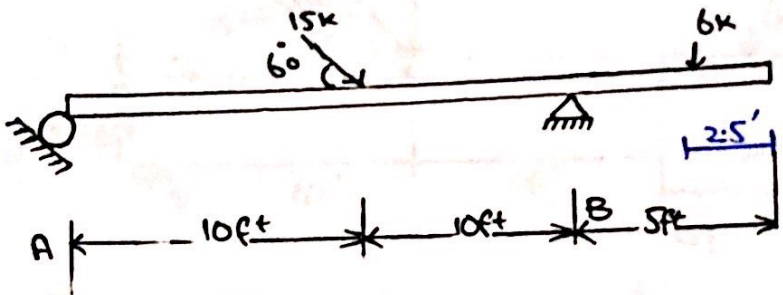
Name = SUBHAN ULLAH KHAN

ID # = 7861

Section = B

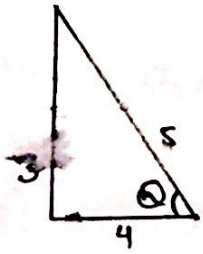
SUBJECT = STRUCTURAL ANALYSIS-I

QNO1:- Determine the Support reaction in the beam given below-



Solution:- first of all we have to find the angle for the roller Support-

So-



Therefore using Trigonometry

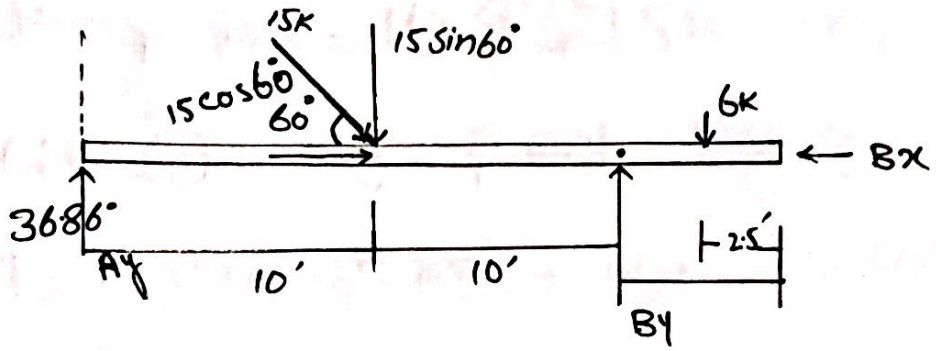
$$\sin Q = P/H$$

putting $P = 3$ $H = 5$

$$Q = \sin^{-1}\left(\frac{3}{5}\right)$$

$$Q = \sin^{-1}(0.6) \Rightarrow 36.86^\circ$$

So NOW-



(1) $\Sigma F_x = 0$ According to Equilibrium

$\rightarrow$ (+) $\leftarrow$ (−)

$15\cos 60° - Bx - Ay \sin 36.86° = 0$

$7.5 - Bx - 0.599\,Ay = 0 \rightarrow (1)$

(2) $\Sigma F_y = 0$ $\uparrow$ (+) $\downarrow$ (−) Taking upward direction vertical force positive

$Ay\cos 36.86° + By - 6K - 15\sin 60° = 0$

$0.80\,Ay + By = 18.99 \rightarrow (2)$

(3) $\Sigma M_B = 0$ (+) ↻ (−) ↺

$(Ay \cos 36.86 \times 20) - (15\sin 60° \times 10) + 6 \times 2.5 = 0$

$16\,Ay - 190 + 15 = 0$

$16\,Ay - 175 = 0$

$$\frac{16Ay}{16} = \frac{175}{16} \quad | Ay = 10.9375k$$

Putting $Ay = 10.9375k$ in equ ② to find $By = ?$

$$0.80(10.9375) + By = 18.99$$

$$8.75 + By = 18.99$$

$$| By = 10.25k |$$

putting value of Ay in equ ① to find out Bx

$$7.5 - Bx - 0.599(10.9375) = 0$$

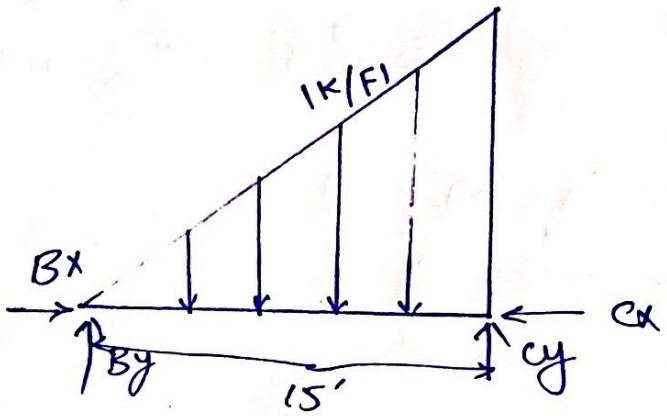
$$| Bx = 0.9375k |$$

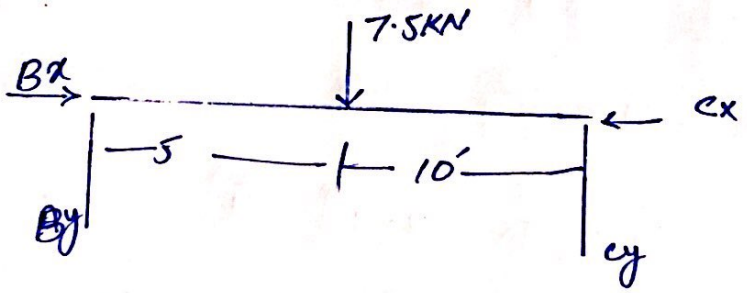
QNO2:-

Sol:- ID# = 7861

(1) Free body diagram

V.U.L





~~Cy = 10K~~ area $= \frac{1}{2} b \times h = \frac{1}{2}(15)(1)$

$= 7.5KN$

Distance $= \frac{1}{3}(b) \Rightarrow \frac{1}{3}(15) \Rightarrow 5'$

(i) $\Sigma F_x = 0 \quad \rightarrow + \quad \leftarrow -$

$B_x - C_x = 0 \rightarrow (1)$

(ii) $\Sigma F_y = 0 \quad \uparrow + \downarrow -$

$B_y + C_y = 7.5 \rightarrow (2)$

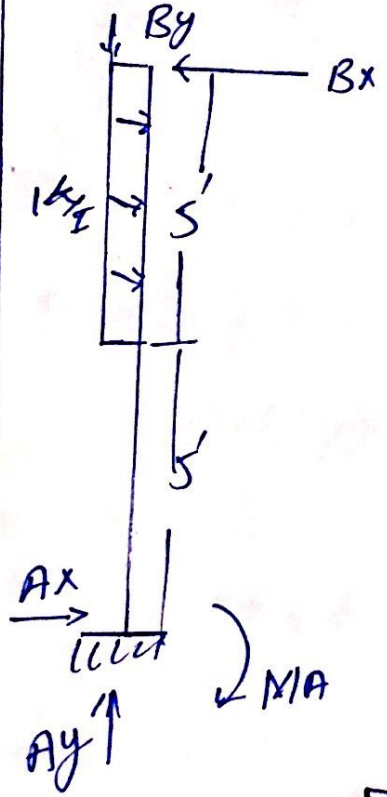
(iii) $\Sigma M_B = 0 \quad \circlearrowleft +$

$(7.5 \times 5) - Cy \times 15 = 0$

$375 = 15Cy \Rightarrow Cy = 2.5K$

Put the value in eq (2)

$By + 2.5 = 7.5 \Rightarrow By = 5K$



(i) $\Sigma Fx = 0 \quad \rightarrow + \quad \leftarrow -$

$Ax + (1 \times 5) - Bx = 0$

$Ax - Bx = -5 \longrightarrow (3)$

(ii) $\Sigma Fy = 0 \uparrow + \quad \downarrow -$

$Ay - By = 0 \longrightarrow (4)$

(iii) $(1 \times 5) \times (2.5 + 5) - 13x \times 10 = 0$

$37.5 = 10Bx = 0$

$Bx = 3.75$

Put the value in eq (3)

~~$Ax - 15 = 25$~~ $Ax - 3.75 = -5$

$Ax = -1.25$

Now Since C and D are at Same line thus the load is transfered So

$Cy = 10K$

So $\underline{Dy = -10K}$

Put the value of By in eq (4)

$$Ay - 20k = 0$$

Put the value of Bx in eq (1)

$$Ay - 5k = 0 \quad Ay = 5k$$

put the value of Bx in eq (1)

$$3.75 - Cx = 0$$

$$\boxed{Cx = 3.75}$$

So

$$Dx = 3.75k$$

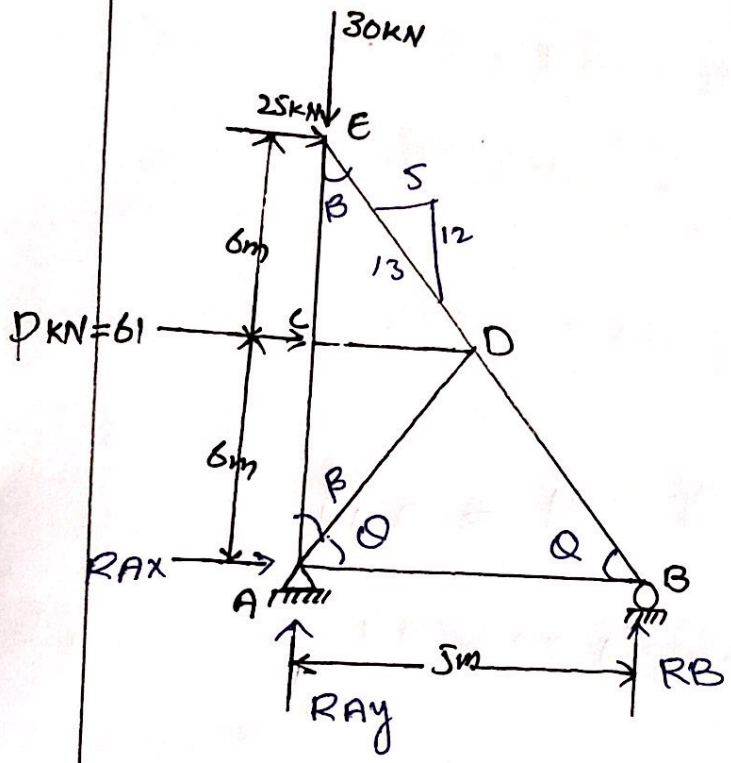
$$\Sigma M_b = +\circlearrowleft +$$

$$(-1 \times 5)(2.5) - (Ax \times 10) + MA = 0$$

$$-2.5 - (1.25 \times 10) + MA = 0$$

$$MA = 15$$

Q NO 3:-



$Q = \tan^{-1}\left(\frac{12}{5}\right)$

$Q = 67.4°$

$B = 90 - Q$

$B = 90° - 67.4°$

$B = 22.6°$

$\Sigma M_B = 0 \quad [\curvearrowright +]$

$25 \times 12 - 30 \times 5 + 61 \times 6 + RAy \times 5 = 0$

$5RAy = -516$

$RAy = -\frac{516}{5} \Rightarrow RAy = 103.2KN$

$\Sigma Fy = 0 \quad [\uparrow +]$

$-103.2 - 30 + R_B = 0$

$R_B = 133.2KN$

$\Sigma Fx = 0 \quad [\rightarrow +]$

$RAx + 61 + 25 = 0$

$RAx = -86\ KN$

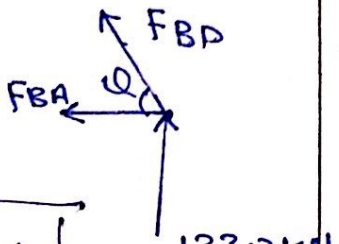
⇒ Using Method of Joint

Joint B:-

$\Sigma F_x = 0 \quad 133.2 + F_{BD}\sin\theta = 0$

$F_{BD} = \frac{-133.2}{0.92}$

$\boxed{F_{BD} = -144.783\,kN}$



$\Sigma F_x = 0$

$F_{BA} = 144.783\cos\theta$

$\boxed{F_{BA} = 55.02\,kN}$

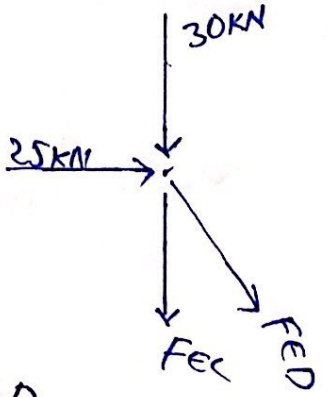
Joint E:-

$\Sigma F_y = 0 \quad [\uparrow +]$

$-30 - F_{EC} - F_{ED}\cos\beta = 0$

$-30 - F_{EC} - (65.05)\cos 22.6° = 0$

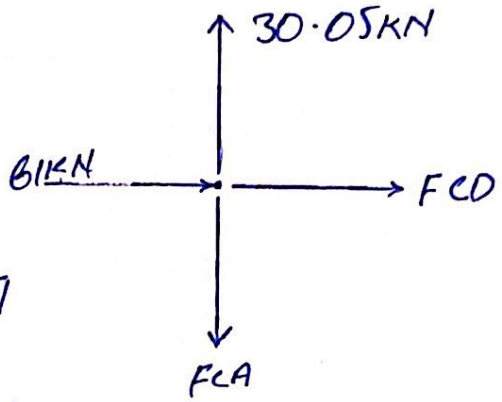
$\boxed{F_{EC} = 30.05\,kN}$



$\Sigma F_x = 0 \quad \xrightarrow{+}$

$25 + F_{ED}\sin\beta = 0 \Rightarrow F_{ED} = -65.05\,kN$

⇒ Joint C :-



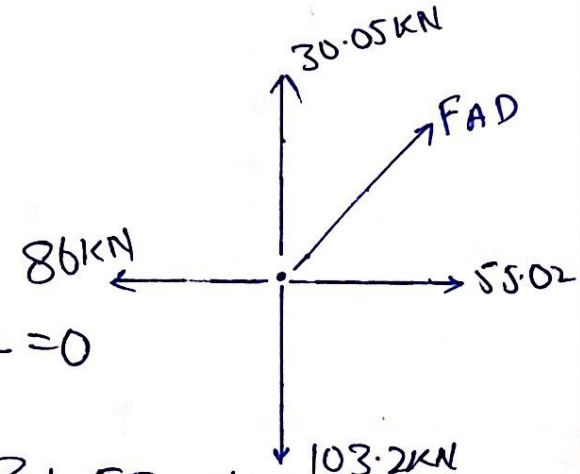
$\Sigma F_x = 0 \quad [\xrightarrow{+}]$

$F_{CD} = 61\,KN$

$F_y = 0 \quad [\uparrow +]$

$F_{CA} = 30.05\,KN$

⇒ Joint A :-



$\Sigma F_x = 0$

$-86 + F_{AD}\cos\theta + 55.02 = 0$

$F_{AD} = \frac{30.98}{\cos(67.38)} = 81.53\,KN$

$\boxed{F_{AD} = 81.53\,KN}$

MEMBER FORCES :-

$F_{AB} = 55.02\,KN$

$F_{AC} = 30.05\,KN$

$F_{BD} = -144.783\,KN$

$F_{CD} = -61\,KN$

$F_{CE} = 30.05\,KN$

$F_{DE} = -65.05\,KN$