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Section A

Department civil engineering

Paper Engineering mechanics.

Q.5 Explain work, energy & power in details along with practical example from daily life?.

Ans:. Work:

The application of a force through certain distance is know as work. & measured in joules (J).

Work = Force × Distance travelled in direction of force

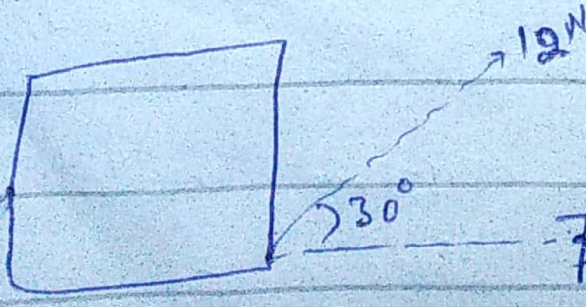
$W = F \cdot d$.

Explanation:

A work is done that when a body is in rest and some external force are applied on them and the body is accelarates are moved from their rest position and they cover some distance in the direction of applied then we will is said work is done

Example:

A box is pulled along by a piece of string which is at 30° to the horizontal. Calculate the work done in pulling the toy if the tension in the string is 12 N, and it is pulled along 7 m.



$W = Fs \cos\theta$.

$= 12 \times 7 \times \cos 30^\circ$

$= 84 \times \cos 30^\circ$

$W = 72.746$.

Energy :-

The measure of the ability of an object (or) System to perform work. Its unit is joule. Denote by (J).

Energy = Fod.

and $1J = 1N.m$.

Explaination:

Energy is that which is the ability to do work. Which we can use for our daily life for our basic facilities.

Examples:

1. Fire energy.
2. hydrolic energy.
3. electrical energy.
4. Heat energy etc.

Power:-

Power is the rate at which work is done, (or) rate at which energy is transfered.

power = work done / time taken.

$P = W/t$.

Example:

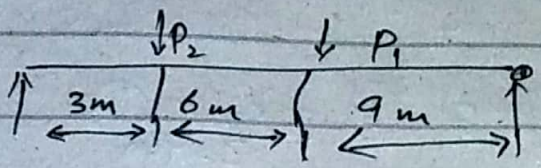
1) Strength need to run five miles

2) The authority a local goverment has to collect taxes.

3) power machine in which we move load from one place to another.

Q.1 Find the Support reaction, Show all your calculations.

(P_1 = 200 + Student ID No), P_2 = 500 + Student ID No.

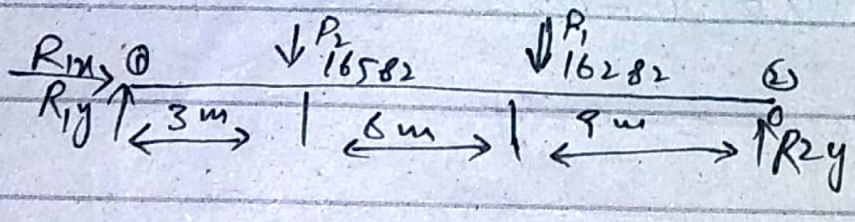


Sol:- $P_1 = 200 + 16082$

$P_1 = 16282$ N.

$P_2 = 500 + 16082$

$P = 16582$ N.



$R_1x = 0$ $\quad \Sigma fu = 0$

$R_1y + R_2y - 16282 - 16582 = 0$ $\quad \Sigma fy = 0$

$R_1y + R_2y = 16282 + 16582$

$R_1y + R_2y = 32864$ eq (1).

$R_1y = [(16282 \times 9) + (16582 \times 15)] / 18.$

$$R_{1y} = \frac{146538 + 248730}{18}$$

$$R_{1y} = 21959 \rightarrow \text{eq } (2).$$

Put eq (2) in (1).

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

$$21959 + R_{2y} = 32846$$

$$R_{2y} = 32846 - 21959$$

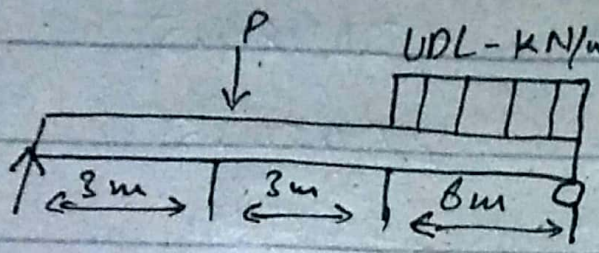
$$R_{2y} = 10887.$$

$R_{1x} = 0 - N$, $R_{1y} = 21959\ N$

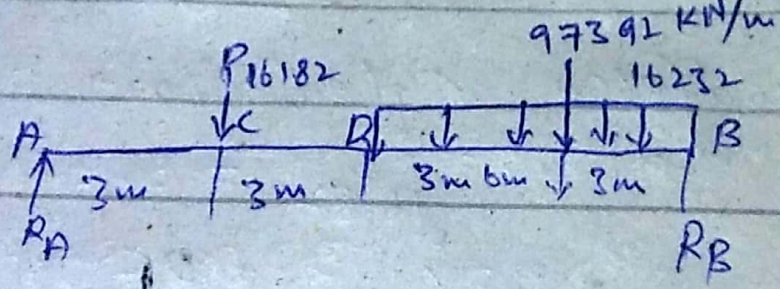
$R_{2y} = 10887.$

Q(2) Draw the neat Shear force diagram. Sho all your calculations.

(P = 100 + Student ID No), (UDL = 150 + Student ID)



Sol:



(ID = 16082)

① Taking moment @A ↻ +

$(16182 \times 3) + (97392 \times 6 \times 3 + 3) - RB(12) = 0$

$48546 + 876528 - RB(12) = 0$

$\frac{12(RB)}{12} = \frac{925074}{12}$

$= \{RB = 77089.5\}$

② $RA + RB = 16182 + 97392$

$RA + 77089.5 = 113574$

$\{RA = 36484.5\}$ ↑+ ↓−

SF @ A = 77089.5

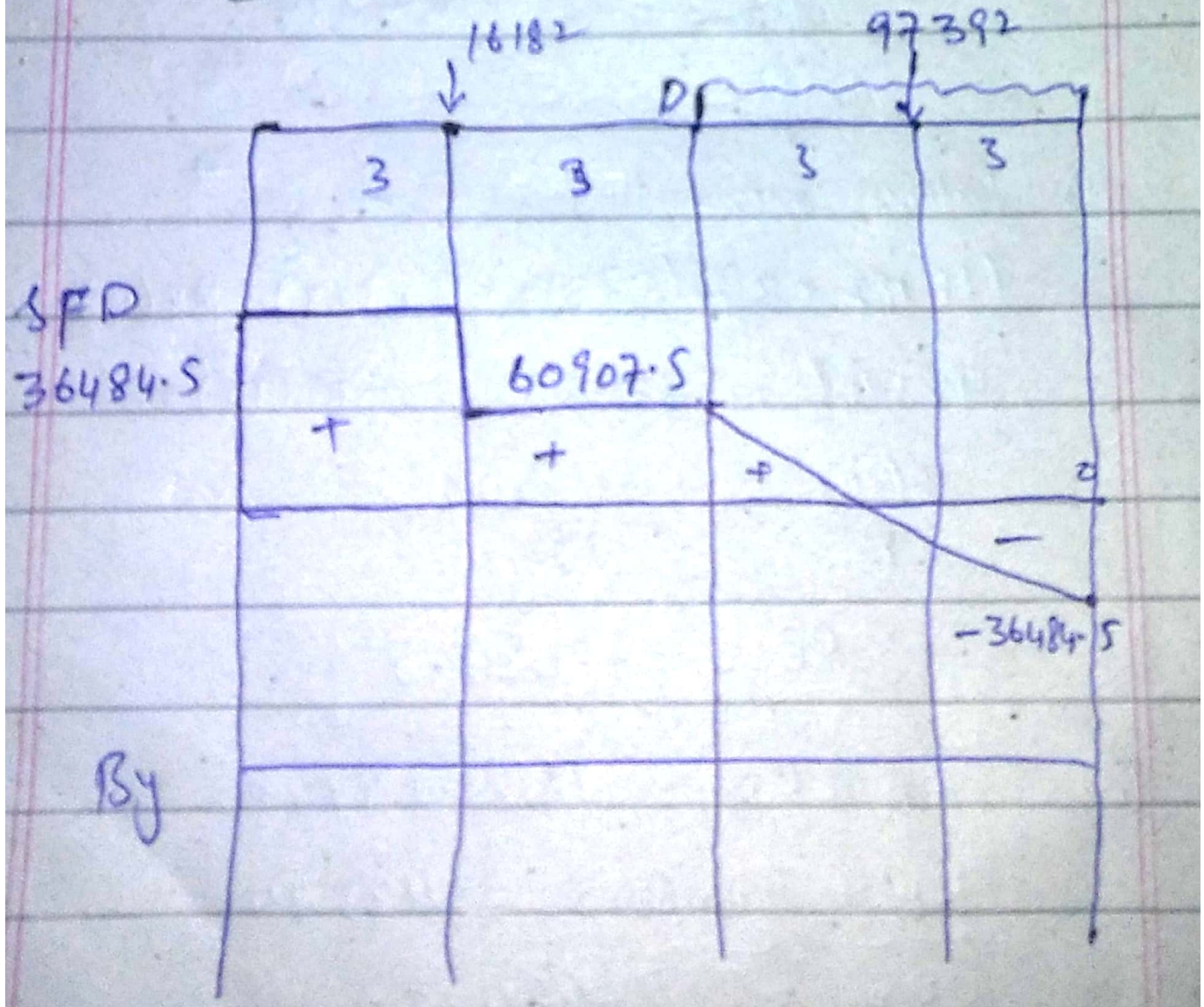
@ C = 77089.5 − 16182 = 60907.5

@ D = 60907.5 − 97392

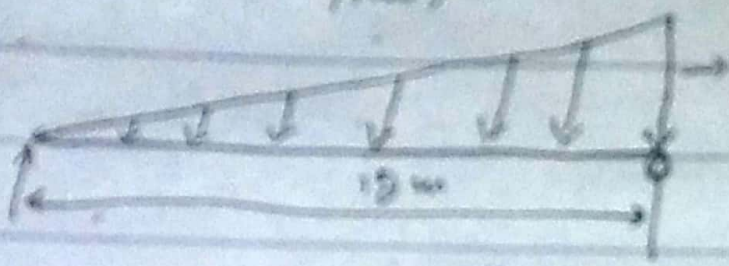
= −36484.5

@ B = 36484.5

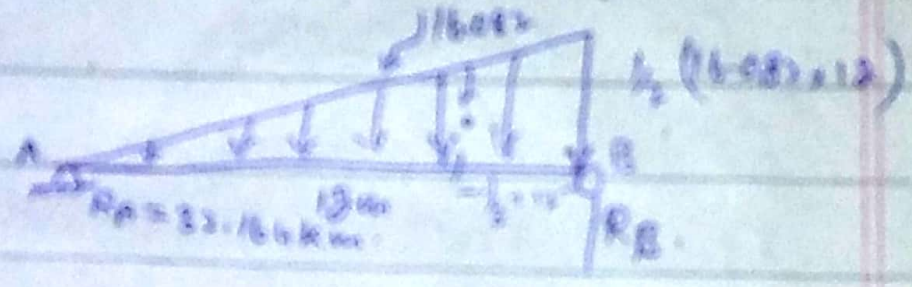
Shear force calculations:



Q3) Draw the neat Shear force & bending moment diagrams, &
(UVL = student ID KN/m)



Sol:



ID = 16082/1000 = 16.082.

Moment @ B = 0

$$(R_A \times 12) - \left(\left(\tfrac{1}{2}(16.082) \times 12\right) \times \left(\tfrac{1}{3} \times 12\right)\right) = 0$$

load. distance

$$R_A = \frac{385.968}{12}$$

$$R_A = 32.164 \text{ KN}.$$

$\Sigma F_y = 0$ ↑ +ve ↓ -ve

$$32.164 - \left(\tfrac{1}{2}(16.082) \times 12\right) + R_B = 0$$

$$R_B = 64.328 \text{ KN}.$$

There are two diagrams of shear force in UVL which can depend upon intensity of load.

Slop of SF = intensity of load.

SF Calculation.

SF at left of A = 0

SF at Right of A = 32.164 KN.

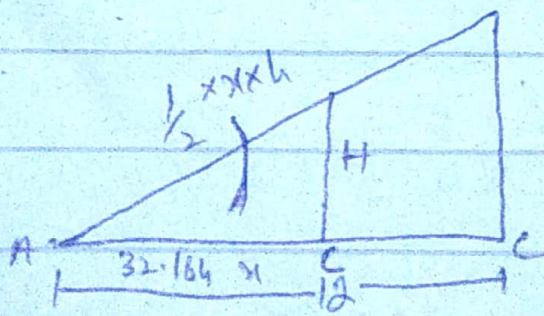
SF at left of B = $32.164 - \left(\frac{1}{2}(16.082) \times 12\right)$

= -64.328

SF at Right of B = $-64.328 + 64.328 = 0$

SF e c = 0

By Similar triangle.



$32.164 - \frac{1}{2} \times x \times h = 0$

$32.164 - \frac{1}{2} \times x \times \frac{16.082}{12} \times x = 0$

By engineering calculation

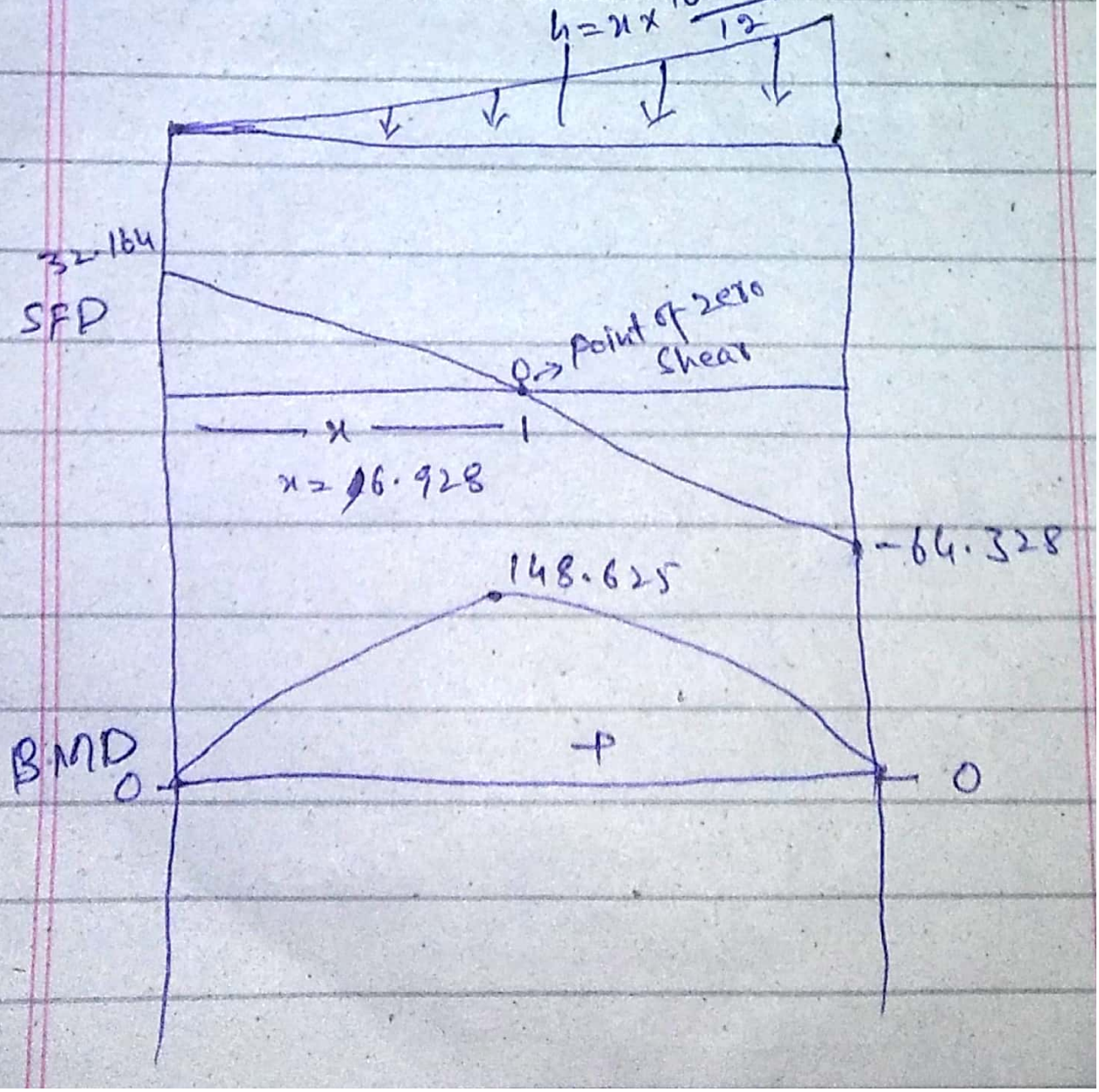
$x = 6.928\ m.$

by Similar triangle

$$\frac{16.082}{12} = \frac{h}{x}$$

$$\frac{16.082}{12} = \frac{h}{6.92}$$

$h = 9.273.$



Q(4) Part (a)

Solution

① Establish the Quardinate System

② Divide the Composite area into different Simple area's.

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

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

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

Finding center point of each from the origin

$y_1 = 0.9/2 = 0.45\ m$

$y_2 = 0.9/2 = 0.45\ m$

$y_3 = 0.9/2 = 0.45\ m$

$z_1 = 0.55/2 = \boxed{0.175\,m}$

$z_2 = 0.35 + (0.65/2) = \boxed{0.675\,m}$

$z_3 = 0.35 + 0.65 + 0.15/2 = \boxed{0.075\,m}$

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

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

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

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

$$\boxed{y_c = 0.6615\,m}$$

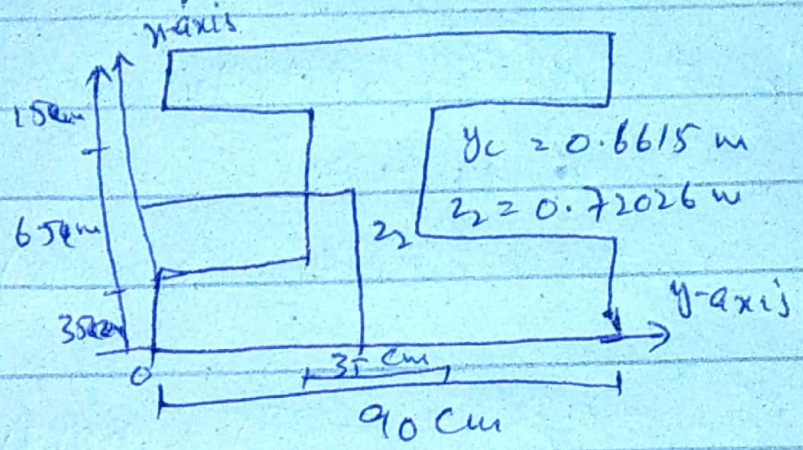
$$z_c = \frac{A_1 z_1 + A_2 z_2 + A_3 z_3}{A_1 + A_2 + A_3}$$

$$z_c = \frac{(0.315 \times 0.175) + (0.2275 \times 0.675) + (0.0975 \times 0.075)}{0.315 + 0.2275 + 0.0975}$$

$$= \frac{0.05512 + 0.155562 + 0.104812}{0.43525}$$

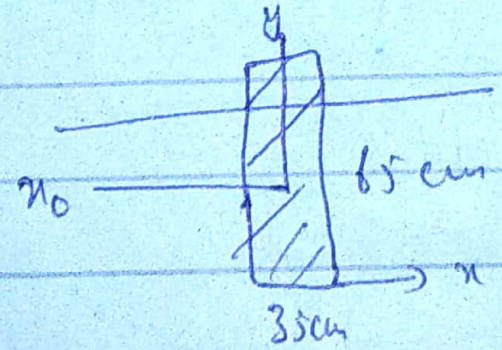
$$= \frac{0.3134945}{0.43525}$$

$$\boxed{z_c = 0.72026 \text{ m}}$$



Part b:

Moment of inertia for (65 cm × 35 cm)



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

$$\boxed{I = 800,989.58 \text{ cm}^4}$$

Radious of Gyration.

$$r_{x_0} = \frac{b}{\sqrt{12}} = \frac{65}{\sqrt{12}} = 18.76 \text{ cm}.$$

$$r_{y_0} = \frac{b}{\sqrt{12}} = \frac{35}{\sqrt{12}} = 10.1 \text{ cm}.$$

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

Section Moduli:

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

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

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