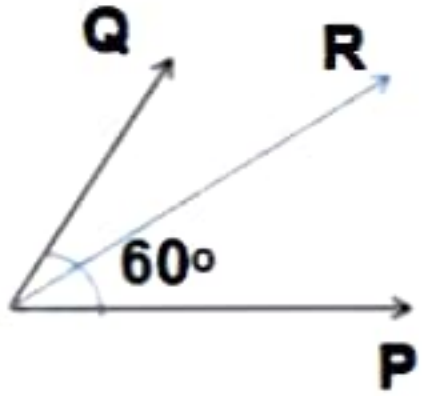
PROB 1: In a concurrent force system, two forces are acting at an angle of 60°. The resultant force is 120kN and one of the forces is 80kN. Determine the other force.



Soln : Given P=80kN, R=120kN, α=60°, Q=?

We know, $R^2 = P^2 + Q^2 + 2PQ\cos\alpha$

or $120^2 = 80^2 + Q^2 + 2x80xQ\cos60°$

or $14400 = 6400 + Q^2 + 80Q$

or $Q^2 + 80 - 8000 = 0$

or $Q = [-80 \pm \sqrt{80^2 - 4x1x(-8000)}] / 2x1$

or $Q = 57.98$ kN or -137.98 kN

(Taking +ve value, since –ve value means α = 120°

∴ Q = 57.98 KN (Ans)

PROB 2: In a concurrent force system, two forces are acting on a point in two different conditions. If they act at 60°, their resultant is 24kN and if they act at 90°, their resultant is 20kN, Determine the magnitude of two forces.

Soln: Let P & Q are the two forces.

i) $\alpha = 60°$, $R = 24kN$

$R^2 = P^2 + Q^2 + 2PQ\cos\alpha$

or $24^2 = P^2 + Q^2 + 2PQ\cos 60°$

or $P^2 + Q^2 + PQ = 576$ .....(i)

ii) $\alpha = 90°$, $R = 20$ kN

$\therefore R^2 = P^2 + Q^2 + 2PQ\cos\alpha$

or $20^2 = P^2 + Q^2 + 2PQ\cos 90°$

or $P^2 + Q^2 = 400$ .....(ii)

From equⁿ (i) $400+PQ = 576$ or $PQ = 176$

Now $(P+Q)^2 = P^2 + Q^2 + 2PQ$

or $(P+Q)^2 = 400+2x176$ or $(P+Q)^2 = 752$

or $P+Q = 27.42$ .....(iii)

Again $(P-Q)^2 = P^2 + Q^2 - 2PQ$

or $(P-Q)^2 = 400 - 2x176 = 48$

or $P-Q = 6.93$ .....(iv)

From equⁿ (iii) & (iv)

$P + Q = 27.42$

$P - Q = 6.93$

$2P = 34.35$

or $P = 17.18kN$ (Ans)

$\therefore Q = 27.42-17.18 = 10.24kN$ (Ans)

PROB 3: Two forces equal to 2P and P act on a Particle. If the first is doubled and the Second is increased by 15N, the direction of resultant remains same. Find the value of P.

Soln : Case i) $\tan\theta = P\sin\alpha / (2P+P\cos\alpha)$ ..... (i)

Case ii) $\tan\theta = (P+15)\sin\alpha / [4P+(P+15)\cos\alpha]$ .....(ii)

From equn (i) & (ii)

$P\sin\alpha / (2P+P\cos\alpha) = [(P+15)\sin\alpha] / [4P+(P+15)\cos\alpha]$

or $1 / (2+\cos\alpha) = P+15 / [4P+(P+15)\cos\alpha]$

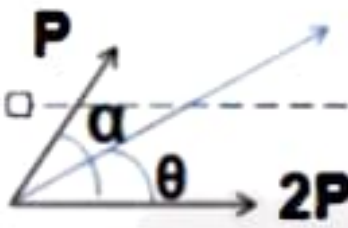
or $4P + P\cos\alpha + 15\cos\alpha = 2P + 30 + P\cos\alpha + 15\cos\alpha$

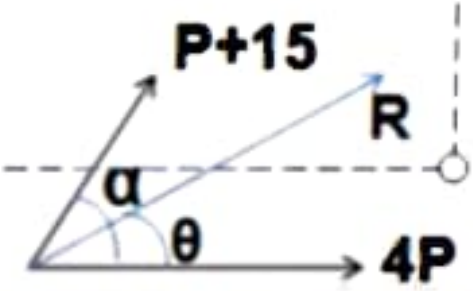
or $1/2+\cos\alpha = P+15 / 4P+(P+15)\cos\alpha$

or $4P + P\cos\alpha + 15\cos\alpha = 2P+30+P\cos\alpha+15\cos\alpha$

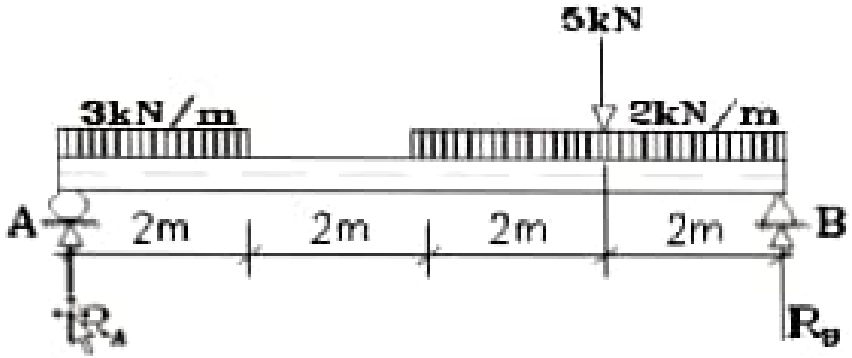
or $2P = 30$

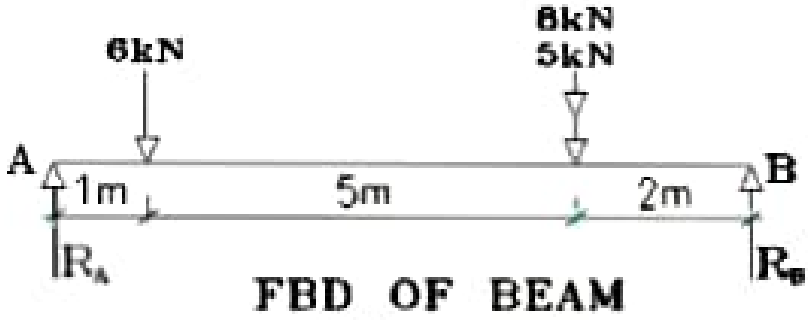
or $P = 15kN$ (Ans)





PROB 4: A simply supported beam AB, 8m long is loaded as shown in Fig. Determine the reactions at supports A & B.





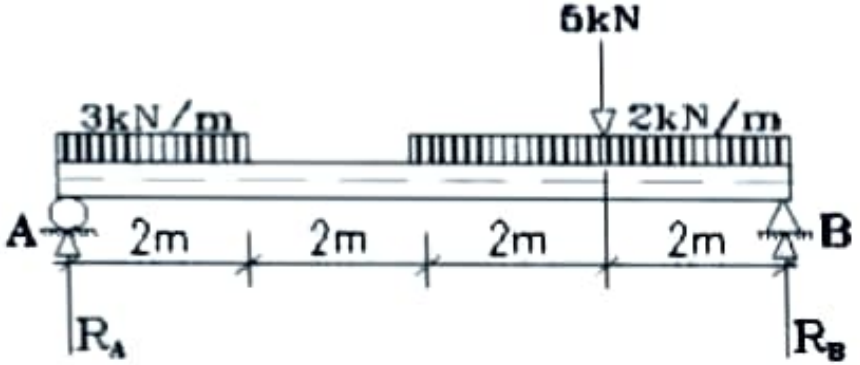
Sol^n : Let R_A and R_B are reactions at A and B.

By taking moment at B, $\Sigma M_B = 0$

$$-R_A \times 8 + 6\times7+5\times2+8\times2 = 0$$

or $$-R_A \times 8 + 42+10+16 = 0$$

or $$R_A \times 8 = 68, \quad \text{or} \quad R_A = 8.5 \text{ kN (Ans)}$$



FBD OF BEAM

Sol^n : Let R_A and R_B are reactions at A and B.

By taking moment at B, $\Sigma M_B = 0$

$$-R_A \times 8 + 6\times7+5\times2+8\times2 = 0$$

or $$-R_A \times 8 + 42+10+16 = 0$$

or $R_A \times 8 = 68$, or $R_A =$ **8.5 kN (Ans)**

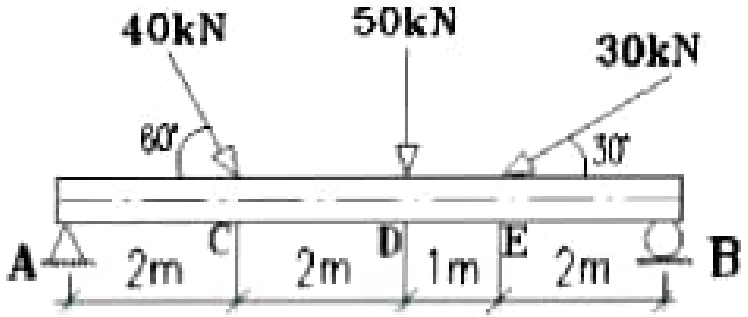
By taking moment at A, $\Sigma M_A = 0$

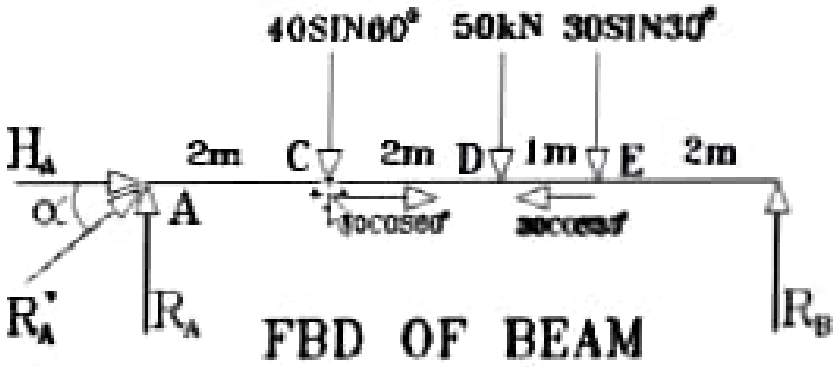
$$R_B \times 8 - 5\times6 - 8\times6 - 6\times1 = 0$$

or $$R_B \times 8 - 30 - 48 - 6 = 0$$

or $R_B \times 8 = 84$, or $R_b =$ **10.5 kN (Ans)**

PROB 5: For a simply supported beam AB as shown in Fig, find the reactions at supports A and B.





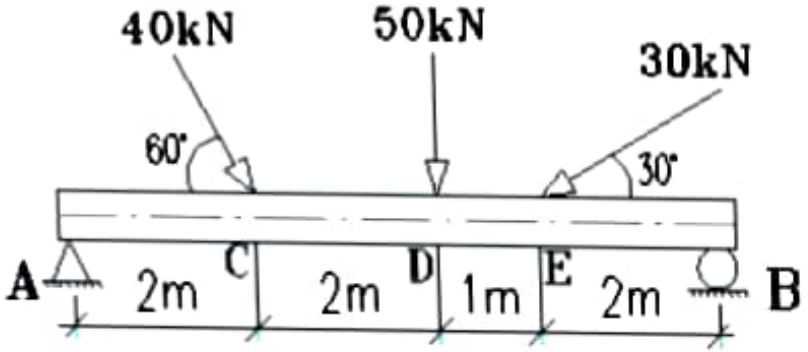
Sol^{n} : Let R_A and R_B are the reaction at A and B.

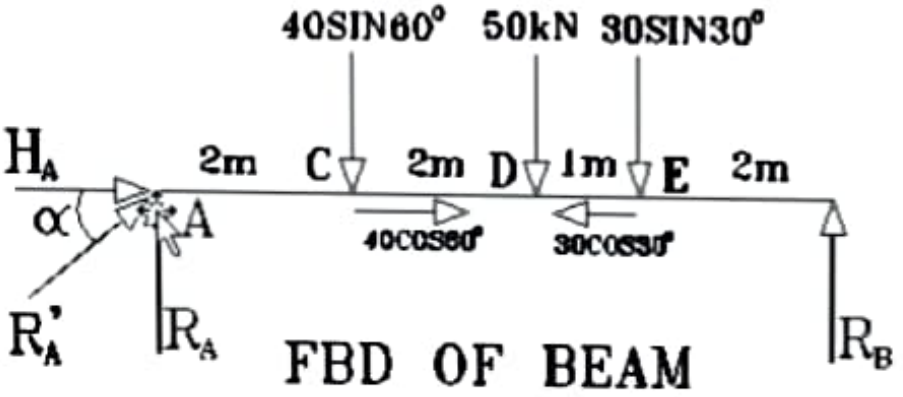
Considering FBD of beam.

Resolving the forces horizontally,

$\Sigma X=0,\ H_A + 40\cos 60° - 30\cos 30° = 0$

or $H_A = 25.98 - 20$ or $H_A = 5.98$ kN





Soln: Let R'_A and R_B are the reactions at A and B.

Considering FBD of beam.

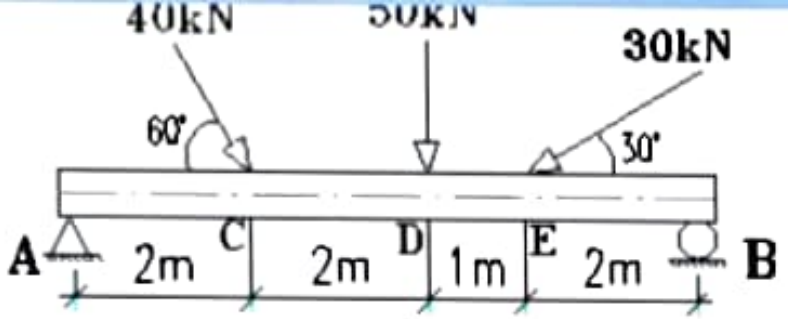
Resolving the forces horizontally,

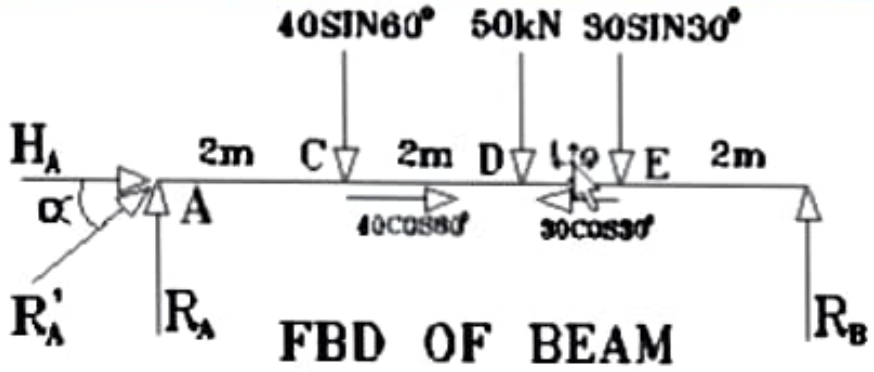
$\Sigma X=0,\ H_A + 40\cos60° - 30\cos30° = 0$

or $H_A = 25.98 - 20$ or $H_A = 5.98$ kN

Taking moment at B, $\Sigma M_B = 0$

$40\sin60°\times5+50\times3+30\sin30°\times2-R_A\times7=0$





Sol^{n} : Let R'_A and R_B are the reactions at A and B.

Considering FBD of beam.

Resolving the forces horizontally,

$$\Sigma X=0,\ H_A + 40\cos60^\circ - 30\cos30^\circ = 0$$

or $H_A = 25.98 - 20$ **or** $H_A = 5.98$ kN

Taking moment at B, $\Sigma M_B = 0$

$$40\sin60^\circ \times 5 + 50 \times 3 + 30\sin30^\circ \times 2 - R_A \times 7 = 0$$

or $R_A \times 7 = 173.2 + 150 + 30$

or $R_A \times 7 = 353.2$ **or** $R_A = 50.46$ kN (Ans)

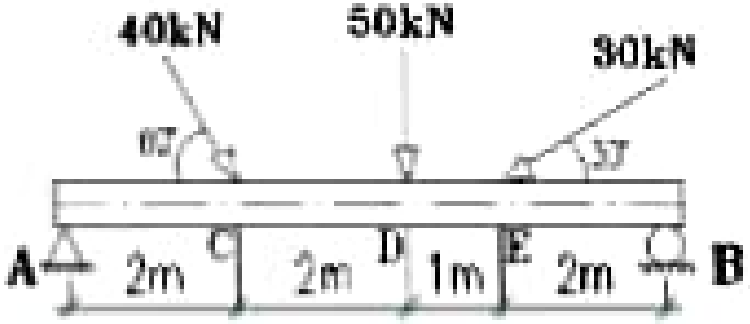
$\Sigma Y=0,\ R_A + R_B - 40\sin60^\circ - 50 - 30\sin30^\circ = 0$

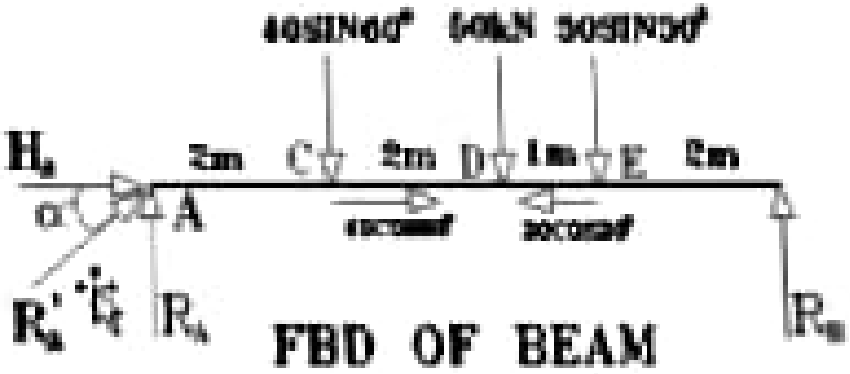
or $R_B = 34.64+50+15-50.46$

or $R_B = 49.18$ kN (Ans)

$R'_A = \sqrt{R_A^2 + H_A^2} = \sqrt{(50.46)^2+(5.98)^2} = 50.81$ kN (Ans)

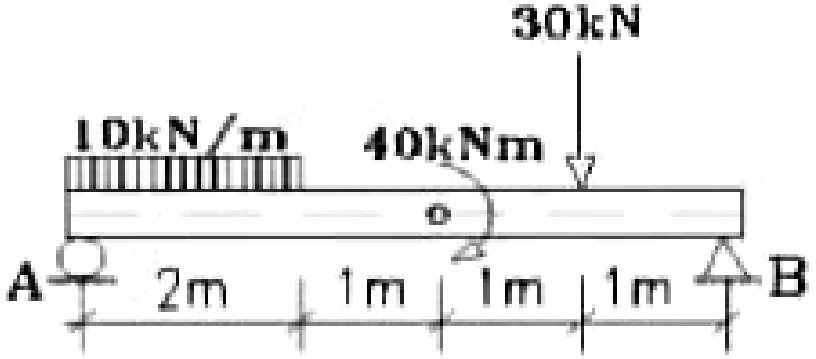
$\alpha = \tan^{-1} R_A/H_A = \tan^{-1}(50.46/5.98) = 83.24^\circ$

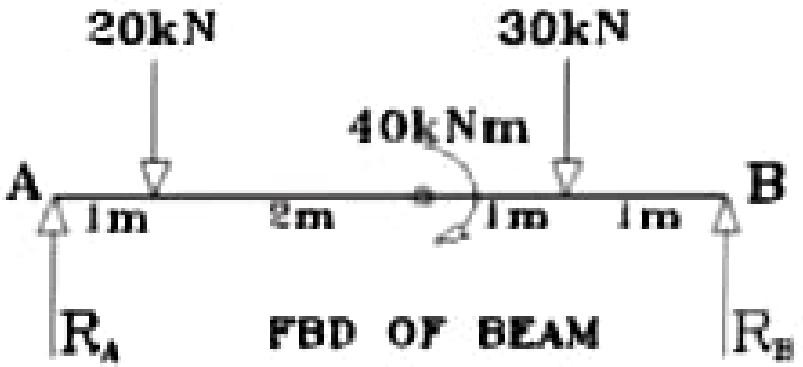




FBD OF BEAM

PROB 6: A simply supported beam of 5m long is subjected to a uniformly distributed load, a point load and a clockwise couple as shown in Fig. Determine reactions at supports A and B.





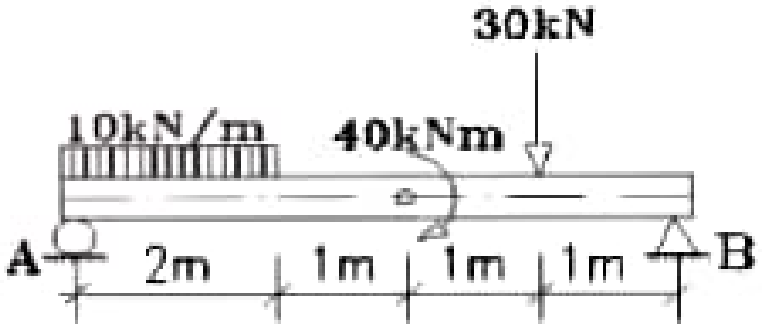
Sol^n : Let R_A and R_B are the reactions at A and B.

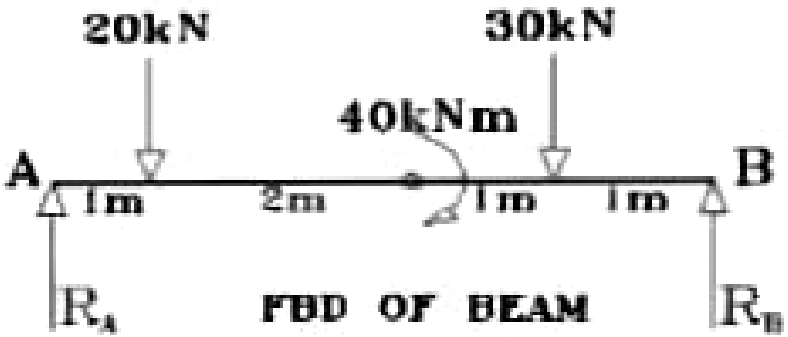
Considering FBD, taking moment at A, $\Sigma M_A = 0$

$R_B \times 5 - 30 \times 4 - 40 - 20 \times 1 = 0$

or $R_B \times 5 = 120 + 40 + 20 = 180$ or $R_B = 36$ kN (Ans)

clockwise couple as shown in Fig. Determine reactions at supports A and B.





Soln : Let R_A and R_B are the reactions at A and B.

Considering FBD, taking moment at A, $\Sigma M_A=0$

$R_B x5-30x4-40-20x1 = 0$

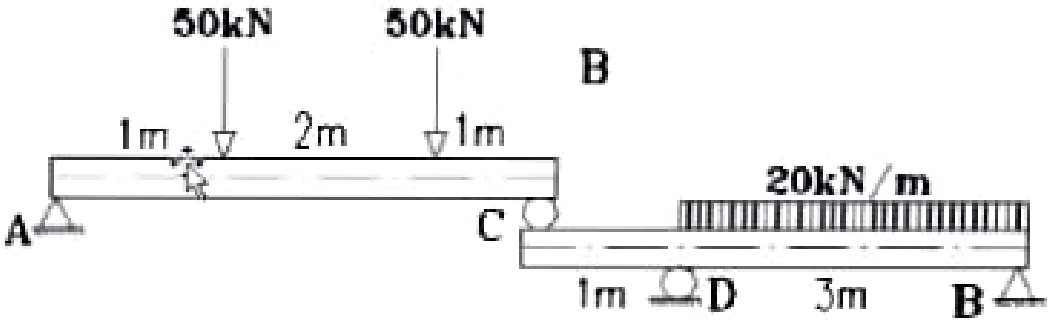
or $R_B x5 = 120+40+20 = 180$ or $R_B = 36$ kN (Ans)

Now resolving the forces vertically,

$\Sigma Y=0$, $R_A + R_B - 20 - 30 = 0$

or $R_A = 20+30-36$ or $R_A = 14$ kN (Ans)

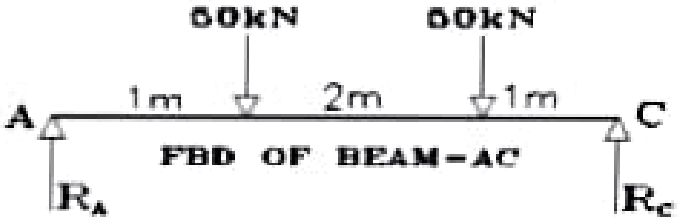
PROB 7: Determine the reactions at supports of the structure, shown in Fig.



Soln : Let R_A ,R_B,R_C and R_D are the reactions at A,B,C and D.

Considering FBD of AC,

Taking moment about A, $\Sigma M_A = 0$



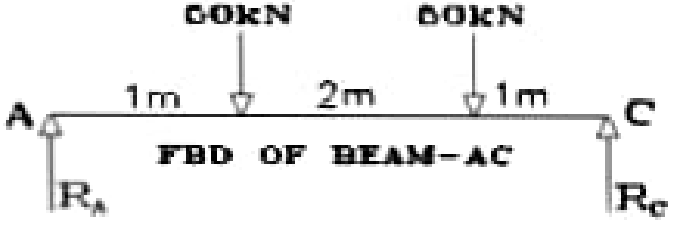
Soln: Let R_A ,R_B,R_C and R_D are the reactions at A,B,C and D.

Considering FBD of AC,

Taking moment about A, $\Sigma M_A = 0$

$R_C x4 - 50x1 - 50x3 = 0$

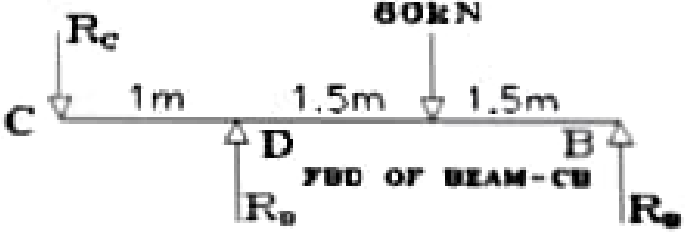
or $R_C x4 = 200$ or R_C = 50kN (Ans)



Now resolving the forces vertically,

$\Sigma Y = 0$ or $R_A + R_C - 50 - 50 = 0$

or $R_A = 50+50-50 =$ 50 kN (Ans)



Considering FBD of CB

Taking moment about B, $\Sigma M_B = 0$

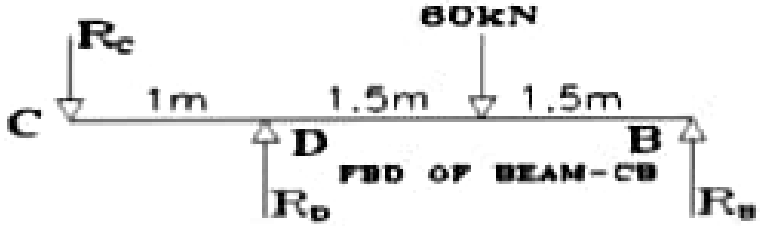
$-R_D \times 3 + 50 \times 4 + 60 \times 1.5 = 0$

or $R_D \times 3 = 200 + 90$ or $R_D = 96.67$ kN (Ans)

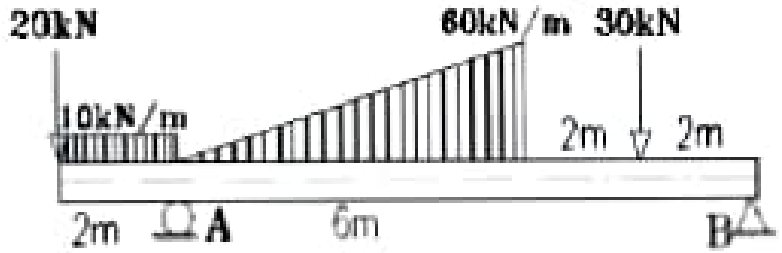
Resolving the forces vertically, $\Sigma Y = 0$

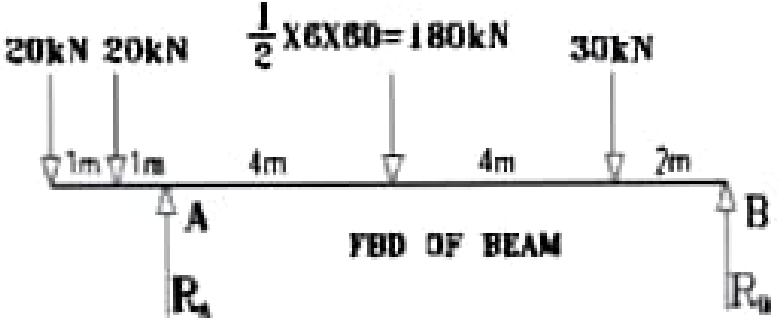
$R_D + R_B - 50 - 60 = 0$

or $R_B = 13.33$ kN (Ans)



PROB 8: An overhanging beam shown in Fig, is on roller at end A and is hinged at the end B. Determined the reactions developed at supports A and B for the loading.





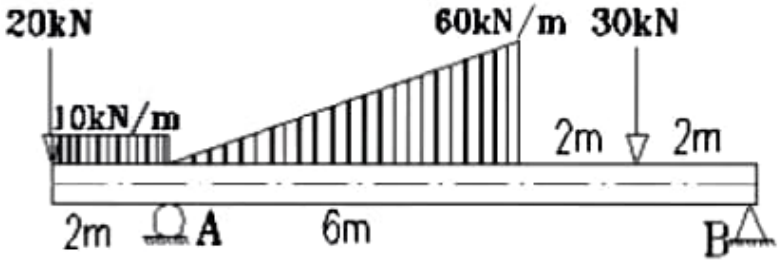
Soln: Let R_A and R_B are the reactions at A & B.

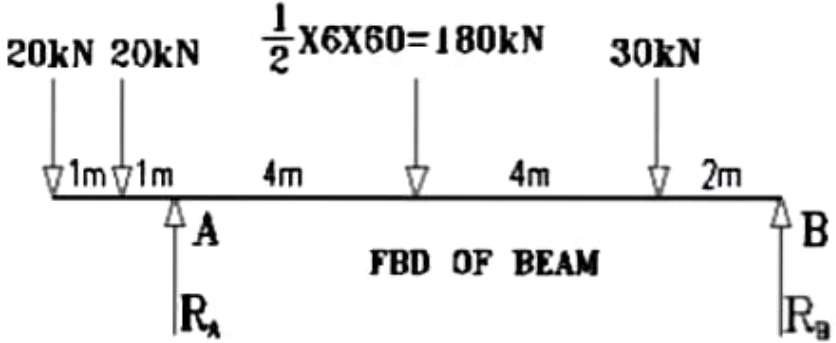
Considering FBD of beam, by taking moment at B,

$\Sigma M_B = 0, \quad 20x12+20x11-R_Ax10+180x6+30x2 = 0$

or $R_Ax10 = 1600$ or R_A = 160 kN (Ans)

end A and is pinned at the end B. Determined the reactions developed at supports A and B for the loading.





Soln : Let R_A and R_B are the reactions at A & B.

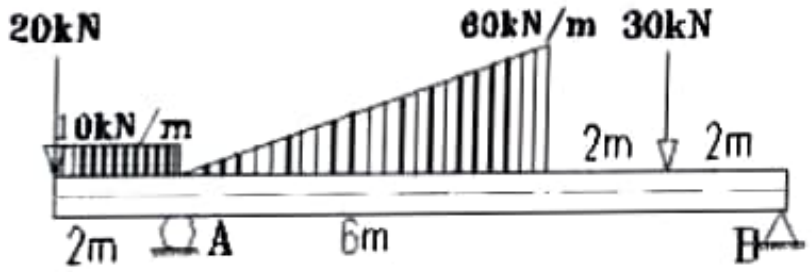
Considering FBD of beam, by taking moment at B,

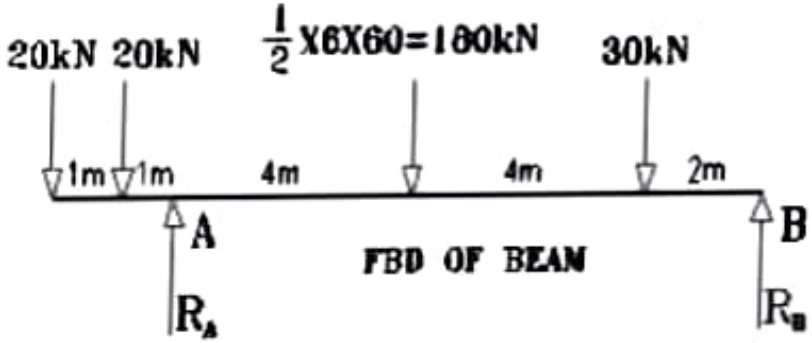
$\Sigma M_B = 0, \quad 20x12+20x11-R_Ax10+180x6+30x2 = 0$

or $R_Ax10 = 1600$ or R_A = 160 kN (Ans)

By resolving the forces vertically, $\Sigma Y = 0$

developed at supports A and B for the loading.





Sol^{n} : Let R_A and R_B are the reactions at A & B.

Considering FBD of beam, by taking moment at B,

$\Sigma M_B = 0, \quad 20x12+20x11-R_Ax10+180x6+30x2 = 0$

or $R_Ax10 = 1600$ **or** R_A **= 160 kN (Ans)**

By resolving the forces vertically, $\Sigma Y = 0$

$R_A + R_B - 20 - 20 - 180 - 30 = 0$

or $R_B = 250 - 160$ **or** R_B **= 90kN (Ans)**