1.

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Course Engineering Mechanics.

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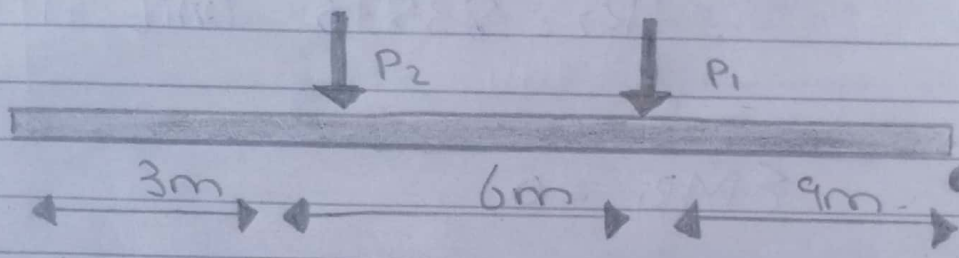
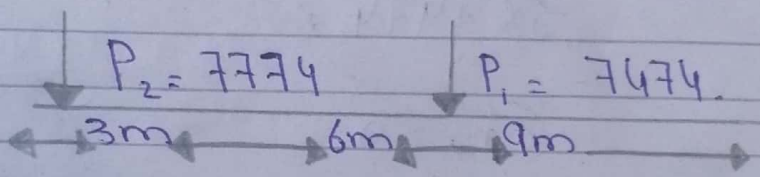
Q1. Find the support reactions, show all your calculations.

(P_1 = 200 + Student ID No), (P_2 = 500 + Student ID)
Marks = 5, (L.O-02).



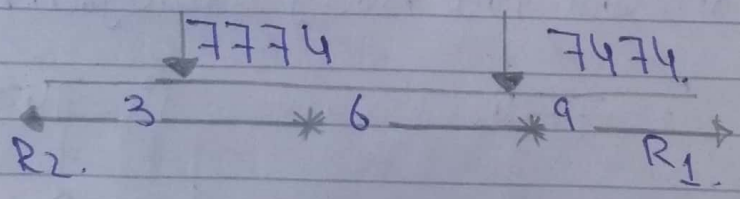


P_1 = 200 + 7274.

→ P_1 = 7474.

P_2 = 500 + 7274.

→ P_2 = 7774.



Equation of equilibrium.

$\Sigma F_H = 0 \Rightarrow \Sigma F_H = 0$

$\Sigma F_V = 0$

$\Sigma M = 0$

$\Sigma F_y = 0$

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$\Sigma M_{R1} = 0$ (-) (+)

$7474 \times 9 + 15 \times 7774 - R_2 \times 18 = 0$

$R = 67266 + 116610/9$

$= \boxed{R_2 = 83876 \text{ unit}}$

$\Sigma M_{R1} = 0$

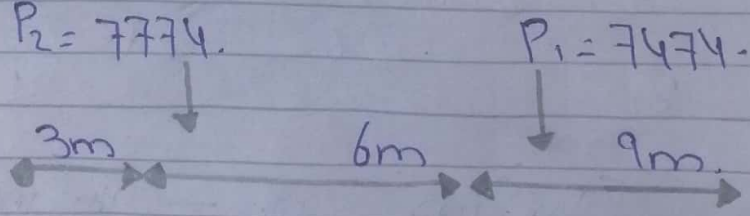
$3 \times 7474.$

$\Sigma f_0 = 0$

$R_2 - 7474 - 7774 + \frac{183876}{9} = 0$

$R_2 = \frac{168628}{9}$ unit

Compost free body Diagram.



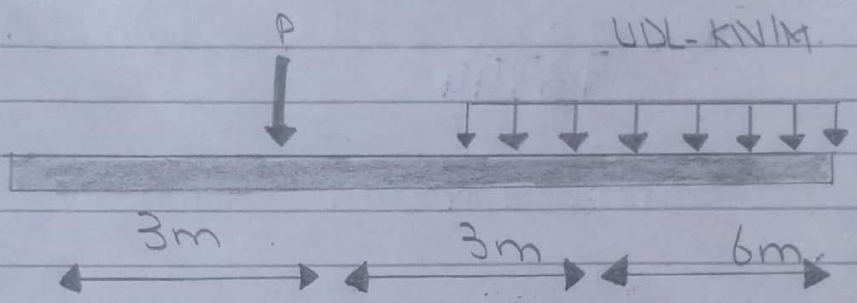
$R_2 = 168628$

$R_1 183876.$

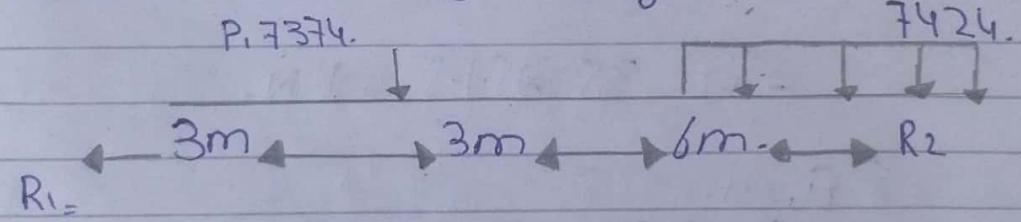
$= R' = 20430.69$ unit.

Q2:- Draw The neat Shear force diagram Show all your calculations.

(P=100+ Student ID No), (UDL)= 150+ Student ID No)
(Marks = 10) CLO-02).



Answer:- Free body Diagram.



$R = 760 + 7274 \Rightarrow \boxed{P = 7374.}$

$ODL = 150 + 7274 \Rightarrow UDL = \boxed{7424\ m/m}$

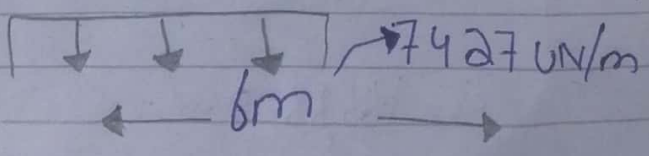
To Find The Reaction.

$\Sigma F_x = 0$

$\Sigma F_v = 0$

$\Sigma M = 0$

$\Sigma M_R = 0$ (+)



$-3 \times 7374 - 9 \times 44544 + 12 \times R = 0$

To find P_2 load (2)

Load = $7424 \times 6 = 44544$.

73744

3m 3m 3m.

$\Rightarrow R_2 = \frac{3 \times 7374 + 9 \times 44544}{12}$.

$= R_2 = 35251.5$ KN.

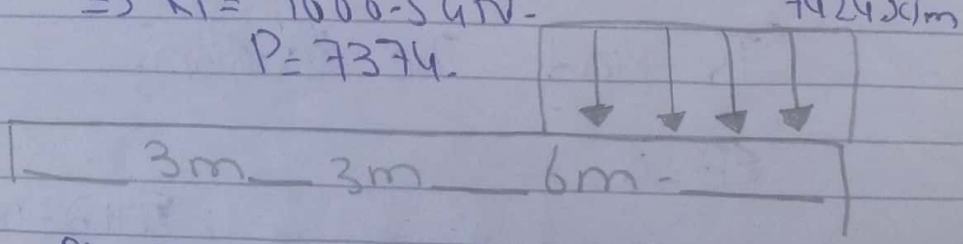
$\Sigma f_v = 0$.

$R_1 - 7374 - 44544 + 35251.5 = 0$

$= R_1 = 7374 + 44544 - 35251.5$

$\Rightarrow R_1 = 16666.5$ KN.

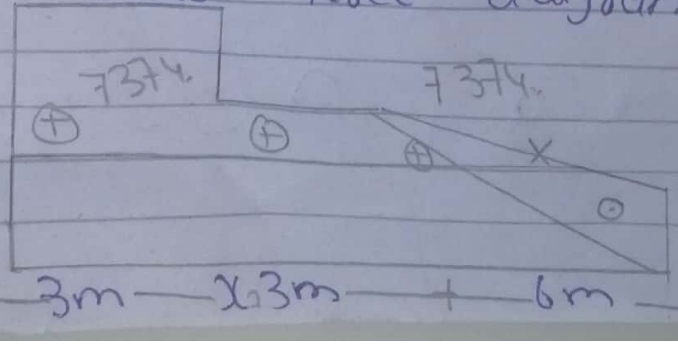
$P = 7374$.



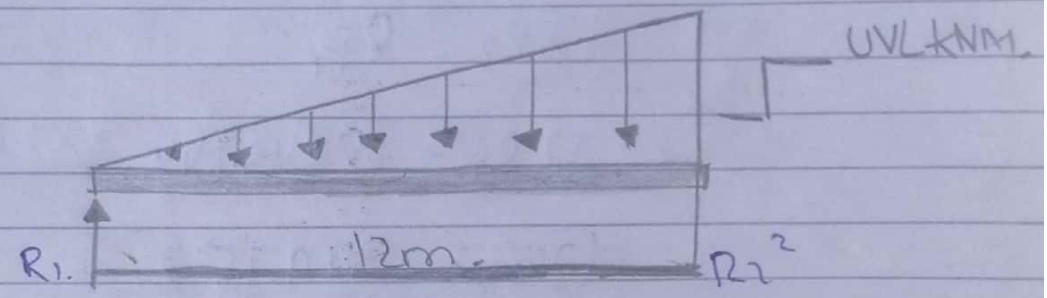
$R_1 = 16666.5$ KN.

$R_2 = 35251.44$

show force daigram.

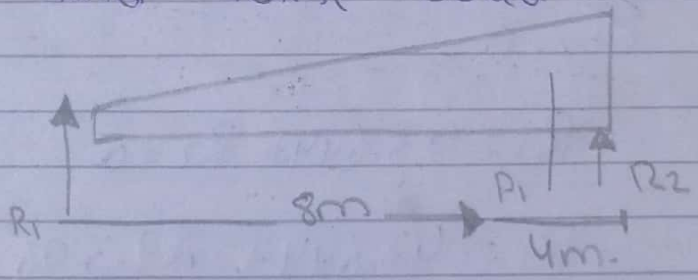


Q3:- Draw The near force and bending moment diagrams. Show all your Calculations. (UVL = Student ID No (1000) Marks = 15 (CLO=02).



Free body Diagram.

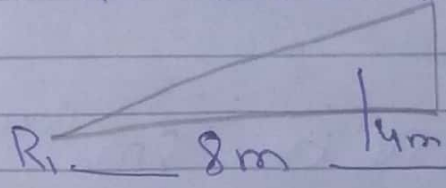
To find Point load.



Point load.

$\Rightarrow P_1 \; \frac{1}{2} (7.274) \times 12.$

$= P_1 = 43.644 \cdot KA1$



$P_1 = 43.644 \, KN.$

To Find The Reaction.

$\Sigma M_2 = 0$.

$-8 \times P_1 + 12 \times R_2 = 0$.

$12R_2 = 8P_1$

$= 12R_2 = 8 \times 43.644$.

$12R_2 = 349.152$.

$= R_2 = 29.096 KN$.

$\Sigma F_V = 0$.

$R_1 = 43.644 + R_2 = 0$

$R_1 = 43.644 + 29.0.96 = 0$

$= R_1 = 43.644 - 29.096$.

$= R_1 = 14548 KN$.

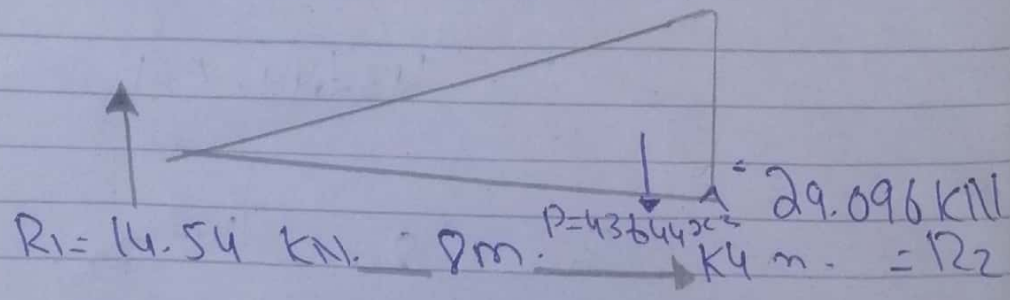


Fig shear force at different. section.

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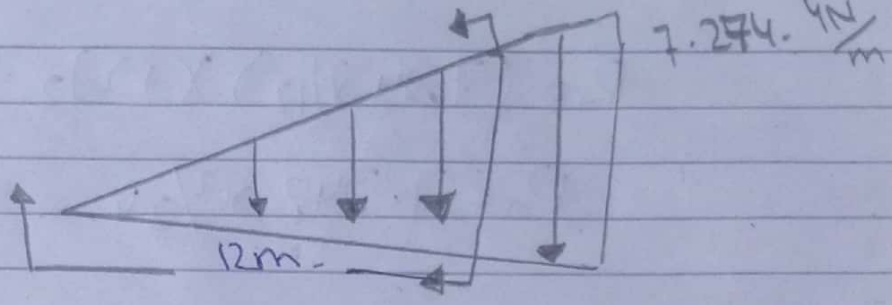
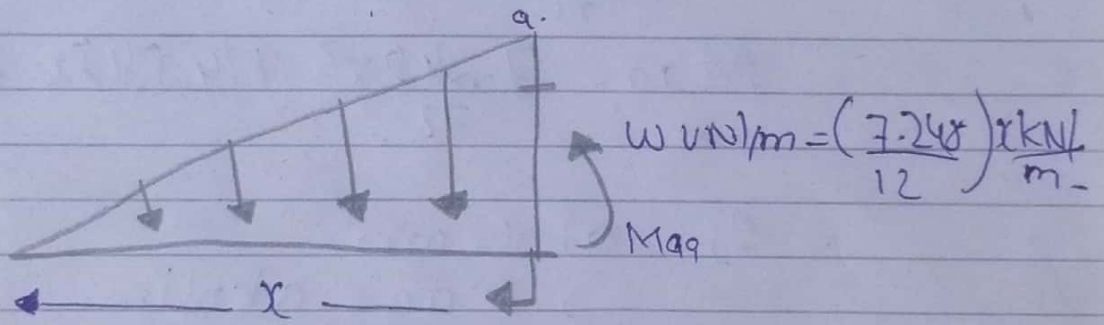


$R_1 = 14.548 kN$ $(0 \leq x \leq 12m)$ $R_2 = 29.0964 kN$.

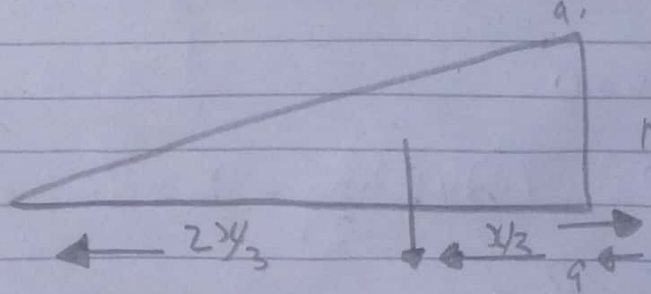
Take Section 9-9.



14.548 kNm.

From Law of similar Triangle.

$$\frac{7.274 kNm}{12m} = \frac{7.248/12}{x}$$



14.548 xkNm.

$1 M_{qq} + \left(\frac{2x}{3}\right) R_1 - (14.548) x = 0 - 0$

$P_1 = (7.248/12)\, x \cdot x/2$

$P_1 = 7.248\, x^2/24.$

$\Rightarrow Maa = -\frac{x}{3} \cdot 7.248 \frac{x^2}{24} + 14.548x$

$Maa = \frac{x^3}{72} \cdot 7.248 + 14.548x$

$Maa = \frac{7.248 x^3}{72} + 14.548x \quad -(9)$

1) at $x = 0m$

$\Rightarrow maa = 0 kNm/m.$

2) at $x = 12m.$

$= maa = 0.k.NNm.$

are The Points where The bend. moment is Zero.

The Point where sheam force is $=$

$\Sigma F_V = 0.$

$14.548 - 7.248 \frac{x^2}{24} = V_0 = 0.$

at $x = 0$

$14.548 - 7.248 - V = 0$

$14.548 - 7.248 \frac{x^2}{24} = 0 = 0.$

$\frac{x^2}{24}) 7248 = 14.548.$

$0.304x^2 = 14.546.$

$\Rightarrow x^2 = \frac{14.548}{0.304}.$

$\sqrt{x^2} = \sqrt{48.172}$

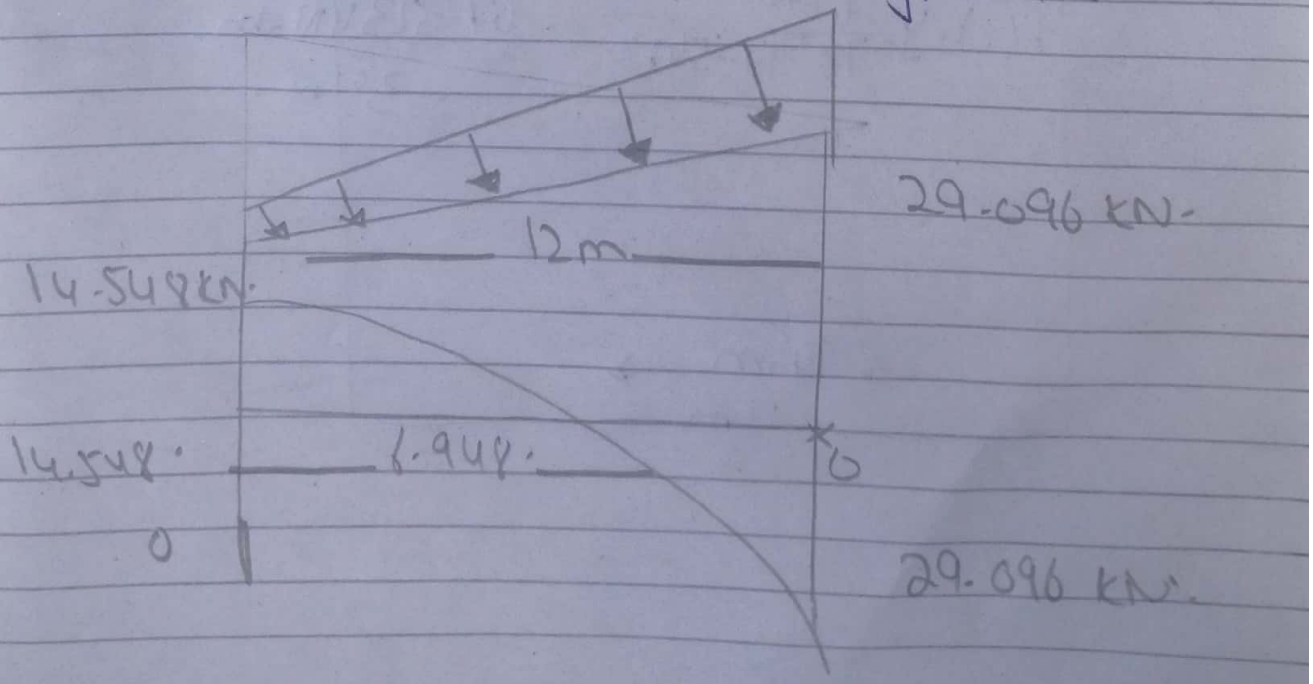
$\Rightarrow x = 6.940.$

at $x = 6.940$ $V = 0.$

$Maa = -\frac{7.248(6.940)^3}{72} + 14.548(6.940).$

$Maa = 67.323 \text{ un.m}$

for shear force Daigram.



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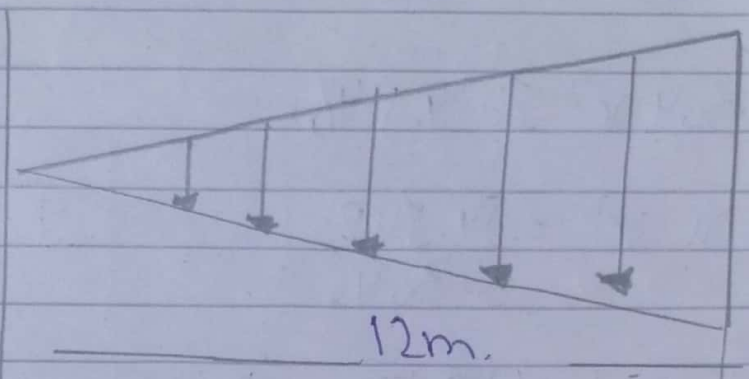
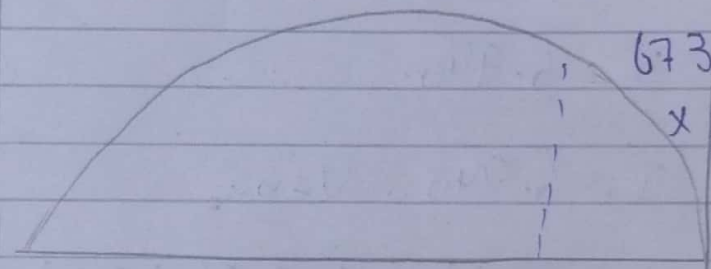
Bending moment diagram.

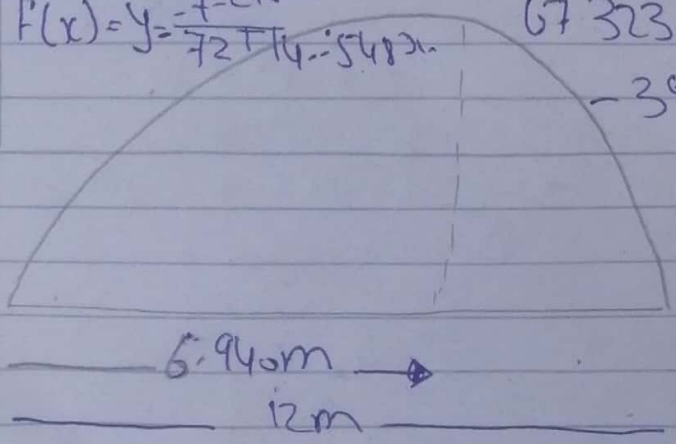




12m.

Shear force.

$F(x) = y = \frac{7 - 24}{72 + 14} = 54x.$



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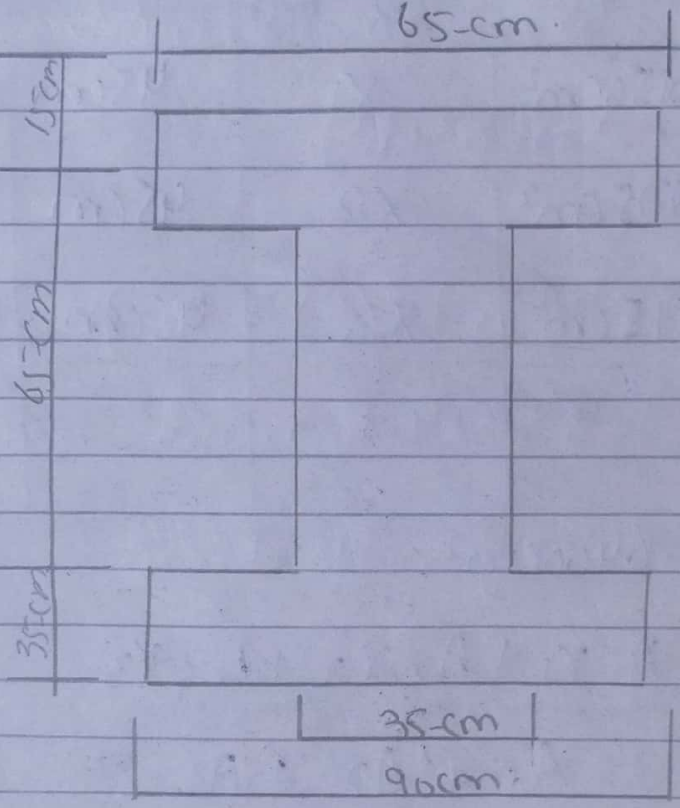
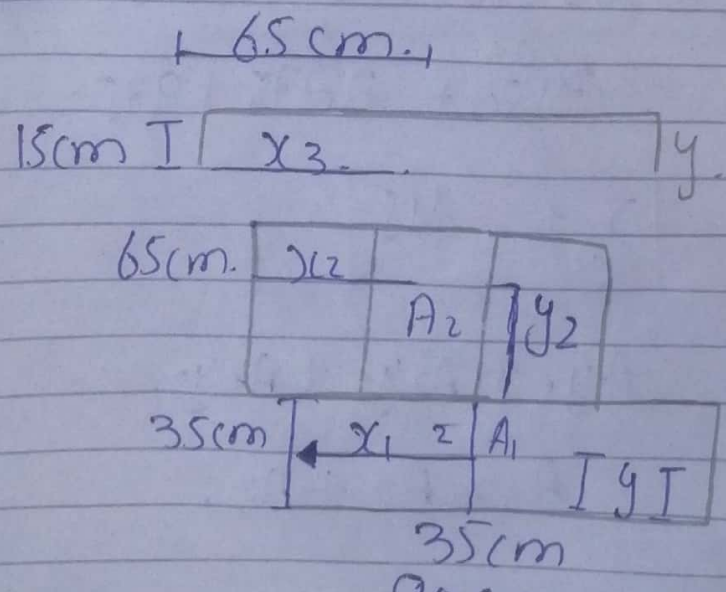
Q4:- Find The Centroid of the given Shape. Show all your calculations.



(b) For mid area (65cm x 35cm) only find The moment of Inertia, Radius of Gyration & section moduli. (Mark = 2+2+2 - (10-02)



$3150cm^2$	x_1	45cm	$\frac{y=1}{1}$

A_1	$3150cm^2$	x_1	45cm	$y_1=17.5$
A_2	$2275cm^2$	x_2	45cm	$y_2=50.$
A_3	$975cm^2$	$x_3.$	45cm	$y_3=107.5.$
$\Sigma A.$				

$\Sigma A. \rightarrow 6400cm^2.$

$$x_2 = \frac{A_1x_1 + A_2x_2 + A_3x_3}{A_1 + A_2 + A_3.}$$

$$y_2 = \frac{A_1y_1 + A_2y_2 + A_3y_3}{A_1 - A_2 + A_3.}$$

$$x_2 = \frac{(3150)(45) + (2275)(45(\ 975)(45(45)}{3150 + 2275 + 975.}$$

$$\boxed{\bar{x} = 45}$$

$$y_2 = \frac{A_1y_1 + A_2y_2 + A_3y_3.}{A_1 + A_2 + A_3.}$$

$$y_c = \frac{(3150)(17.5)+(2275)(50)+(975)(107.5)}{3150+2275+975}$$

$$\boxed{y_c = 42.76.}$$

Q4(B). Given data.

area = 65cm x 35cm.

Required?

moment of Inertial = ?
Radius of Gyration ?
Section of moduli = ?

For moment of inertial.

$I_x \quad 1/6b^3$

$= 1/3\,(65)x(35)^3$

$= 1/3\,(65)(35)^3 = 928958\,mm^4.$

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

$1/3\,(65)^3(35) = 3203958\,mm^4.$

$I_x' = 1/12\,bh^3.$

$= 1/12\,(65)(35)^3 = 665.4\,mm^4.$

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$\bar{I}y = \frac{1}{12} b^3 h.$

$\frac{1}{12}(65)^3(35) = 800989\ mm^4.$

$Jc = \frac{1}{12} bh(b^2+h^2)$

$\frac{1}{12}(65)(35)(65^2+35^2)$

$= 1033229.16.mm^4$

(b) Radius of gyration

$r = \left(\frac{I}{A}\right)^{1/2}$ $A = b \times d.$

$A = 65 \times 35$

$1/2 = 2275$

$r = \left(\frac{1033229.16}{2275}\right)$

$r = 21.31\ mm.$

(c) Section moduli.

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

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

$S = 13270.83\ mm^3$

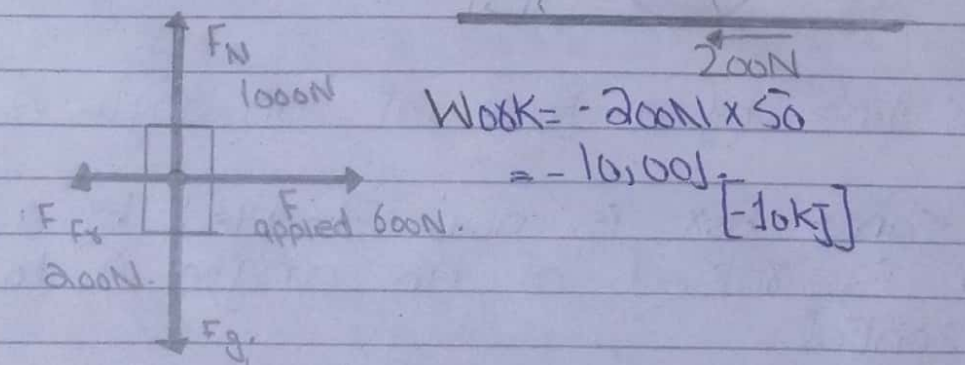
Q5:- Explain work. energy & Power in details along with practical examples from daily life. (Marks = 10, CLO-01).

Work:- The application of a force. Through certain distance is known as work. It measured in Joules. (J)

Work = Force x Distance Travelled in direction of force.
$W = F \cdot d$.

Work Done by Friction.

W is the work done (J)
F is the force applied (N.
d is the distance (M).



Work = -200N x 50
= -10,000J.
[-10kJ]

Work: Example.

A box is Pushed across a floor by a constant force of 100N. What is the work done by the force to move the box 5m?

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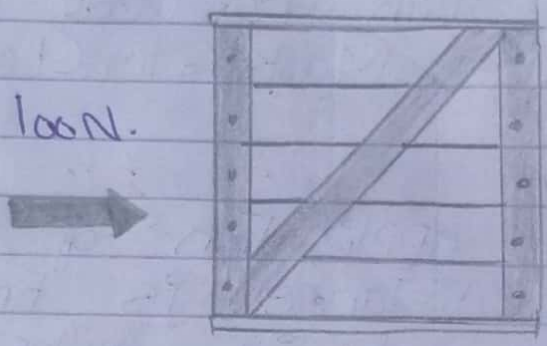


$W = fs$
$= 100 \times 5$
$= 500\,J.$

If the floor is smooth, where does this energy go?

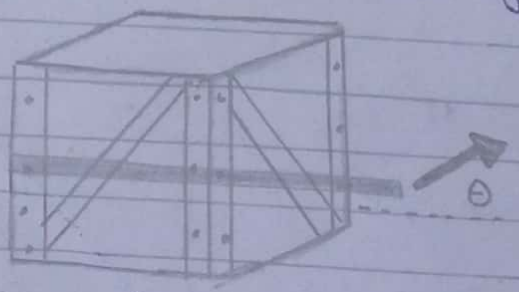
The box accelerates & gains kinetic energy.

If the floor is rough, where does the energy go?

Some or all the energy is lost as heat & sound.

Work done by a force at an angle θ

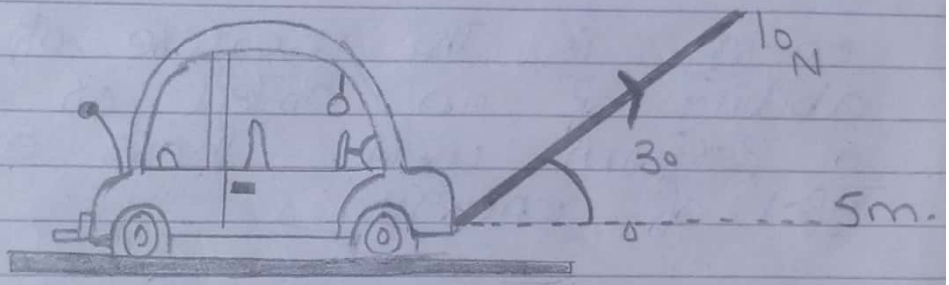
The same box is now dragged by a rope which is raised at an angle θ to the horizontal.



This time the box moves in a different direction to the direction of the applied force. How does this affect the work done? Can you think of any suggestions?

Work : Example.

A Toy Car 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 10N, if it is Pulled along 5m.



$$W = F s \cos\theta$$
$$= 10 \times 5 \times \cos 30^\circ$$
$$= 43.3 J.$$

Energy: is the measure of the ability of an object or a system to perform work. Its unit is Joule & is denoted by J. There are many Types of energy.

- kinetic energy.
- elastic energy.
- Nuclear energy.
- gravitational Potential energy.
- chemical energy.

1. Joule (J) is The Mks unit of energy. equal to The force of one Newton acting Through one meter.

1 Joule (J) = 1N-m.

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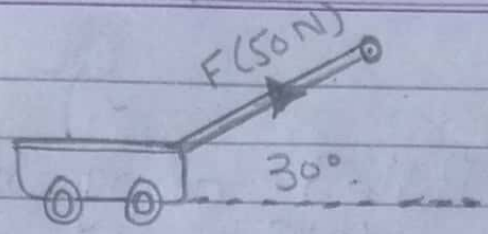


What is energy?

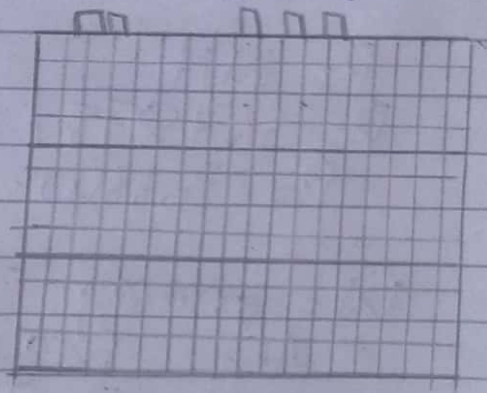
energy is the measure of the ability of an object or a system to perform work. There are many types of energy:

- Kinetic energy:- energy of an object due to its speed.
- Gravitational Potential energy:- energy of an object due to position in 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 things have more energy than their cold counterparts.

Ep: Example:-

A supermarket employee lifts a baked bean tin, weighing 250 g from the floor. To a shelf 2m high. How much gravitational Potential energy does it gain?

($g = 9.81\ Ng^{-1}$).



$\Delta EP = MG\Delta h$

$= 0.250 \times 9.81 \times 2$

$= 4.9\ J.$

What is Power?

Power is the rate at which work is done, or the rate at which energy is Transferred.

Power = work done / Time Taken

$P = W/t.$

Where:-

- Power is measured in watts (w)
- Work done or energy Transferred is measured in Joules (J).
- Time is measured in seconds (s).

Power : Example.

A Crane lifts a load of 1500 kg to a height of 25m at a steady rate, in at Time of 2 min. What is Power of The Crane?

$P = W/t$

$P = 367875 / 120.$

$P = 3066W.$

W = energy Transferred $= \Delta E.$

$\Delta Ep = MgAh.$

$W = 1500 \times 9.81 \times 25$

$W = 367875 J.$