

NEW

Semester - II

Engineering Mechanics

UNIT

2

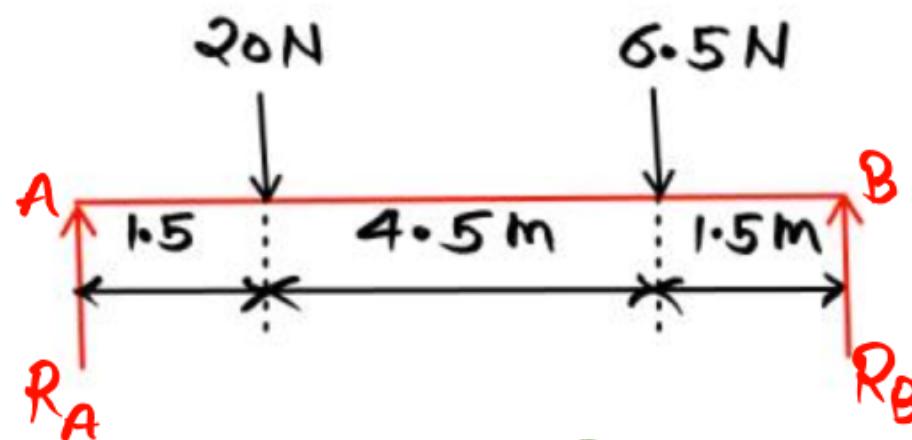
Equilibrium (संतुलन)

UNIT-II Equilibrium

Equilibrium and Equilibrant, Free body and free body diagram, Analytical and graphical methods of analysing equilibrium. Lami's Theorem statement and explanation, Application for various engineering problems.

Beam- Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, uniformly distributed load, couple), Beam reaction for cantilever, simply supported beam with or without overhang - subjected to combination of Point load and uniformly distributed load.

Q.



समनुलिखन के सभी० से

$$\sum F_y = 0 \text{ से}$$

$$R_A + R_B - 20 - 6.5 = 0$$

$$R_A + R_B = 26.5 \text{ N} \quad \textcircled{1}$$

$\sum M_A = 0$ से (taking moment about Point A)

$$R_B \times 7.5 - 6.5 \times 6 - 20 \times 1.5 + R_A \times 0 = 0$$

$$7.5 R_B - 39.0 - 30 = 0$$

$$7.5 R_B = 69 \Rightarrow R_B = 9.2 \text{ N} \quad \underline{\text{Ans}}$$

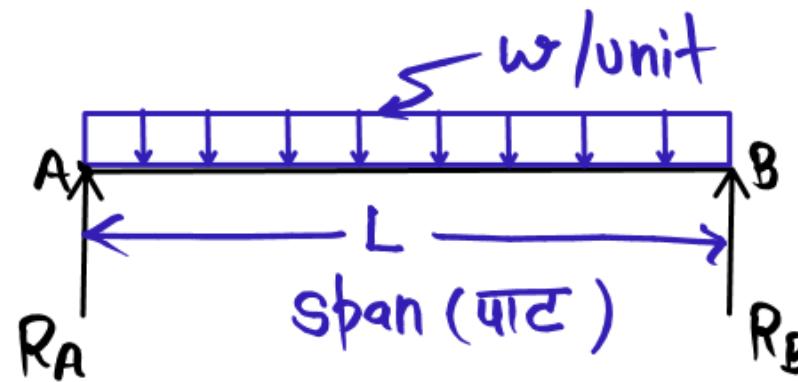
R_B का मान सभी० ① से लिया गया

$$R_A + 9.2 = 26.5$$

$$R_A = 17.3 \text{ N} \quad \underline{\text{Ans}}$$

शुद्ध आलंबिका धरन के लिए प्रतिक्रिया, जब धरन की सम्पूर्ण भृक्ति पर समर्पित भार लगा है -

(Reactions for Simply supported beam subjected to U.D.L at total Length.)



सन्तुलन के समीक्षा

$$m_F = 0$$

$$R_A + R_B - w \times L = 0$$

$$R_A + R_B = w \cdot L$$

$$R_B \times L - wL \times \frac{L}{2} + R_A \times 0 = 0$$

for U.D.L.

$$\text{total Load} = U.D.L \times \text{Length}$$

Moment = total Load \times Length
2

$$L \cdot R_B - \frac{\omega L^2}{2} = 0$$

$$L \cdot R_B = \frac{\omega L^2}{2}$$

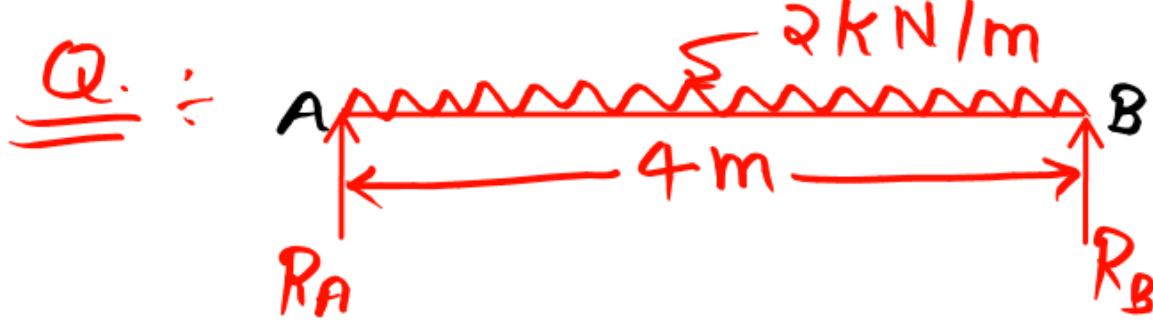
$$R_B = \frac{\omega L}{2}$$
 समी० १ के रखने पर

$$R_A + \frac{\omega L}{2} = \omega L$$

$$R_A = \frac{\omega L}{1} - \frac{\omega L}{2}$$

$$R_A = \frac{2\omega L - \omega L}{2}$$

$$R_A = \frac{\omega L}{2}$$



संतुलन के समी०

$$\sum F_y = 0 \text{ से}$$

$$R_A + R_B - 8 = 0$$

$$R_A + R_B = 8 \text{ KN} \quad \text{--- ①}$$

$\sum M_A = 0$ से (taking moment about Point A)

$$R_B \times 4 - (2 \times 4) \times \frac{4}{2} + R_A \times 0 = 0$$

$$4R_B - 16 = 0$$

$$R_B = \frac{16}{4} \Rightarrow R_B = 4 \text{ KN}$$

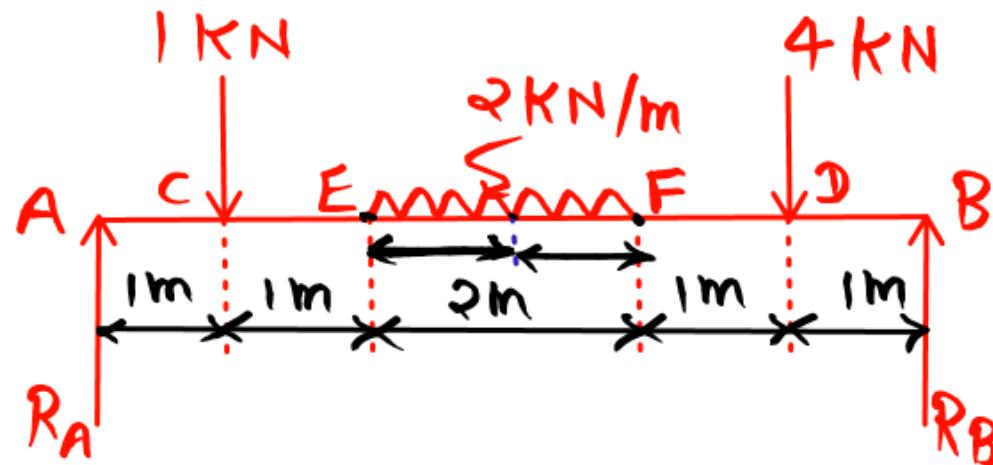
Put in Eq ①

$$R_A + 4 = 8$$

$$R_A = 8 - 4$$

$$R_A = 4 \text{ KN}$$

Q.



सन्तुलन के समीक्षण

$$\sum F_y = 0 \text{ से}$$

$$R_A + R_B - 1 - 4 - 2 \times 2 = 0$$

$$R_A + R_B - 5 - 4 = 0$$

$$R_A + R_B = 9 \text{ KN} \quad \text{--- (1)}$$

$\sum M_A = 0$ से (taking moment about Point A)

$$R_B \times 6 - 4 \times 5 - 4 \times \left(\frac{2}{2} + 2 \right) - 1 \times 1 + R_A \times 0 = 0$$
$$6R_B - 20 - 4 \times 3 - 1 = 0$$

$$6R_B - 20 - 12 - 1 = 0$$

$$6R_B - 33 = 0$$

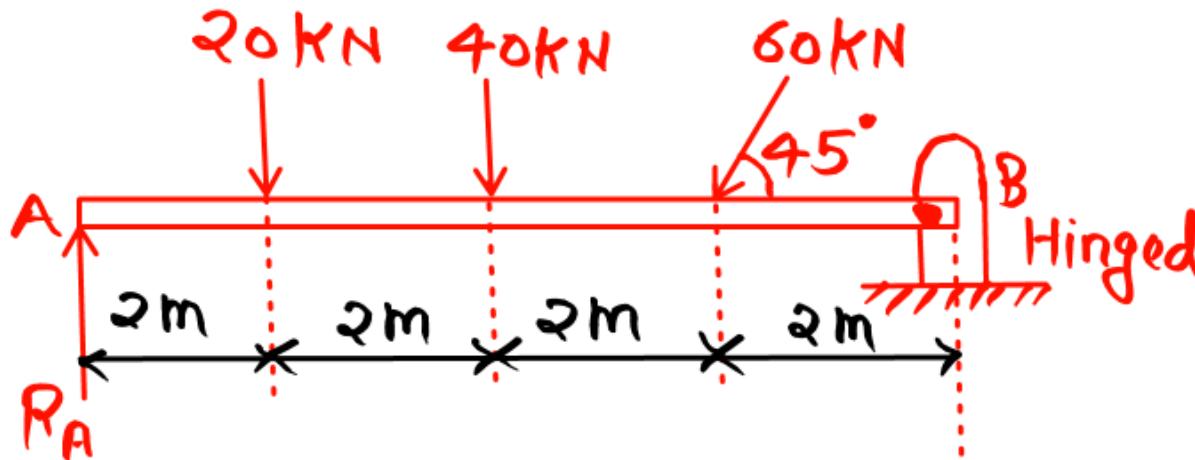
$$R_B = \frac{33}{6}$$

$$R_B = 5.5 \text{ KN} \quad \text{Put in Eq (1)}$$

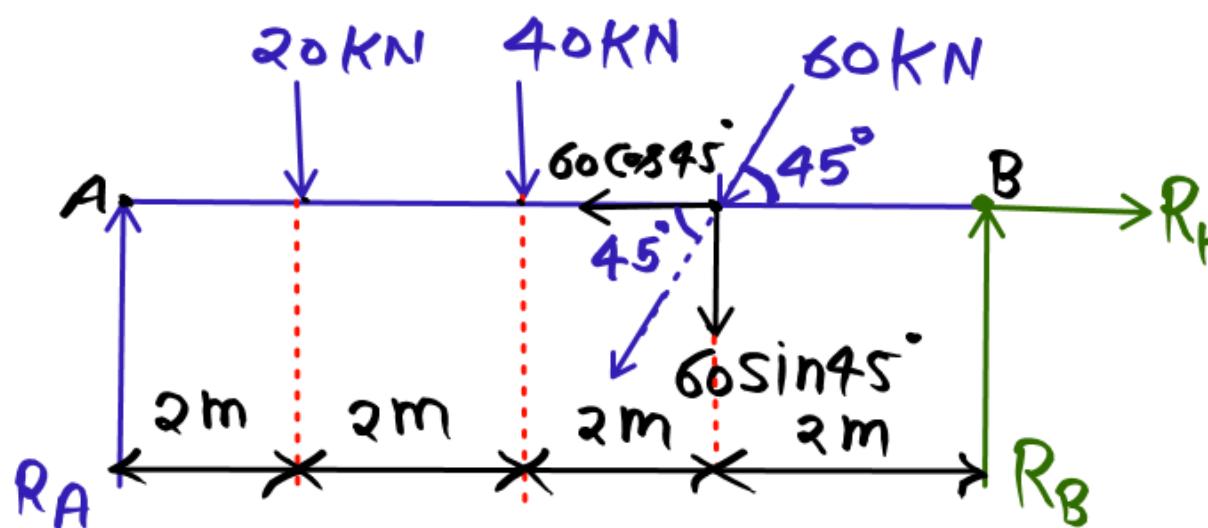
$$R_A + 5.5 = 9$$

$$R_A = 3.5 \text{ KN}$$

Q.:-



F.B.D.



संतुलन के समी०

$$\sum F_x = 0 \text{ से } (-\leftarrow +)$$

$$R_H - 60\cos 45^\circ = 0$$

$$R_H = 42.426 \text{ KN} \quad \underline{\text{Ans}}$$

$$\sum F_y = 0 \text{ से}$$

$$R_A + R_B - 20 - 40 - 60\sin 45^\circ = 0$$

$$R_A + R_B - 20 - 40 - 42.426 = 0$$

$$R_A + R_B = 102.426 \text{ KN} \quad \underline{\text{①}}$$

$$\sum M_A = 0 \text{ से } (\text{taking moment about Point A})$$

$$R_B \times 8 - 60\sin 45^\circ \times 6 - 40 \times 4 - 20 \times 2 + R_A \times 0 = 0$$

$$8R_B - 254.558 - 160 - 40 = 0$$

$$8R_B = 454.558$$

$$R_B = 56.82 \text{ KN} \quad \underline{\text{Ans}} \quad \text{Put in Eq. ①}$$

$$R_A = 102.426 - 56.82 \Rightarrow R_A = 45.60 \quad \underline{\text{Ans}}$$

Q.1

15 मी. लम्बे दोनों किनारों पर सरल आधारित एक बीम पर 5 KN, 6 KN तथा 4 KN के लोड वायं सपोर्ट से क्रमशः 3 मी., 9 मी. और 6 मी. की दूरी पर क्रिप्ताशील हैं। दोनों सपोर्ट पर उत्तिक्रिप्त कात कीजिए।

"Loads 5 KN, 6 KN and 4 KN acts on a simply supported beam of length 15m at distance 3m, 9m and 6m from Left support.
Find out the reactions on both supports."

(H.W.)

$$R_A = 8.8 \text{ KN}$$

$$R_B = 6.2 \text{ KN.}$$

