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ID : 7830

Submitted TO : Engr. Faqir Khan.

Section : "B"

Paper : Structure "I"

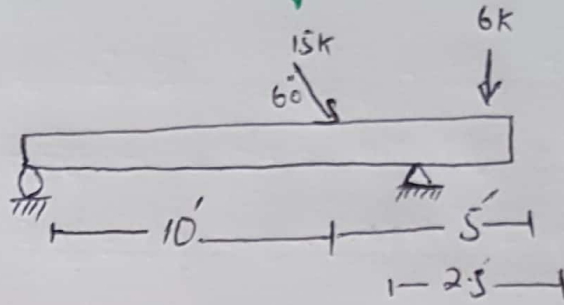
Date : 22 Aug - 2020

*INU - Official :

(1)

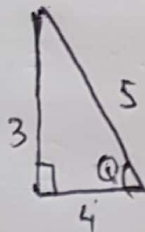
Q NO 1

Determine the support reaction in the beam below in Figure 1
..... is given ?



Solution:

First of all we have to find the angle θ of the roller support.



$\Rightarrow P = 3$
 $\Rightarrow h = 5$

\therefore using Trigonometry:

$\Rightarrow \sin Q = \frac{P}{h}$

$\Rightarrow \sin Q = \frac{3}{5}$

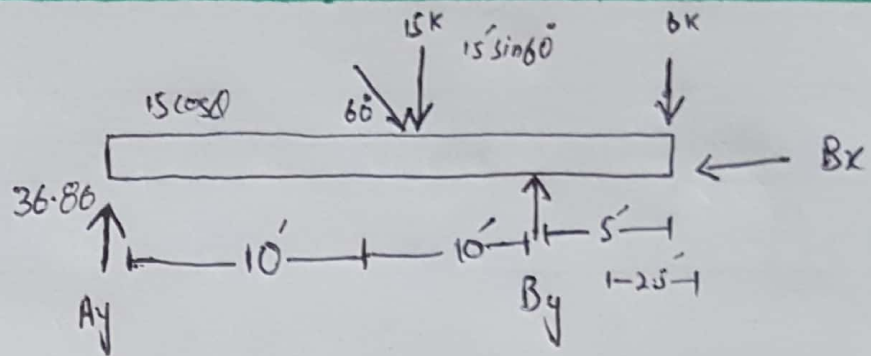
$\Rightarrow Q = \sin^{-1}(\frac{3}{5})$

$\Rightarrow Q = 36.86^\circ$

So,

P.T.O

(2)



$$\begin{aligned} \textcircled{1} \quad \sum F_x &= 0 \rightarrow \leftarrow \\ &\Rightarrow 15 \cos 60^\circ - B_x - A_y \sin 36.86^\circ = 0 \\ &\Rightarrow 7.5 - B_x - 0.599 A_y = 0 \quad \text{--- (i)} \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad \sum F_y &= 0 \uparrow \downarrow \\ &\Rightarrow A_y \cos 36.86^\circ + B_y - 6 \text{ k} - 15 \sin 60^\circ = 0 \\ &\Rightarrow 0.80 A_y + B_y - 18.99 = 0 \\ &\Rightarrow 0.80 A_y + B_y = 18.99 \quad \text{--- (2)} \end{aligned}$$

$$\begin{aligned} \textcircled{3} \quad \sum M &= 0 \curvearrowright \curvearrowleft \\ &\Rightarrow (A_y \cos 36.86^\circ \times 20) - (15 \sin 60^\circ \times 10) + 6 \times 25 = 0 \\ &\Rightarrow 16 A_y - 190 + 15 = 0 \\ &\Rightarrow 16 A_y - 175 = 0 \\ &\Rightarrow A_y = \frac{175}{16} \\ &\Rightarrow \boxed{A_y = 10.9375 \text{ k}} \end{aligned}$$

P.T.O.

(3)

NOW

Put the value in eq (2).

So;

$$\Rightarrow 0.80(10.9375) + B_y = 18.99$$

$$\Rightarrow 8.75 + B_y = 18.99$$

$$\Rightarrow B_y = 18.99 - 8.75$$

$$\boxed{B_y = 10.25 \text{ K}}$$

NOW ;

Put the value of A_y in eq (1).

$$\Rightarrow 7.5 - B_x - 0.599(10.9375) = 0$$

$$\Rightarrow \boxed{B_x = 0.9375 \text{ K}}$$

xxx

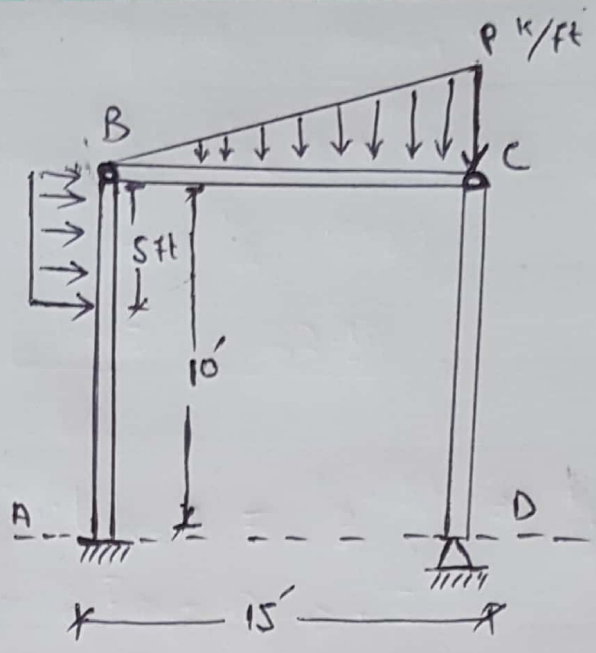
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P.T.O

Q NO # 2



Solution:

First of all :

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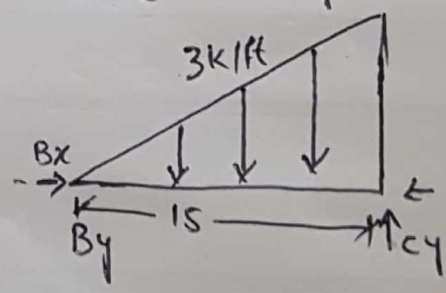
then we take 3

So;

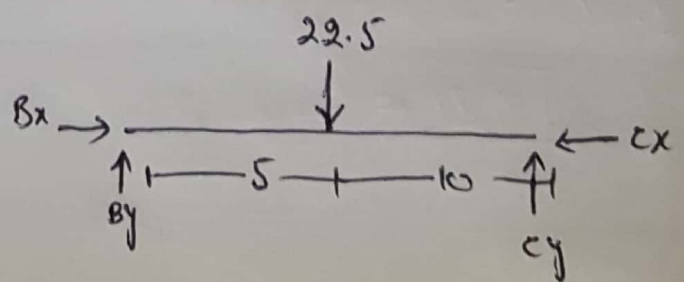
$P = 3$

① Free body diagram

⇒ U.V.L :



⇒ B.D



P.T.O

(5)

hence find Area:

$$\Rightarrow \text{Area} = \frac{1}{2} b \cdot h \quad \begin{matrix} \therefore b = 15 \\ h = 3 \end{matrix}$$
$$= \frac{1}{2} (15 \times 3)$$

$$\boxed{\text{Area} \Rightarrow 22.5}$$

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

$$\Rightarrow \textcircled{i} \quad \Sigma F_x = 0 \rightarrow + \leftarrow$$

$$\Rightarrow B_x - C_x = 0 \quad \text{--- (i)}$$

$$\Rightarrow \textcircled{ii} \quad \Sigma F_y = 0 \uparrow \downarrow$$

$$\Rightarrow B_y + C_y = \boxed{22.5 \text{ K}} \quad \text{--- (2)}$$

$$\Rightarrow \textcircled{iii} \quad \Sigma M_B = 0 \uparrow \downarrow \curvearrowright \curvearrowleft$$

$$\Rightarrow (22.5 \times 5) - C_y \times 15 = 0$$

$$\Rightarrow 112.5 = 15 C_y$$

$$\boxed{C_y = 7.5 \text{ K}}$$

now

Put the value in eq (2)

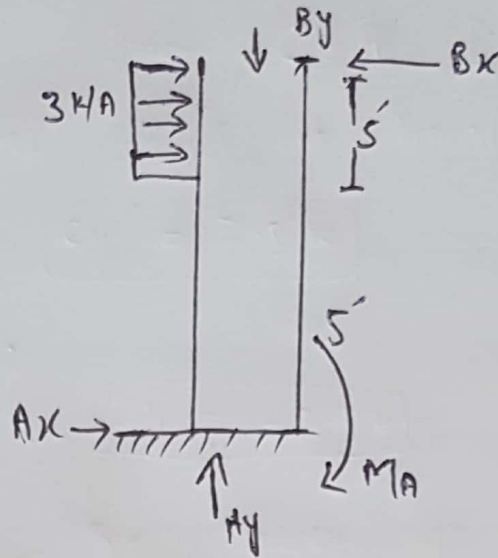
$$\Rightarrow B_y + 7.5 = 22.5$$

$$\Rightarrow \boxed{B_y = 15 \text{ K}}$$

P.T.O

(6)

So;



$$\textcircled{i} \quad \sum F_x = 0 \rightarrow + \leftarrow$$

$$\Rightarrow Ax + (3 \times 5) - Bx = 0$$

$$\Rightarrow Ax - Bx = -15 \quad \textcircled{3}$$

$$\textcircled{ii} \quad \sum F_y = 0 \uparrow \downarrow -$$

$$Ay - By = 0$$

$$\textcircled{iii} \quad \sum M_2 = 0 \curvearrowright \curvearrowleft$$

$$\Rightarrow (3 \times 5) \times (2.5 + 5) - Bx \times 10 = 0$$

$$\Rightarrow 15 \times 7.5 = 10x$$

$$\Rightarrow \boxed{Bx = 11.25 \text{ k}}$$

\Rightarrow Put the value in eq. $\textcircled{3}$

$$\Rightarrow Ax - 11.25 = -15$$

$$= \boxed{Ax = -3.75 \text{ k}}$$

(7) :

⇒ NOW ; since C & D are at same line
that load is transferred so ;

$$\Rightarrow C_y = 7.5 \text{ K}$$

Then ;

$$D_y = -7.5 \text{ K}$$

⇒ Put the value of B_y in (ii) :

$$\Rightarrow A_y - 15 = 0$$

$$A_y = 15 \text{ K}$$

⇒ Put the value of B_x in eq (i)

$$\Rightarrow 11.25 - C_x = 0$$

$$\Rightarrow C_x = 11.25 \text{ K}$$

So

$$D_x = -11.25 \text{ K}$$

$$\Rightarrow M_B = 0 \text{ (Σ)}_B$$

$$\Rightarrow -(3 \times 5)(2.5) - (A_x \times 10) + M_A = 0$$

$$\Rightarrow -(37.5) - (-3.75) \times (10) + M_A = 0$$

$$\Rightarrow -37.5 + 37.5 + M_A = 0$$

$$\Rightarrow M_A = 0$$

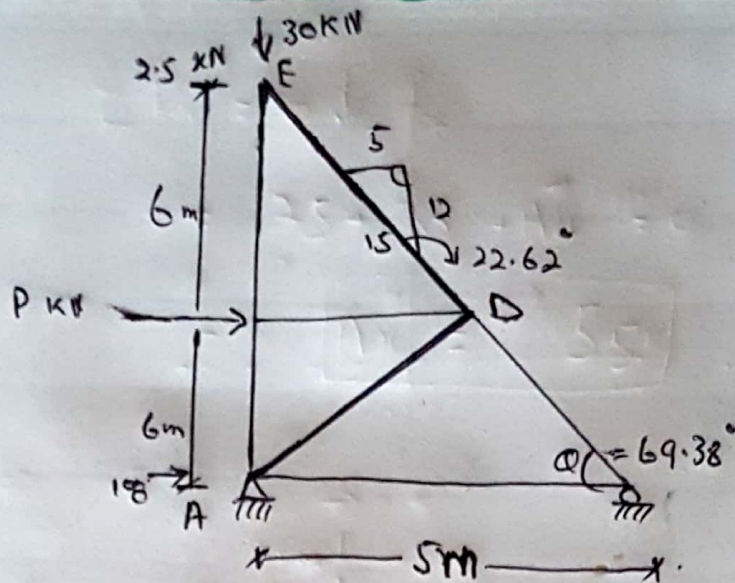
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(8)

QNO # 3



$$\therefore \sin \theta = \frac{P}{h}$$

$$\Rightarrow \theta = \sin^{-1}$$

Solution:

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$$\textcircled{i} \Rightarrow \sum M_A = 0 \downarrow \uparrow$$

$$\Rightarrow (2.5 \times 12) - (B_y \times 5) + (30 \times 6) = 0$$

$$\textcircled{96} \Rightarrow 300 - (B_y \times 5) + (180) = 0$$

$$\Rightarrow -300 + 180 = 5B_y$$

$$\Rightarrow \frac{480}{5} = B_y$$

$$\Rightarrow \boxed{B_y = 96}$$

$$\textcircled{ii} \sum F_y = 0 \downarrow \uparrow$$

$$\Rightarrow A_y + B_y - 30 = 0$$

$$\Rightarrow A_y + 96 - 30 = 0$$

$$\Rightarrow \boxed{A_y = -86}$$

P.T.O

(9)

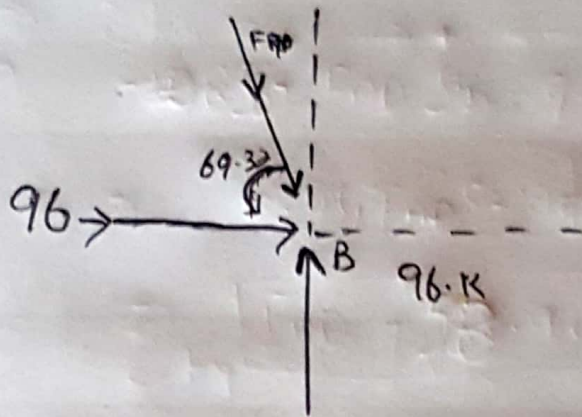
(iii)

$$\sum F_x = 0 \downarrow + \uparrow$$

$$= 25 + 30 + A_x = 0$$

$$= \boxed{A_x = 55 \text{ k}}$$

Joint B



$$\textcircled{1} \quad \sum F_x = 0 \rightarrow + \leftarrow$$

$$\Rightarrow 96 - F_{BD} = 0$$

$$\Rightarrow \boxed{F_{BD} = 96 \text{ N (T)}}$$

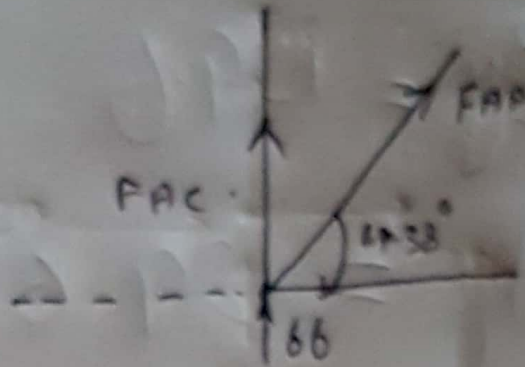
$$\textcircled{2} \quad \sum F_y = \uparrow \downarrow$$

$$\Rightarrow -F_{BD} \cos 69.38^\circ + 96 = 0$$

$$= 0.35 F_{BD} = +96$$

$$= \boxed{F_{BD} = 274 \text{ N}} \text{ (T)}$$

P.T.O

Joint A

$$\Rightarrow \sum F_x = 0 \rightarrow + \leftarrow$$

$$\Rightarrow \cancel{66} \cancel{55} F_{AD} \sin 69.38^\circ = 0$$

$$\Rightarrow 0.94 F_{AD} = \cancel{66} \cancel{55}$$

$$\Rightarrow \boxed{F_{AD} = 58.9 \text{ (T)}}$$

$$\Rightarrow \sum F_y = 0 \uparrow \downarrow$$

$$\Rightarrow 66 + F_{AC} + F_{AD} \cos 69.38^\circ = 0$$

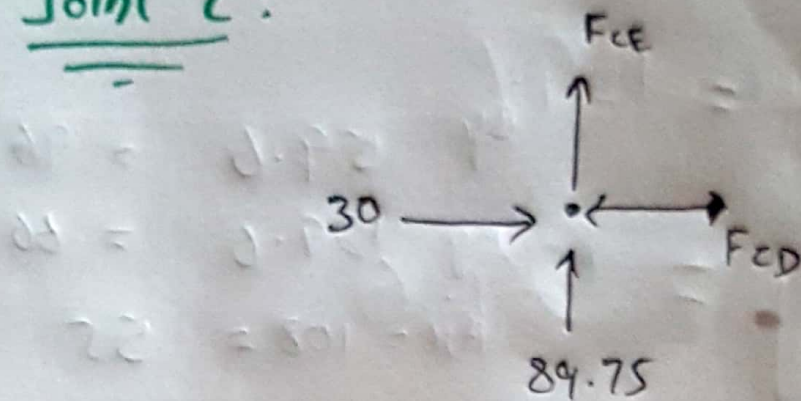
$$\Rightarrow \cancel{66}$$

$$\boxed{F_{AC} = 89.75 \text{ N}}$$

P.T.O.

(11)

Joint C:



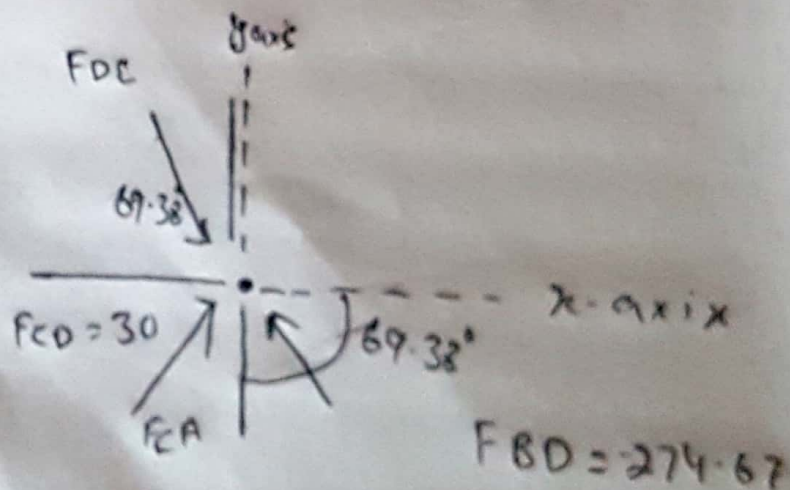
$$\Rightarrow \sum F_x = 0 \rightarrow + \leftarrow -$$

$$\boxed{F_{CD} = 30 \text{ k} (T)}$$

$$\Rightarrow \sum F_y = 0 \uparrow + \downarrow -$$

$$\Rightarrow \boxed{F_{CE} = 89.75 \text{ N}}$$

Joint D:



$$\Rightarrow -30 F_{DE} \sin 69.38 - 274.67 \cos 69.38 = 0$$

$$\Rightarrow \boxed{F_{DE} = 138.35 \text{ N}}$$

End!