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Section : "B"

Paper : Structure I.

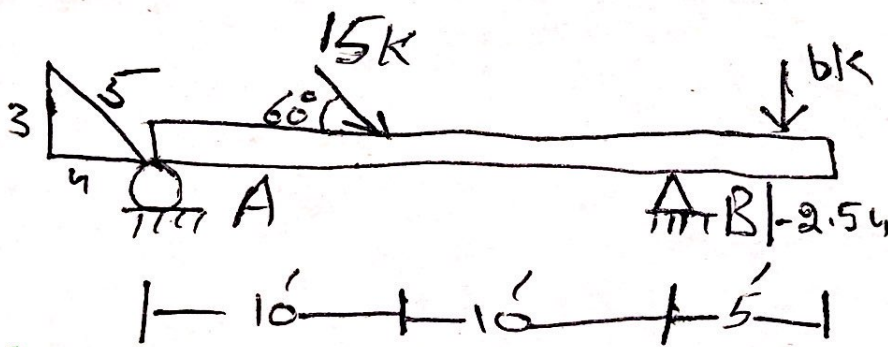
Date : 22 Aug - 2020.

\*INU - Official "

Q No. 1 :-

①

Determine the support  
in the beam .....  
..... is given in figure.



Sol:-

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



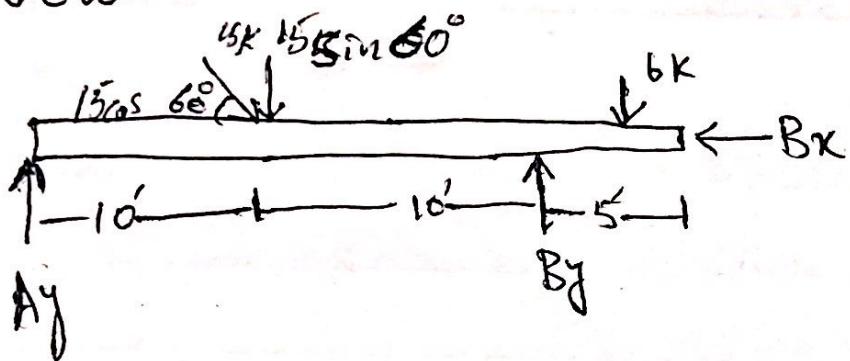
∴ using Trigonometry

$$\sin \theta = \frac{P}{H}$$

$$\sin \theta = \frac{3}{5}$$

$$\theta = \sin^{-1} \left( \frac{3}{5} \right) \Rightarrow \theta = 36.86^\circ$$

So now



1.  $\sum F_x = 0 \quad \rightarrow \leftarrow$

$$15 \cos 60^\circ - B_x - A_y \sin 36.86^\circ = 0$$

$$7.5 - B_x - 0.599 A_y = 0 \quad \rightarrow \textcircled{1}$$

2.  $\sum F_y = 0 \quad \uparrow \downarrow$

$$A_y \cos 36.86^\circ + B_y - 6k - 15 \sin 60^\circ = 0$$

$$0.80 A_y + B_y - 18.99 = 0$$

$$0.80 A_y + B_y = 18.99 \quad \textcircled{2}$$

3.  $\sum M = 0 \quad \curvearrowleft + \curvearrowright$

$$(A_y \cos 36.86^\circ \times 20) - (15 \sin 60^\circ \times 10) + 6 \times 2.5 = 0$$

$$16A_y - 190 + 15 = 0$$

$$16A_y - 175 = 0$$

$$A_y = 175/16$$

$$A_y = 10.9375 \text{ K}$$

Put the value in eq (2)

$$0.80(10.9375) + B_y - 18.99$$

$$8.75 + B_y = 18.99$$

$$B_y = 18.99 - 8.75$$

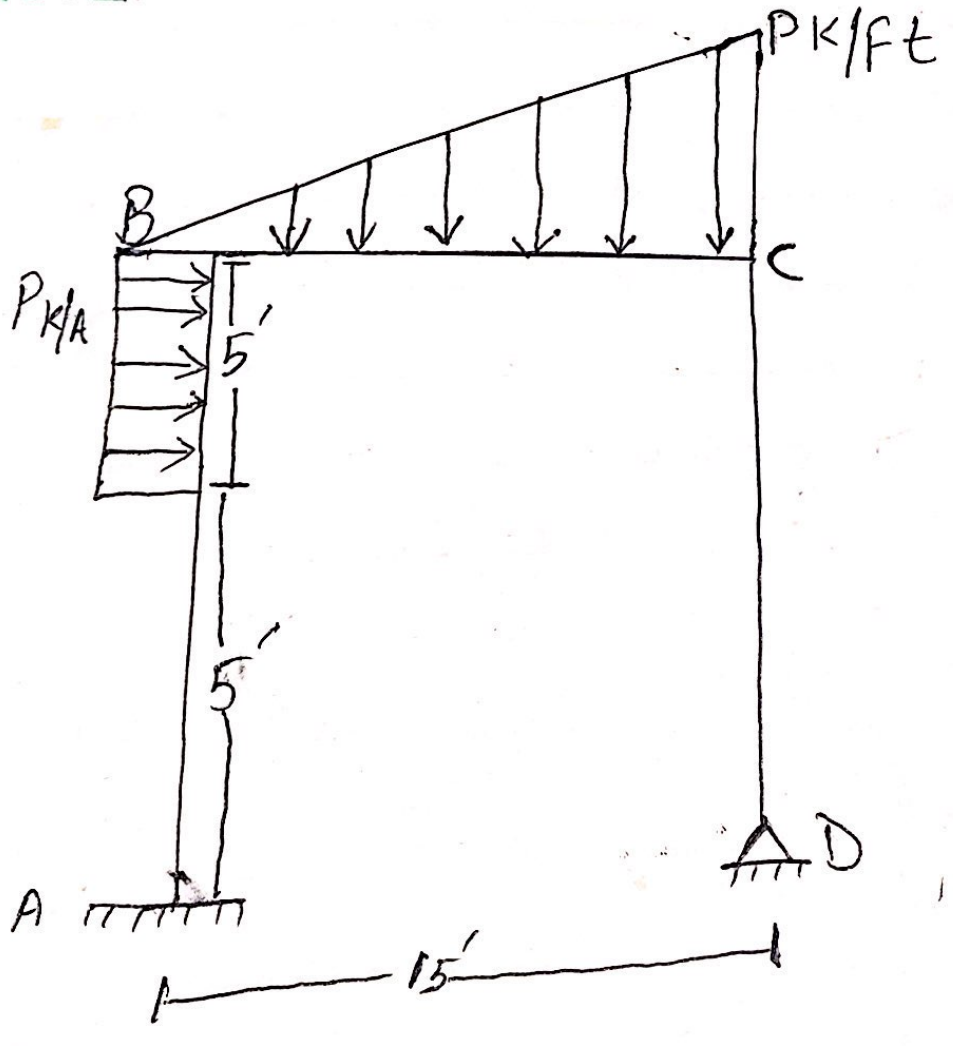
$$B_y = 10.25 \text{ K}$$

Put the value of  $A_y$  in eq (1)

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

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

Q No. 2



First of All ID is 7845

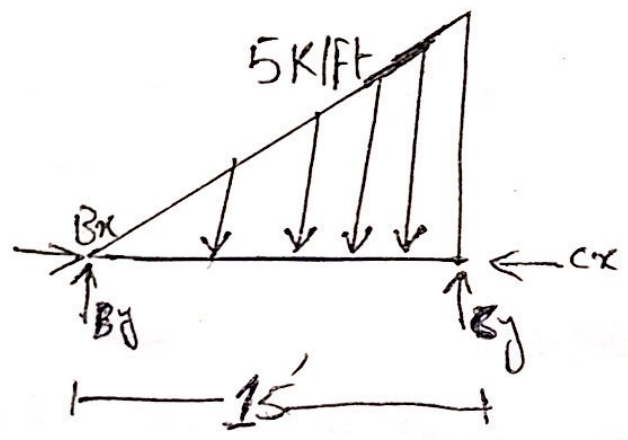
Then we tak 5

So,

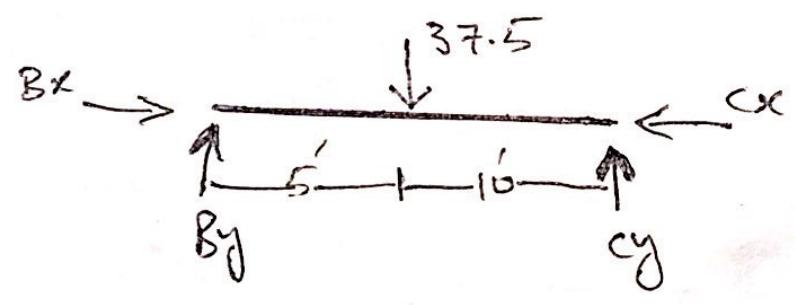
$$P = 5$$

# Free body diagram :-

UVL



B.D



$$Area = \frac{1}{2} bh$$
$$= \frac{1}{2} (15 \times 5)$$

$$Area = 37.5$$

(6)

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

i.  $\Sigma F_x = 0 \quad \rightarrow \leftarrow$

$$B_x - C_x = 0 \quad \text{--- (1)}$$

ii)  $\Sigma F_y = 0 \quad \uparrow \downarrow$

$$B_y + C_y = 37.5 \text{ K} \quad \text{--- (2)}$$

iii)  $\Sigma M_B = 0 \quad \uparrow \downarrow$

$$(37.5 \times 5) - C_y \times 15 = 0$$

$$187.5 = 15 C_y$$

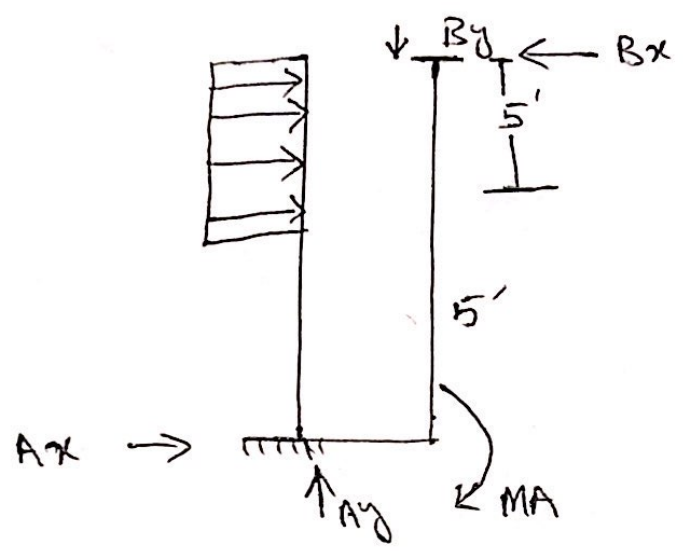
$$C_y = 12.5$$

Put the value in ~~(1)~~ eq (2)

$$B_y + 12.5 = 37.5$$

$$B_y = 25 \text{ K}$$

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i)  $\Sigma F_x = 0 \quad \rightarrow \leftarrow$

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

$$Ax - Bx = -25 \rightarrow \textcircled{3}$$

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

$$Ay - By = 0$$

iii)  $\Sigma M_z = 0 \quad \curvearrowright + \curvearrowleft -$

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

$$25 \times 7.5 = 10 Bx$$

$$\boxed{Bx = 18.75 \text{ k}}$$



Put the value in eq (3)

$$Ax - 18.75 = -25$$

$$Ax = -6.25k$$

Now since C & D are at same line that load is transferred so

$$Cy = 12.5$$

so  $Dy = -12.5$

Put the value of  $B_y$  in eq

$$\Rightarrow Ay - 25 = 0$$

$$\Rightarrow Ay = 25k$$

Put the value of  $B_x$  in eq (1)

$$\Rightarrow 18.75 - Cx = 0$$

$$\Rightarrow Cx = 18.75$$

So

$$\Delta x = -18.75$$

$$\Rightarrow M_B \text{ O.K. } \vec{L}$$

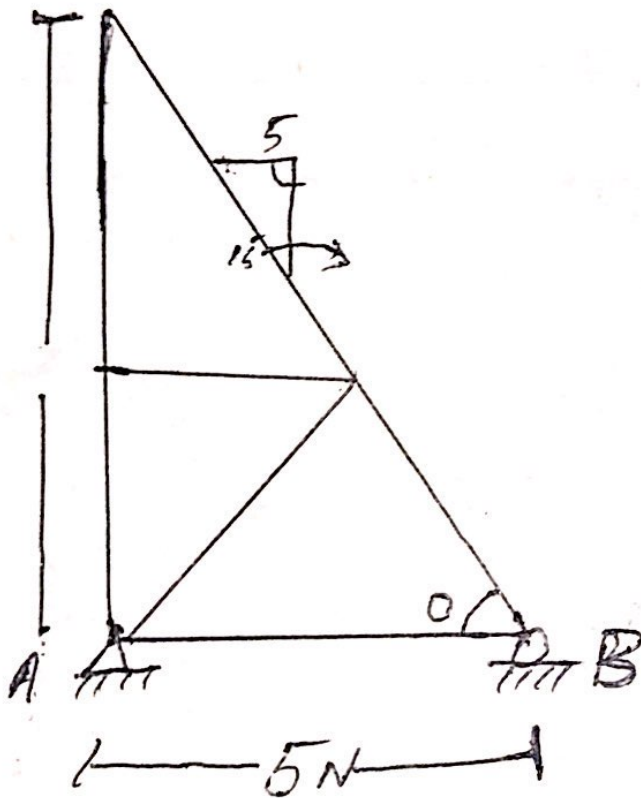
$$\Rightarrow -(5 \times 5)(2.5) - (Ax \times 10) + MA = 0$$

$$\Rightarrow -(62.5) - (-6.25) \times (10) + MA = 0$$

$$\Rightarrow -62.5 + 62.5 + MA = 0$$

$$\Rightarrow \boxed{MA = 0}$$

QNO# 03



$$\sin = P/H$$
$$Q = \sin^{-1}(5/13)$$
$$Q = 22.62$$

Sol:-

$$\sum M_A = 0 \text{ N} +$$

$$(25 \times 12) - (B_y \times 5) + (45 \times 6) = 0$$

$$300 + 270 = 5 B_y$$

$$B_y = 114 \text{ k}$$

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

$$A_y + B_y - 30 = 0$$

$$A_y + 114 - 30 = 0$$

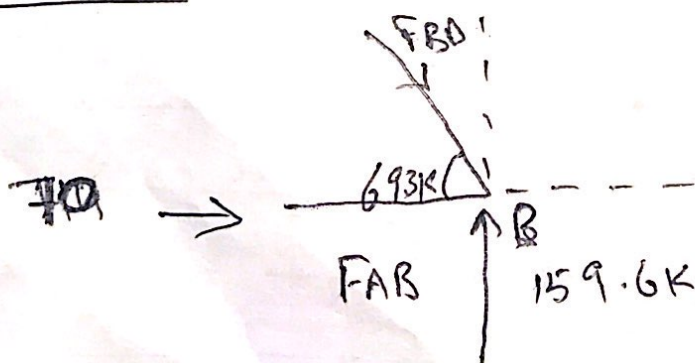
$$A_y = -84 \text{ k}$$

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

$$25 + 45 + A_x = 0$$

$$A_x = -70 \text{ k}$$

Joint B



$$\sum F_x = 0$$

$$-70 - F_{AB} = 0$$

$\rightarrow + \leftarrow -$

(19)

~~$F_{AB} = 70 \text{ N}$~~   $F_{AB} = 70 \text{ k}$

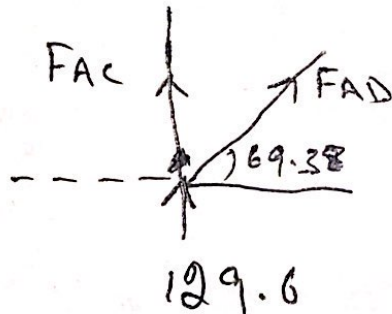
$$\sum F_y = 0 \quad \uparrow + \quad \downarrow -$$

$$- F_{BD} \cos 69.38^\circ + 114 = 0$$

$$0.35 F_{BD} = 114$$

$$F_{BD} = 325.71 \text{ N} \quad T$$

Joint A :-



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

$$+ 70 + F_{AD} \sin 69.38 = 0$$

$$F_{AD} = 65.51 \text{ N}$$

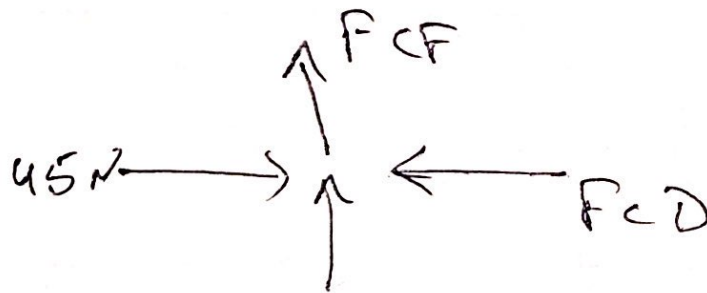
$$\sum F_y = 0 \uparrow \downarrow$$

(13)

$$= -84k + F_{AC} - F_{AD} \cos 69.38^\circ = 0$$

$$= F_{AC} = 98.96$$

Joint C.



$$\cancel{\sum F_x = 45k}$$

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

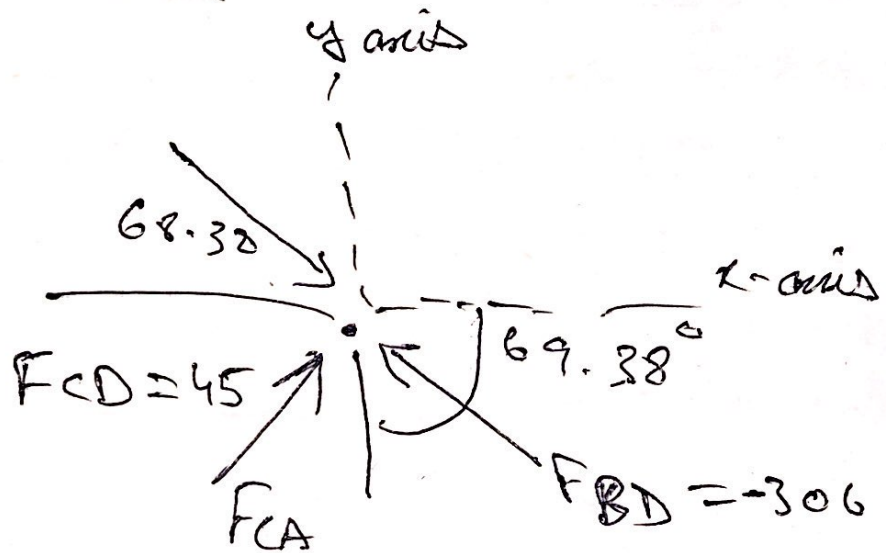
$$\cancel{\sum F_x = 45k} \quad \boxed{F_{CD} = 45k} \quad T$$

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

$$\boxed{F_{CE} = 98.96}$$

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# Joint D



$$\sum F_x = 0 \quad \rightarrow \quad \leftarrow$$

$$-45 F_{DE} \sin 69.38 - 306 \cos 69.38 = 0$$

$F_{DE} = 154.40 \text{ N}$