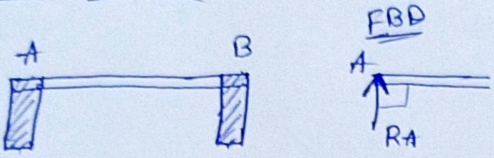
Module: 03

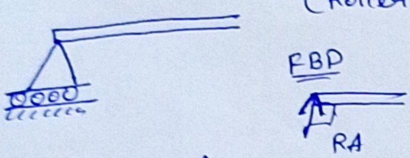
⇒ Types of Supports:

① Simple Support:



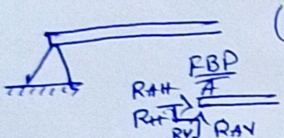
② Roller Support:

(Roller bags/ Trolley)

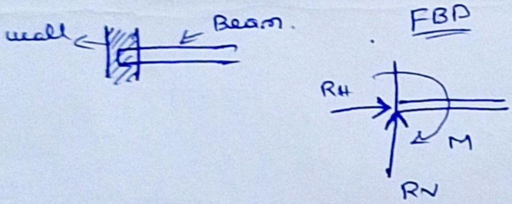


③ Hinge Support:

(Door/windows) Closing/opens (Books etc.....)



④ Fixed Support:

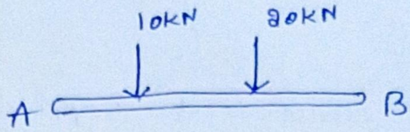


⇒ Types of Loadings:

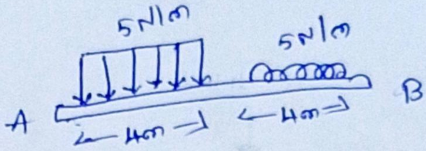
① point Load
(concentrated Load)

② UDL
(uniformly Distributed Load)

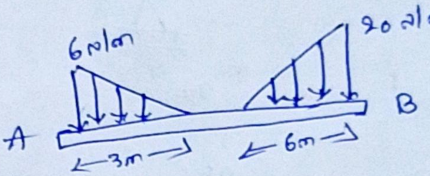
③ UVL
(uniformly varying Load)



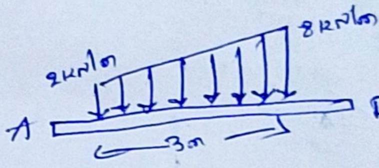
Point Load



UDL



UVL

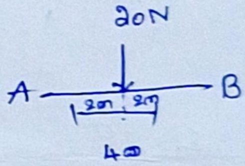


Trapezium UVL

Convert to PL:

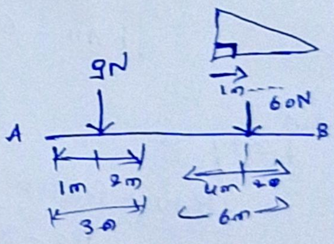
⇒ UDL = b × h
= 4 × 5 = 20N

b/2 = 4/2 = 2m



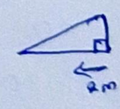
⇒ UVL = $\frac{1}{2}$ × b × h
= $\frac{1}{2}$ × 3 × 6
= 9N

b/3 = 3/3 = 1m

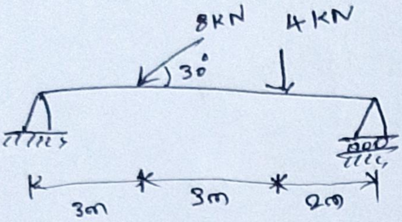


UVL = ½ × b × h
= ½ × 6 × 20
= 60N

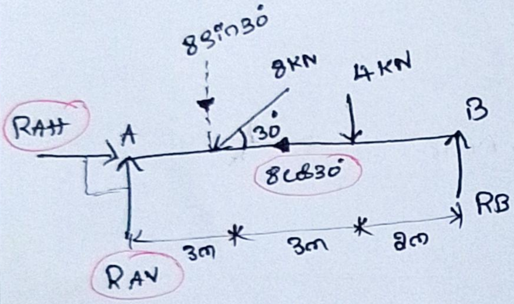
b/3 = 6/3 = 2m



(2) Find the reaction at supports A & B for the beam shown in fig.



Solu^n: FBD of beam AB!



$\overset{+}{\rightarrow} \Sigma fx = 0$

$RAH - 8\cos 30° = 0$

$RAH - 6.928 = 0$

$\boxed{RAH = 6.928 KN}$

$\overset{+}{\uparrow} \Sigma fy = 0$

$RAV + RB - 4 - 8\sin 30 = 0$

$\boxed{RAV + RB - 8 = 0} \rightarrow (1)$

$\overset{+}{\circlearrowright} \Sigma MA = 0$

$8\sin 30° \times 3 + 4 \times 6 - RB \times 8 = 0$

$\boxed{RB = 4.5 KN}$

put, RB in equ^n (1)

$\boxed{RAV = 3.5 KN}$

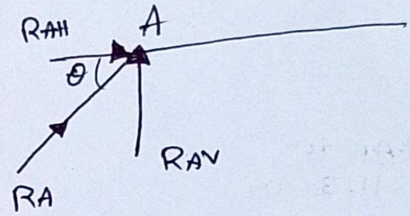
$RA = \sqrt{RAH^2 + RAV^2}$

$= \sqrt{6.928^2 + 3.5^2}$

$\boxed{RA = 7.761 KN}$

$\theta = \tan^{-1} \left| \frac{RAV}{RAH} \right|$

$\boxed{\theta = 26.802°}$



Types of supports:

1. simple
2. Roller
3. Hinged | pinned
4. fixed

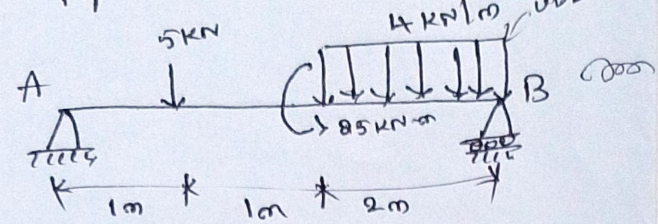
Types of Beams:

1. simply supported
2. continuous
3. cantilever
4. propped cantilever
5. overhanging

Types of Loads:

1. concentrated
2. UDL
3. UVL

(4) Find the reaction at supports A & B for the beam shown in fig.

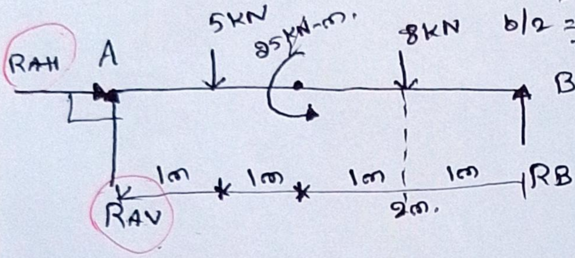


Solu^n: FBD of beam AB:

Couple/ Torque/moment

UDL = b×h
= 2×4
= 8KN

b/2 = 2/2
= 1m



$\rightarrow \Sigma fx = 0$

$\boxed{RAH = 0}$

$\uparrow \Sigma fy = 0$

$RAV + RB - 5 - 8 = 0 \rightarrow (A)$

$\boxed{RAV + RB - 13 = 0}$

$\circlearrowright \Sigma MA = 0$ F×D (KN-m)

$5 \times 1 + 8 \times 3 - 25 - RB \times 4 = 0$

$4 - RB \times 4 = 0$

$RB \times 4 = 4$

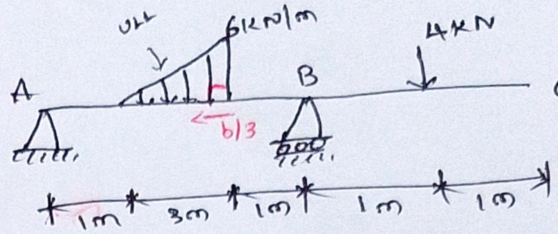
$\boxed{RB = 1KN}$

(A) $\Rightarrow RAV + 1 - 13 = 0$ $\boxed{RAV = 12KN}$

Reaction at A,

RA = RAV = 12KN
RB = 1KN

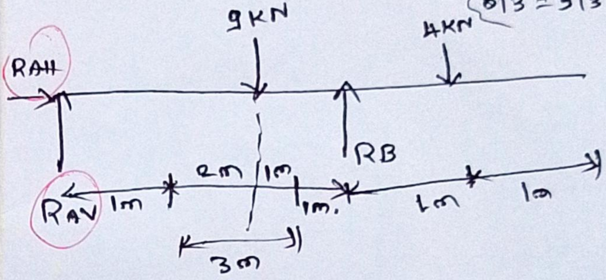
(8) Find the reaction at supports A & B for the beam shown below.



Solu^n: FBD of beam!

UVL = ½ × b × h
= ½ × 3 × 6
= 9KN

b/3 = 3/3 = 1



$\rightarrow \Sigma fx = 0$

$\boxed{RAH = 0}$

$\uparrow \Sigma fy = 0$

$RAV + RB - 9 + 4 = 0$

$\boxed{RAV + RB - 13 = 0} \rightarrow (1)$

$\circlearrowright \Sigma M_A = 0$

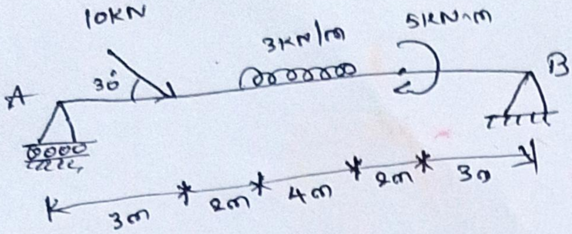
$9 \times 3 + 4 \times 6 - RB \times 5 = 0$

$\boxed{RB = 10.2KN}$

RB in (1)

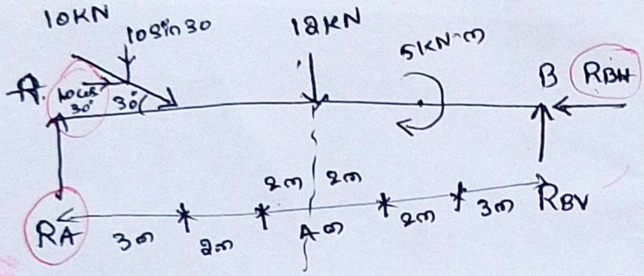
$\boxed{RAV = 2.8KN}$

(4) find the reaction at supports A & B for the beam shown in fig.



Solu: FBD of beam!

UDL = 4×3
= 12KN
b/2 = 4/2
= 2



$\xrightarrow{+}$ $\Sigma fx = 0$

$10\cos 30 - RBH = 0$

$\boxed{RBH = 8.66 KN}$

$\overset{+}{\circlearrowright} \Sigma MA = 0$

$10\sin 30 \times 3 + 12 \times 7 + 5 - RBV \times 14 = 0$

$\boxed{RBV = 7.428 KN}$

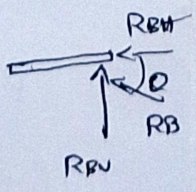
$\uparrow^{+} \Sigma fy = 0$

$RA - 12 - 10\sin 30 + 7.428 = 0$

$\boxed{RA = 9.572 KN}$

$RB = \sqrt{RBH^2 + RBV^2}$

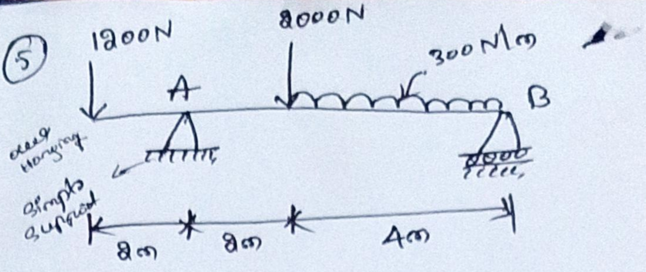
$\boxed{RB = 11.409 KN}$



$\theta = \tan^{-1}\left(\frac{7.428}{8.66}\right)$

$\boxed{\theta = 40.62°}$

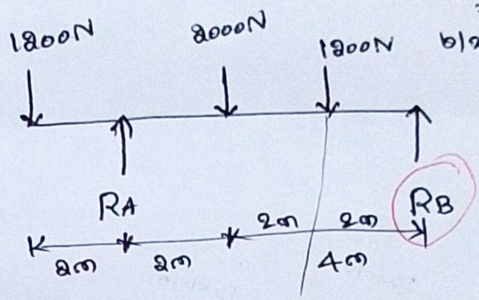
(5)



Calculate support reactions for the beam loaded as shown.

Solu: FBD of beam:

UDL = 4×300
= 1200N
b/2 = 4/2 = 2



$\overset{+}{\circlearrowright} \Sigma MB = 0$

$-1200 \times 2 - 2000 \times 4 - 1200 \times 8 + RA \times 6 = 0$

$\boxed{RA = 3333.333 N}$

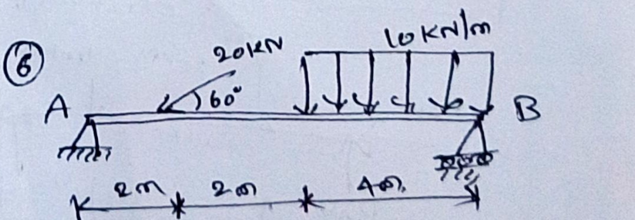
$+\uparrow \Sigma fy = 0$

$RA + RB - 1200 - 2000 - 1200 = 0$

$3333 - 4400 + RB = 0$

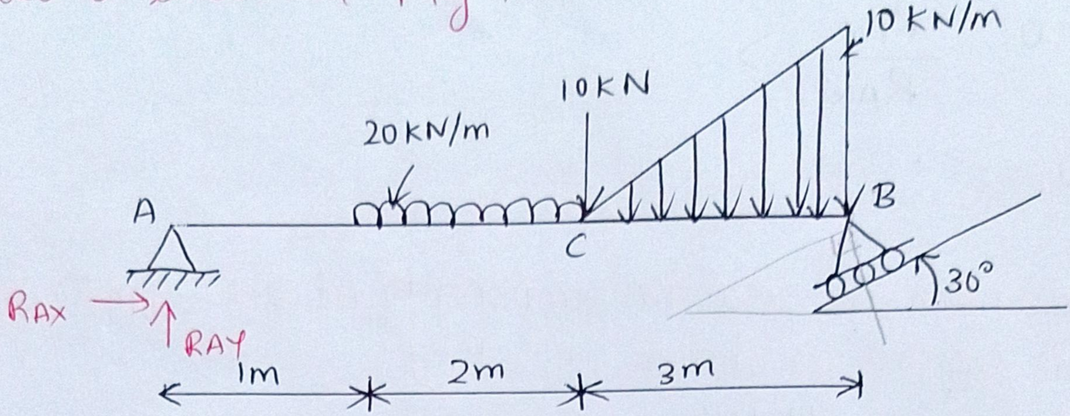
$\boxed{RB = 1066.66 N}$

(6)



find the reaction at supports A & B for the beam shown in fig

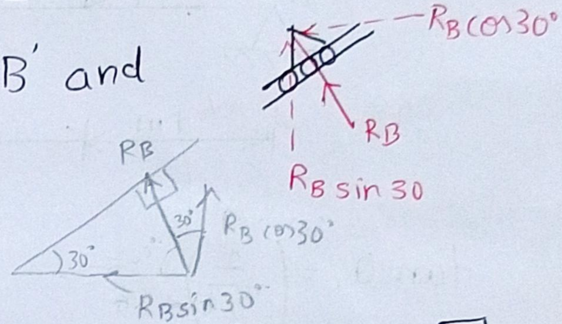
Q) Determine the reactions at the supports for the beam loaded as shown in Fig.



Triangular load $= \frac{1}{2} \times 3 \times 10 = 15\,KN$

acts at $\frac{1}{3} \times 3 = 1\,m$ from point 'B' and

$\frac{2}{3} \times 3 = 2\,m$ from point 'C'



(i) $\Sigma M_A = 0$.

$-R_B \sin 30°(6) + 15(2+3) + 10(3) + 20(2)\left[\frac{1}{2} \times 2 + 1\right] = 0$.

$-R_B \sin 30°(6) + 15(5) + 30 + 40(2) = 0$.

$-R_B \sin 30(6) + \underline{75 + 30 + 80} = 0$.

$-R_B \sin 30(6) + 185 = 0$.

$R_B = 61.66\ KN$ // $(\uparrow)$.

(ii) $\Sigma F_x = 0$

$-R_B \cos 30 + R_{Ax} = 0$

$R_{Ax} = 53.39\ KN\ (\rightarrow)$.

(iii) $\Sigma F_y = 0$.

$R_{Ay} + R_B \sin 30 - 20(2) - 10 - \frac{1}{2}(3)(10) = 0$

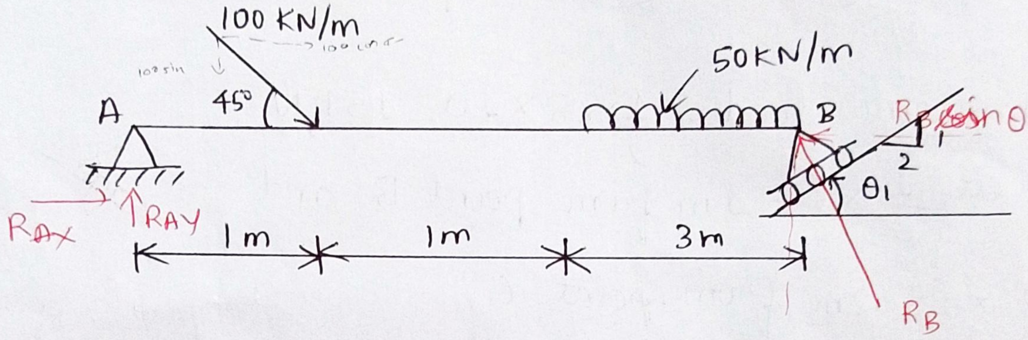
$R_{Ay} + 61.66 \sin 30 - 40 - 10 - 15 = 0 \Rightarrow R_{Ay} = 34.17\ KN$

$$R_A = \sqrt{R_{Ax}^2 + R_{Ay}^2} =$$

$$\tan\theta = \frac{R_{Ay}}{R_{Ax}} \Rightarrow$$

$$\theta =$$

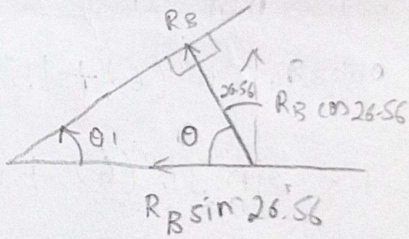
Q> Determine the reaction components at the supports for the beam loaded as shown in Fig



$$\tan\theta_1 = \left(\frac{1}{2}\right)$$

$$\theta_1 = 26.56°$$

$$\theta = [180 - (90 + 26.56°)] = 63.44°$$



(i) $\Sigma M_A = 0$

$$-R_B \cos 26.56(5) + 50(3)\left[\frac{1}{2} \times 3\right] + 100\sin 45(1)$$

$$R_B = 133.19 \text{ kN}$$

(ii) $\Sigma F_y = 0$

$$R_{Ay} - 100\sin 45 - 50(3) + R_B \cos 26.56 = 0$$

$$R_{Ay} = 101.57 \text{ kN}$$

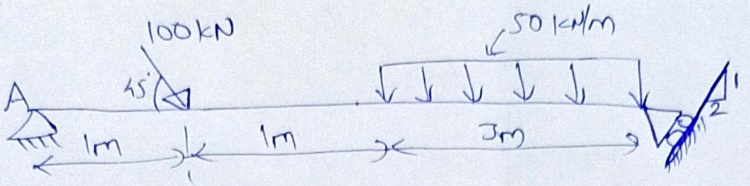
(iii) $\Sigma F_x = 0$

$$R_{Ax} - R_B \sin 26.56 + 100\cos 45 = 0$$

$$R_{Ax} = -11.15 \text{ kN } (\leftarrow)$$

$$R_A = \sqrt{R_{Ax}^2 + R_{Ay}^2}$$

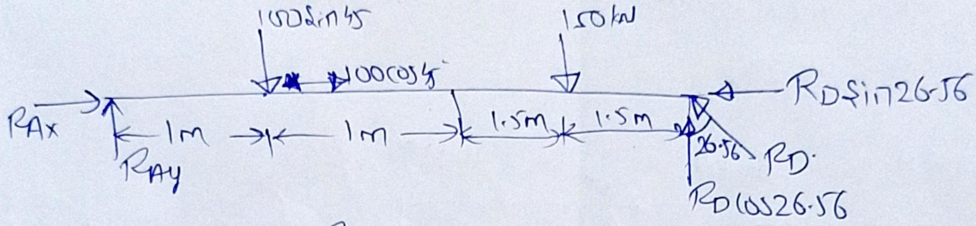
* Determine the reactions at the supports



Soln:-

$$\tan\theta = 1/2$$

$$\theta = \tan^{-1}[1/2] = 26.56°$$



$\Sigma f_x = 0 \Rightarrow R_{Ax} - R_D \sin 26.56 + 100\cos 45 = 0$

$R_{Ax} - 0.477 R_D = 70.71$

$\Sigma f_y = 0 \Rightarrow R_{Ay} + R_D \cos 26.56 - 100 \sin 45 - 150 = 0$

$R_{Ay} + 0.894 R_D = 220.71.$

$\Sigma M_A = 0 \Rightarrow -5 R_D \cos 26.56 + 150 \times 3.5 + 100 \sin 45 \times 1 = 0$

$R_D = 133.19 \text{ kN}.$

$\therefore R_{Ax} = -11.15 \text{ kN}$

$R_{Ay} = 101.63 \text{ kN}.$

$R_A = \sqrt{(7.175)^2 + (101.63)^2} = 101.88 \text{ kN}.$

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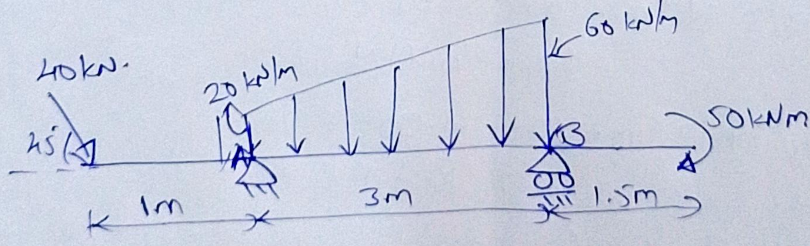
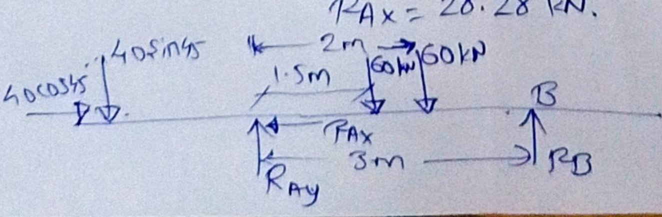


Trapezoidal

Soln:

$\Sigma f_x = 0 \Rightarrow 40\cos 45 - R_{Ax} = 0$

$R_{Ax} = 28.28 \text{ kN}.$



$\Sigma f_y = 0.$

$R_{Ay} + R_B - 40\sin 45 - 60 - 60 = 0$

$R_{Ay} + R_B = 148.28$

$\Sigma M_A = 0 \Rightarrow -R_B \times 3 + 60 \times 1.5 + 60 \times 2 + 50 - 40\sin 45 \times 1 = 0$

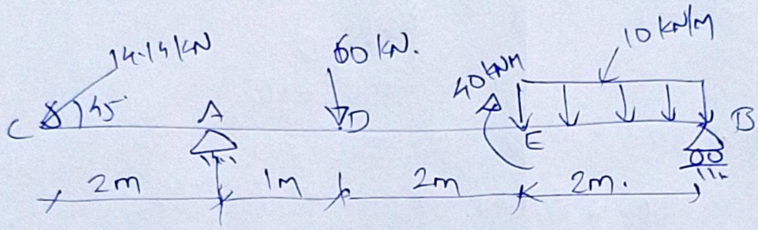
$R_B = 77.23 \text{ kN}$

$R_{Ay} = 71.04 \text{ kN}$

$R_A = \sqrt{(28.28)^2 + (71.04)^2} = 78.46 \text{ kN}$

$\theta = 68.29°.$

Assign
*



$R_B = 32 \text{ kN}$

$R_A = 58.85 \text{ kN}$

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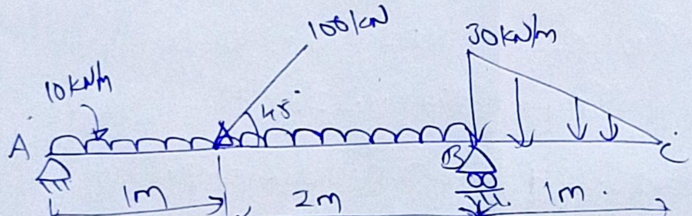
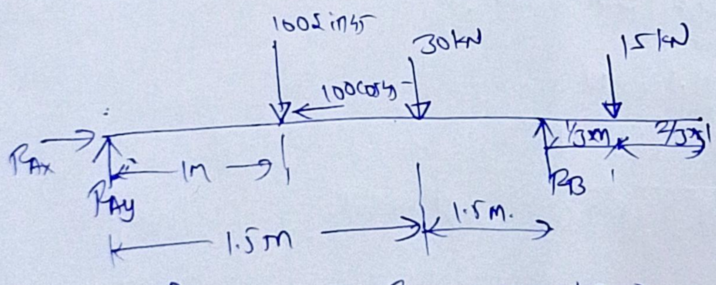


⇒



$\Sigma f_x = 0 \Rightarrow R_{Ax} - 100\cos 45 = 0$

$R_{Ax} = 70.7 \text{ kN}$

$\Sigma f_y = 0 \Rightarrow R_{Ay} + R_B - 100\sin 45 - 30 - 15 = 0$

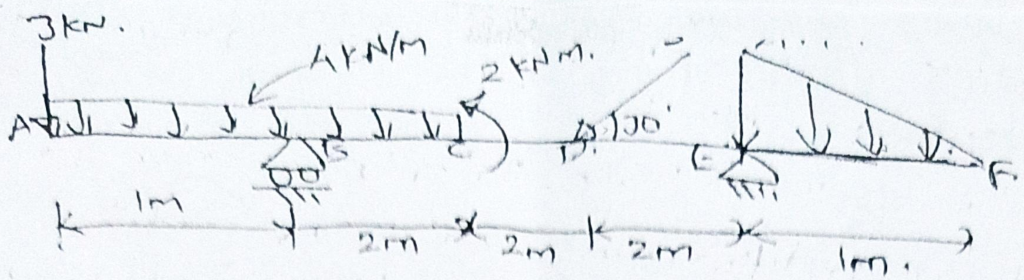
$R_A + R_C = 115.7 \text{ kN}$

$\Sigma M_A = 0 \Rightarrow -R_C * 3 + (100\sin 45) \times 1 + 30 \times 1.5 + 15 \times 3.33 = 0$

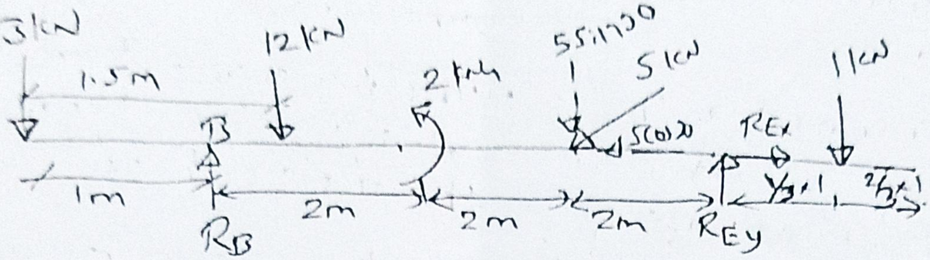
$R_C = 55.22 \text{ kN}$

$R_A = 60.49 \text{ kN}$

5)



Sol:



$\Rightarrow \Sigma F_x = 0 \Rightarrow R_{Ex} - 5\cos 30 = 0$

$$\boxed{R_{Ex} = 4.33 \text{ kN}}$$

$(+\circlearrowleft)\ \Sigma M_B = 0 \Rightarrow -3\times 1 + 12\times 0.5 - R_{Ey}\times 6 - 2 + 5\sin 30\times 4 + 1\times 6.334 = 0$

$$\boxed{R_{Ey} = 2.889 \text{ kN}}$$

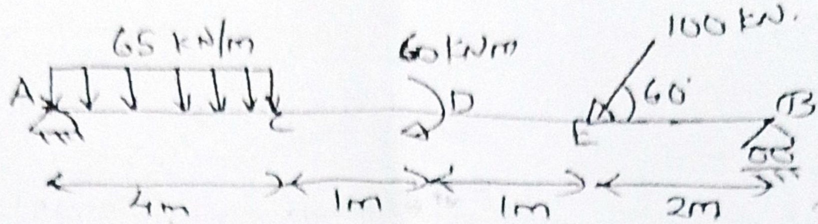
$\Sigma F_y = 0 \Rightarrow R_B + R_{Ey} - 3 - 12 - 5\sin 30 - 1 = 0$

$$\boxed{R_B = 15.611 \text{ kN}}$$

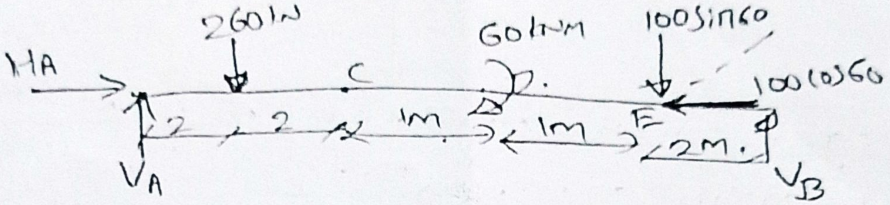
$\therefore R_E = \sqrt{(R_{Ex})^2 + (R_{Ey})^2} = 5.21 \text{ kN}.$

$\theta = \tan^{-1}\left[\frac{2.889}{4.33}\right] = 33.71$.

Determine the reactions at A & B of the beam below



Soln:- udl to point load = 65×4 = 260 kN acting @ 2m from A.



(+) $\Sigma M_A = 0$

$$260 \times 2 + 60 + 100 \sin 60 \times 6 - V_B \times 8 = 0$$

$$\boxed{V_B = 137.45 \text{ kN}}$$

(→) $\Sigma F_x = 0$

$$H_A - 100 \cos 60 = 0$$

$$\boxed{H_A = 50 \text{ kN}}$$

(+↑) $\Sigma F_y = 0$

$$V_A + V_B - 260 - 100 \sin 60 = 0$$

$$\boxed{V_A = 209.15 \text{ kN}}$$

$$R_A = \sqrt{V_A^2 + H_A^2} = \sqrt{50^2 + (209.15)^2} = \underline{\underline{215 \text{ kN}}}$$

$$\tan\theta = \frac{V_A}{H_A} \Rightarrow \theta = \underline{\underline{76.5}}$$