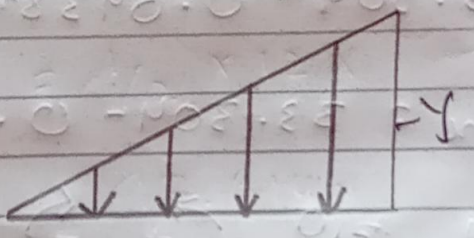
$R_1 \times 12 - 99.912 \times 4 = 0$

$12R_1 - 399.648 = 0$

$12R_1 = 399.648$

$R_1 = \frac{399.648}{12}$

$R_1 = 33.304\ KN$

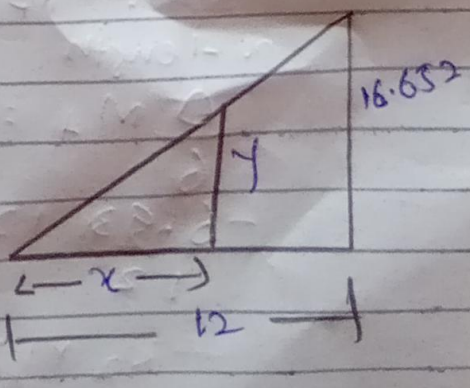


Finding Y by angle of similarity:

$x/y = 12/16.652$

$\frac{16.652\ x}{12} = Y$

$y = 1.3876x$



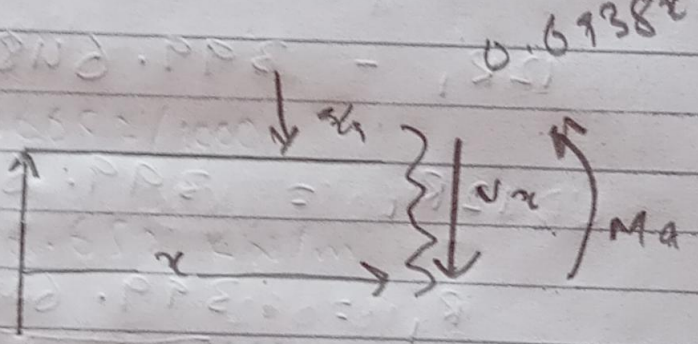
$W_o = \frac{1}{2}(y)(x)$

$= \frac{1}{2}(1.3876x)(x)$

$W_o = 0.6938x^2$

Origin A

Limit $[0 = x = 12]$



$\Sigma F_y = 0 \; + \downarrow$

$33.304 - 0.6938x^2 - V_x = 0$

$V_x = 33.304 - 0.6938x^2$

$\Sigma M_{1-1} = 0 \; \curvearrowright + \; \curvearrowleft -$

$33.304 - 0.6938x^2 \times x/3 - M_x = 0$

$M_x = 33.304 - 0.2312x^3$

x - length	V_x (KN)	M (KN-m)
0	33.304	0
6	8.077	399.32
6.93	0	149.269
12	66.608	0

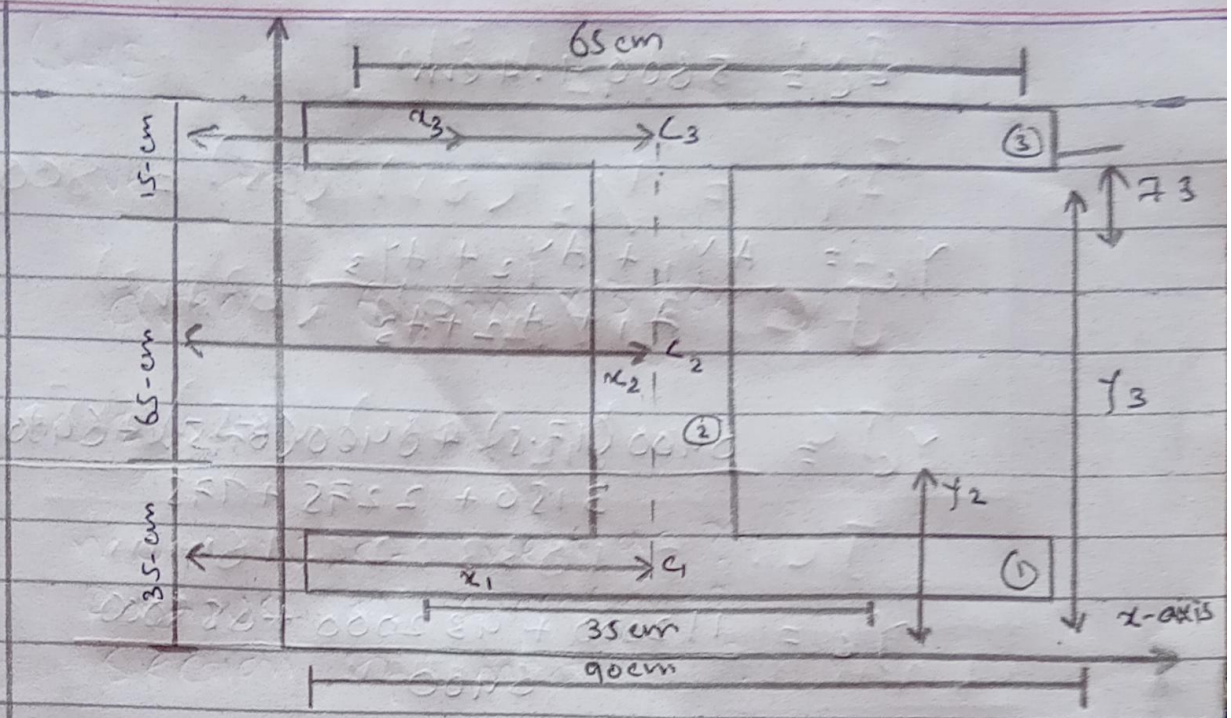
(12)

$$33.304 - 0.6938x^2 = 0$$

$$\frac{33.304}{0.6938} = \frac{0.6938x^2}{0.6938}$$

$$\sqrt{x^2} = 48 = 6.93m$$

Qu: 4A



cm

					cm
A_1	$3150cm^2$	x_1	45	y_1	17.5
A_2	$2275cm^2$	x_2	45	y_2	67.5
A_3	$975cm^2$	x_3	45	y_3	$107.\bar{5}$

$\Sigma A = 6400cm^2$

$$x_c = \frac{Ax_1 + Ax_2 + Ax_3}{A_1 + A_2 + A_3}$$

$$x_c = \frac{6400(45) + 6400(45) + 6400(45)}{3150 + 2275 + 975}$$

$$x_c = \frac{288000 + 28000 + 28000}{6400}$$

$$x_c = 56004.4 \text{ cm}$$

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

$$y_c = \frac{6400(17.5) + 6400(67.5) + 6400(109.5)}{3150 + 2275 + 975}$$

$$y_c = \frac{112000 + 432000 + 688000}{6400}$$

$$y_c = 544107.5$$

(Q4(B)

Given data:

area = 65 cm x 35 cm

TO Find:

moment of inertia = ?
Radius of Gyration = ?
section of modulis = ?

For moment of inertia:

$I_x = 1/3\ bh^3$

$I_x = 1/3\ (65) \times (35)^3$

$= 1/3\ (65) \times (35)^3$

$I_x = 4128958\ mm^4$

$I_y = 1/3\ b^3 h$

$I_y = 1/3\ (65)^3 (35)$

$I_y = 3203958\ mm^4$

$\bar{I}_{x'} = 1/12\ bh^3$

$= 1/12\ (65)(35)^3$

$\bar{I}_{x'} = 6635.41\ mm^4$

$$\bar{I}_{y'} = 1/12\, b^3 h$$

$$\bar{I}_{y'} = 1/12\,(65)^3(35) = 800989\ mm^4$$

$$\bar{J}_C = 1/12\, bh(b^2+h^2)$$

$$J_C = 1/12\,(65)(35)((65)^2+(35)^2)$$

$$\boxed{J_C = 1033229.16\ mm^4}$$

Radius of gyration:

$$r = (1/A)^{1/2}$$

$$A = b \times d$$

$$A = 65 \times 35$$

$$A = 2275$$

$$r = \left(\frac{1033229.16}{2275}\right)^{1/2}$$

$$\boxed{r = 21.31\ mm}$$

Section moduli:

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

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

$$\boxed{S = 13270.83\ mm^2}$$

Ans 5: 1) WORK: DEF: "The product of force and displacement is called work."

Explaination: A force is said to be positive work when the applied force has a component in the direction of the displacement of the point of application and a force does negative work if the force component opposite to the direction of displacement at the point of application of the force.

Example: when a ball is held above the ground and then dropped, the work done by the gravitional force on the ball as it falls is equal to the height of the ball (force) multiply by the distance to the ground (displacement) when the force (F) is constant and the angle between the force and displacement (S) is θ.

Then the work done is given by.

$$W = FS\cos\theta$$

⇒ The SI unit of work is Joul (J)

2) ENERGY:

DEF: "The ability of a body to do work."

OR

"The capacity for doing work."

Explanation: It may exist in potential, Kinetic, thermal, Electrical, chemical, nuclear or in other various forms i.e Energy is the process of transfer from one body to other.

Examples: Light energy, heat energy,

mechanical energy, gravitational energy, Chemical energy.

⇒ we divide our energy use among four economic sectors, residential, Commerical, transportation and industrial. Heating and cooling our home lighting office, building, driving and manufacturing the products that we really use in our daily lives are function that require energy.

⇒ The SI unit of energy is Joule (j)

3) POWER:

DEF: a the rate of doing work.

Explanation: It is the work done in unit time.

⇒ Some time the power of motor vehicle and other machine are given in term of horsepower (hp) which is approximately equal to 745.7 watts.

Example:

⇒ power is the strength needed to run five miles.

⇒ power is the authority a local government has to collect taxes.

⇒ the SI unit of power is watt (W) which is (J/s).