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Subject Engineering Mechanics

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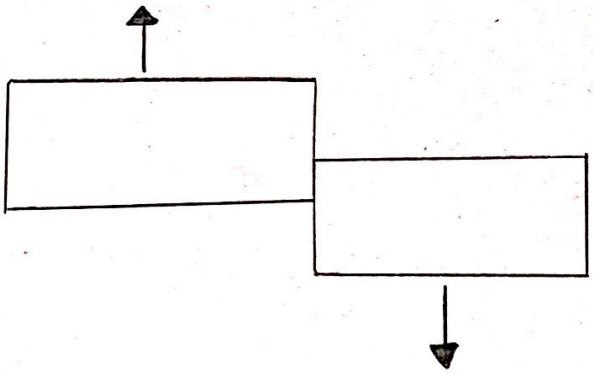
Summer Final term Exam

Q1) Briefly discuss shear force and bending moment. Also differentiate between moment of resistance and bending moment.

Ans Shear force:-

A shear force is a force applied perpendicular to a surface, in opposition to an offset force acting in the opposite direction. This results in a shear strain. In simple terms, one part of the surface is pushed in one direction, while another part of the surface is pushed in the opposite direction.



Bending Moment:-

A bending moment is the reaction induced in a structural element when an external force or moment is applied to the element causing the element to bend. The most common

of simplest structural element subjected to bending moment is the beam. It is measured in terms of force and distance.

Difference b/w Bending Moment & Moment of Resistance.

Bending Moment:-

A bending moment is the reaction persuaded in a structural element when an external force or moment is applied to the element affecting the element to bend.

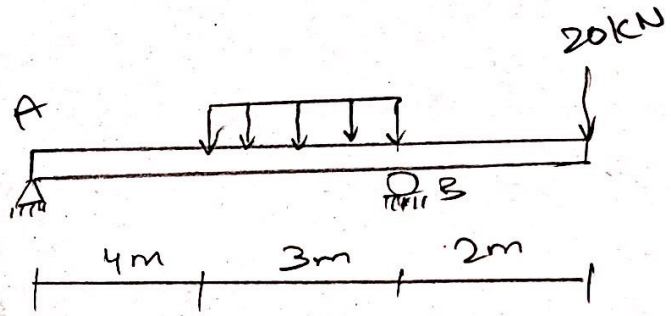
Moment of Resistance:-

The moment of resistance is the couple formed by the internal forces in a beam subjected to bending under the maximum permissible stress.

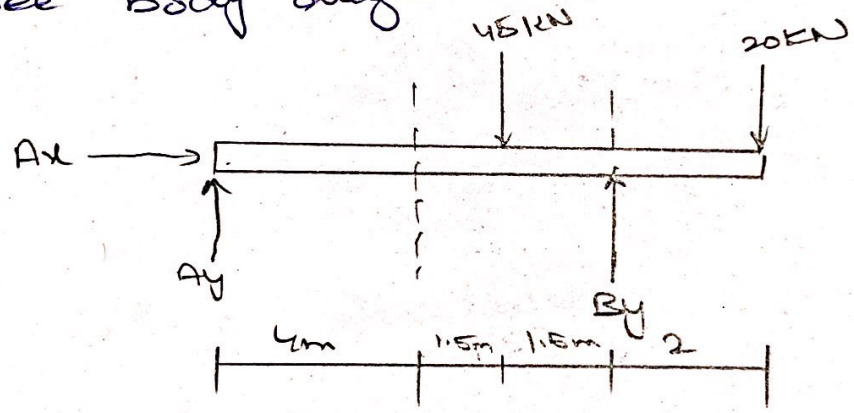
Q2

Draw shear force - - -

1)



Free body diagram



$\Sigma f_x = 0 \xrightarrow{+}$ $\quad A_x = 0$

$\Sigma f_y = 0 \uparrow^{+}$

$A_y - 45 + B_y - 20 = 0$

$$\boxed{A_y + B_y = 65\,KN}$$

$\Sigma M_A = 0 \curvearrowright^{+}$

$45(5.5) - B_y(7) + 20(9) = 0$

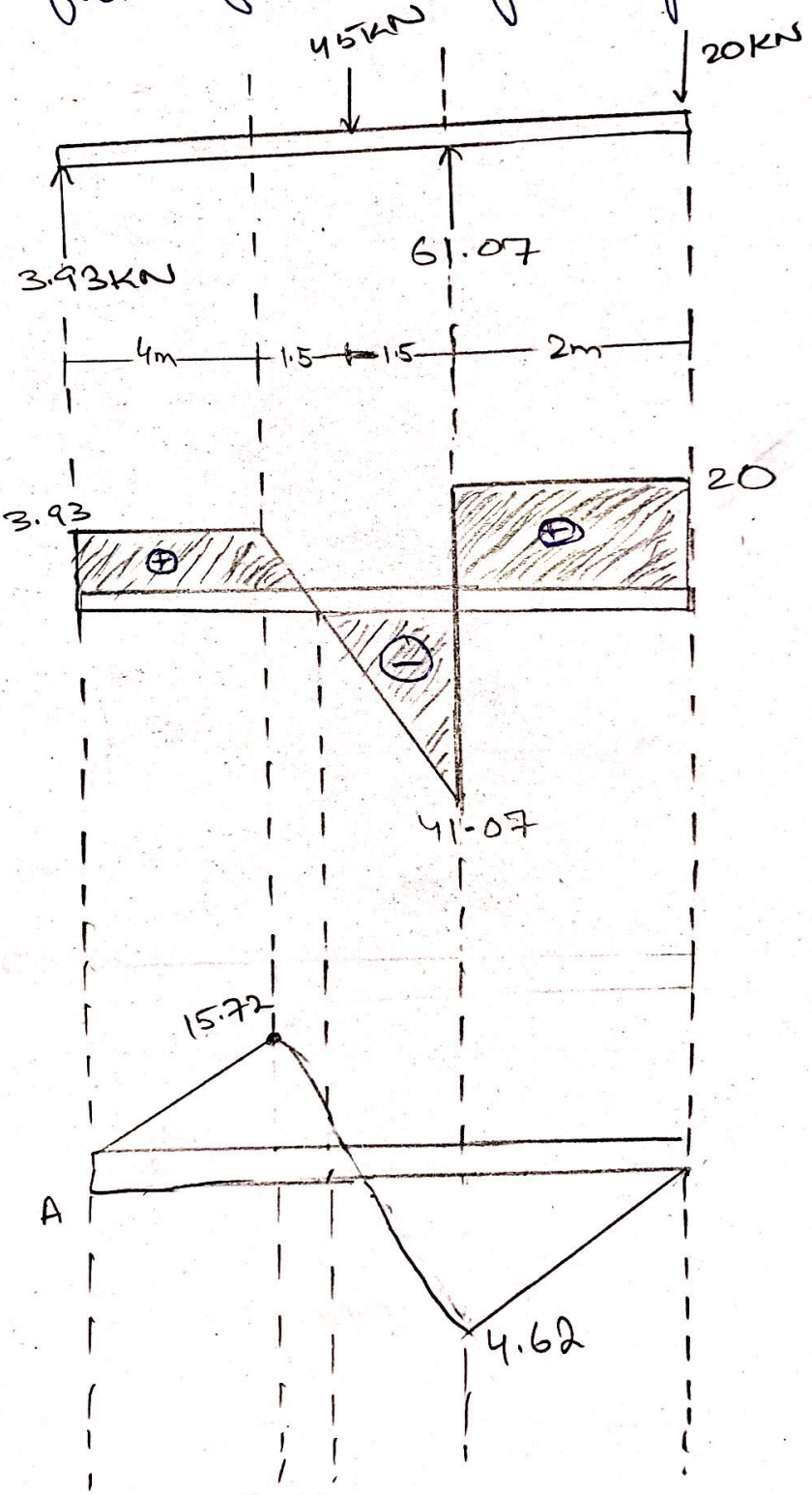
$247.5 - 7B_y + 180 = 0$

$B_y = 427.5/7$

$$B_y = 61.07$$

→ $$A_y = 3.93$$

Now from free body diagram.

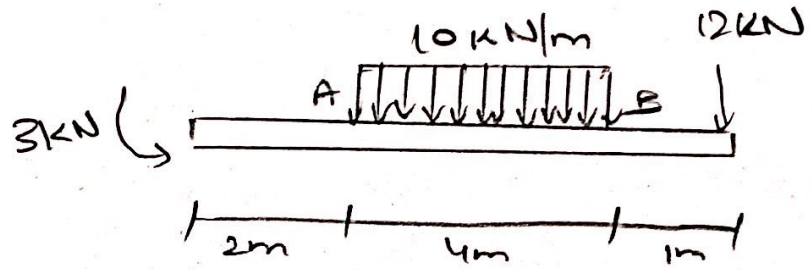


SFD

BM

Part (B)

2)



By taking moment at A

$\Sigma M_A = 0$

$-R_{BY} \times 4 - 3 + 10 \times 4 \times 4/2 + 12 \times 5 = 0$

$R_{BY} = 34.25KN$

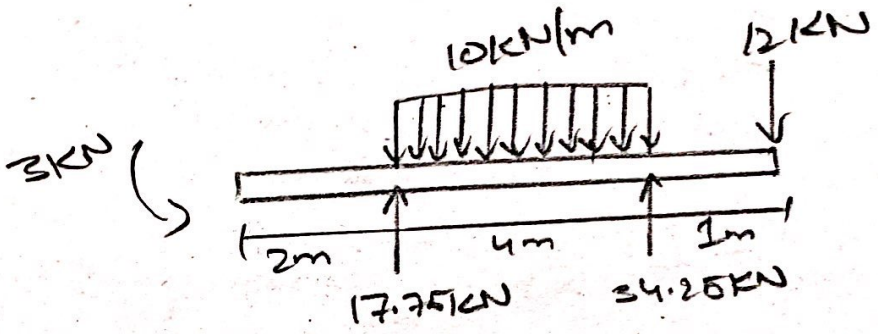
$\Sigma f_y = 0$

$R_{AY} + R_{BY} = 10 \times 4 + 12$

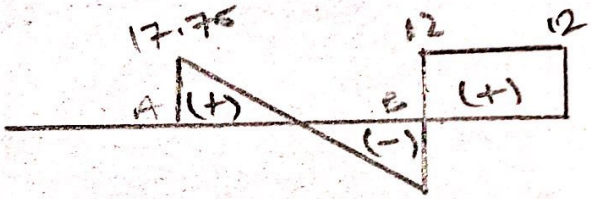
$R_{AY} = 17.75KN$

$\Sigma f_x = 0$

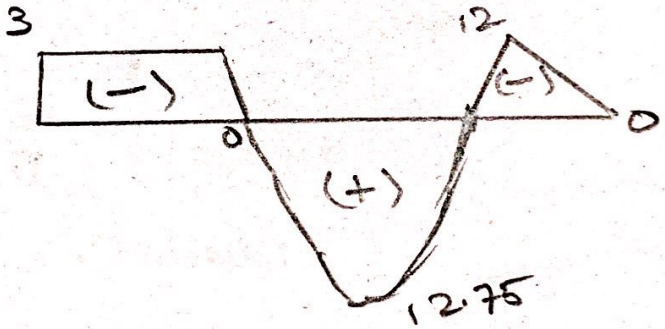
$R_{AX} = 0$



SFD(KN)



BMD (KNm)



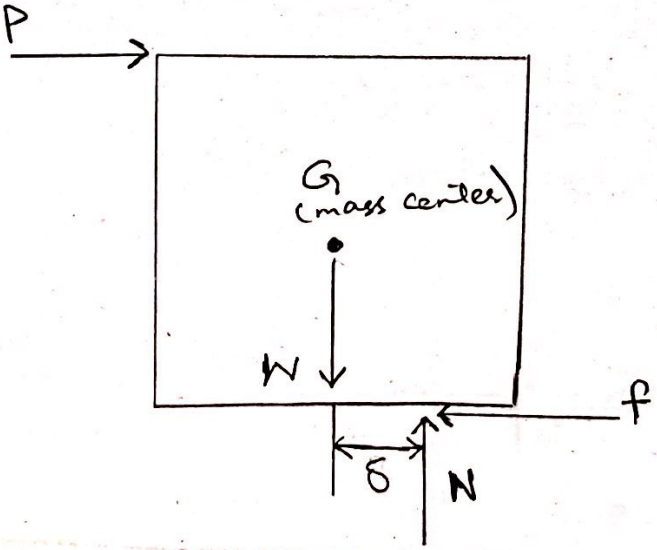
Q3 Briefly describe coulomb theory of friction

Ans Coulomb's law of friction:-

The law states that for two dry solid surfaces sliding against one another, the magnitude of the kinetic friction exerted through the surface is independent of the magnitude of the velocity (ie; the speed) of the slipping of the surfaces against each other.

Coulumb Friction:-

- Opposes impending motion.
- Is tangent to the surface of contact.
- Is a function of the normal force and the surface material.



Q3 (8)

2) Define the following terms.

1) Principle axes:-

Principal Axes are the Plane X-Y Axes about the centroid of the Area.

If you rotate the coordinate system, the components of the angular velocity and the angular moment vectors and the moment of Inertia all change. It turns out there's a coordinate system that makes the moment of Inertia tensor matrix diagonal. It only has three non-zero coefficients, on the main diagonal. The physical significance of this is that objects are ~~then~~ only happy to spin without wobbling about the x, y and z axes of the coordinate system that diagnolizes the moment of Inertia tensor matrix. These are the principal axes.

2) Radius of Gyration:-

The moment of Inertia of a body about an axis is sometimes represented using the radius of gyration. Now, what do you mean by radius of gyration? We can define the radius of gyration as the imaginary distance from the centroid at which the area of cross-section is imagined to be focused at a point in order to obtain the same moment of Inertia. It is denoted by k. The radius of gyration is used to compare how various structural shapes will behave under compression along an axis. It is used to predict buckling in a compression beam or member.

3) Work:-

The definition of work in physics reveals its relationship to energy - whenever work is done, energy is transferred. For a work to be done, a force must be exerted and there must be displacement in the direction of the force with this said we can say that

Work is the product of the component of the force in the direction of the displacement and the magnitude of the displacement.

$$W = \Delta E$$
$$W = F \times d$$

W = work done (J)

ΔE = Energy transferred (J)

F = force (N)

d = distance moved in the direction of the force. (m)

4) Power:-

Power is the rate at which energy is transferred or the rate at which work is done.

$$P = \frac{W}{t}$$

$$P = \frac{\Delta E}{t}$$

P = Power (Watt)

W = Work done (J)

ΔE = Energy transferred (J)

t = time (s)

5) Energy:-

Energy is defined as the capacity of a physical system to perform work. Energy exists in several forms such as heat, kinetic or mechanical energy, light potential energy, electrical, solar, wind hydroelectric or other forms.

6) Newton equation of Motion:-

Newton's second law, which states that the force F acting on a body is equal to the mass m of the body multiplied by acceleration of its centre of mass $F=ma$ is the basic equation of motion