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7839



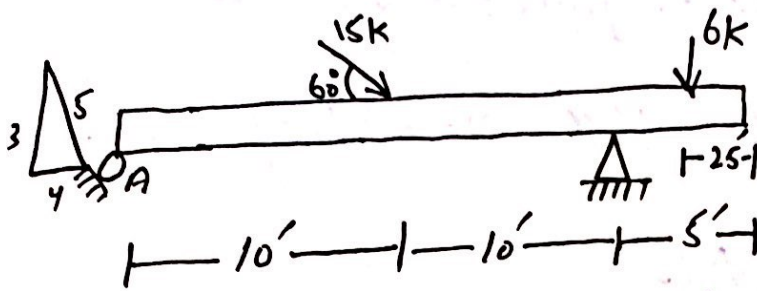
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Section :- B

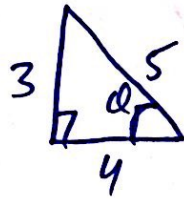
Date :- 22/08/2020

Paper :- Structural 1.

Q No 1 :-



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



$\therefore$  using Trigonometry

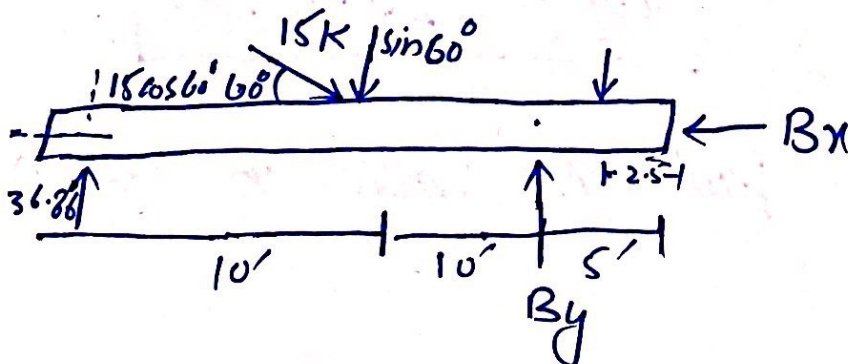
$$\sin Q = \frac{P}{H}$$

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

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

$$Q = 36.86^\circ$$

So Now



$$1:- \Sigma F_x = 0 \quad \xrightarrow{+} \xleftarrow{-}$$

$$15 \cos 60^\circ - B_x - A_y \sin 36 \cdot 86^\circ = 0$$

$$= 7.5 - B_x - 0.599 A_y = 0 \quad \text{--- (1)}$$

$$2:- \Sigma F_y = 0 \quad \uparrow \downarrow$$

$$A_y \cos 36 \cdot 86^\circ + B_y - 6k - 15 \sin 60^\circ = 0$$

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

$$0.80 A_y + B_y = 18.99 \quad \text{--- (2)}$$

$$3:- \Sigma M_B = 0 \quad \uparrow \downarrow$$

$$(A_y \cos 36 \cdot 86 \times 20) - (15 \sin 60^\circ \times 10) + 6 \times 2.5 = 0$$

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

$$A_y = \frac{175}{16}$$

$$\boxed{A_y = 10.9375 \text{ k}}$$

Put the value in Eq. (2)

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

$$8.75 + B_y = 18.99$$

$$B_y = 18.99 - 8.75$$

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

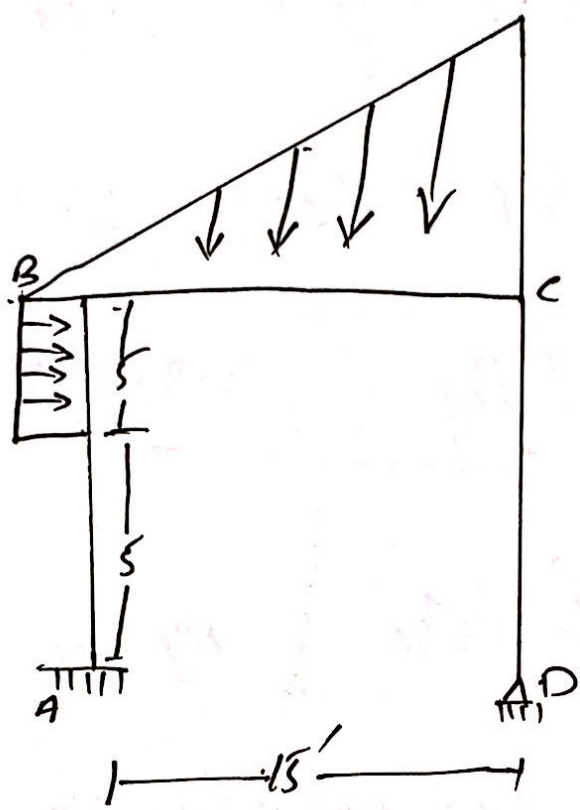
Putting the value of  $A_y$  in Eq (1)

$$7.5 - B_x - 0.59(10.9375) = 0$$

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



Q No 2 :-

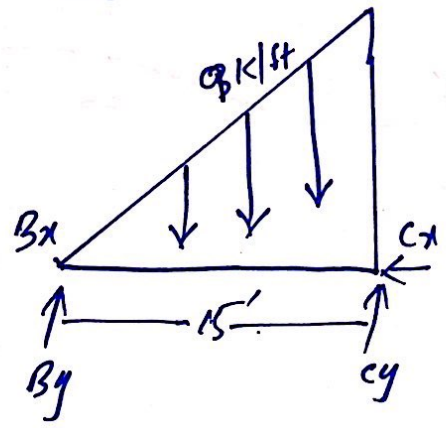


Sol :-

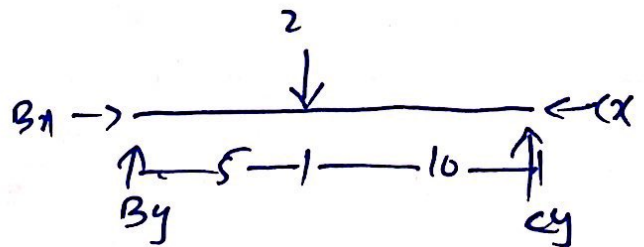
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① Free Body Diagram :-

U.V.L :-



B.D :-



$$\text{Area} = \frac{1}{2}bh$$

$$= \frac{1}{2}(15 \times 9)$$

$$\Rightarrow 67.5$$

$$\text{Dist} = \frac{1}{9}(b) = \frac{1}{9}(15) = 1.6$$

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

A

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

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

$$B_y + C_y = 67.5 \text{ k} \quad \text{--- (2)}$$

iii)  $\Sigma M_B = 0 \quad \curvearrowright \curvearrowleft$

$$(67.5 \times 1.6) - C_y \times 15 = 0$$

$$108 = 15C_y \Rightarrow C_y = \frac{108}{15} \Rightarrow$$

$$C_y = 7.2 \text{ k}$$

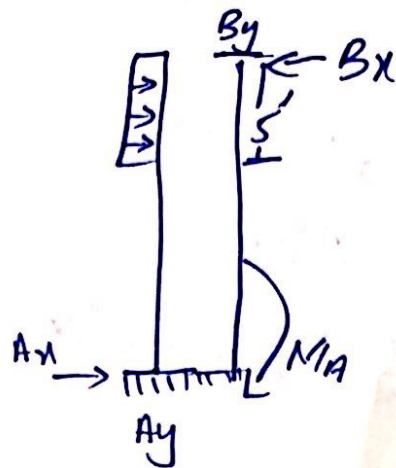
Putting the value in eq (2)

$$B_y + 7.2 = 67.5$$

~~$$C_y = 7.2$$~~

$$B_y = 67.5 - 7.2$$

$$B_y = 60.3 \text{ k}$$



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

$$A_x + (9 \times 5) - B_x = 0$$

$$A_x - B_x = -45 \quad (3)$$

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

$$A_y - B_y = 0$$

$$iii) \quad \sum M = 0 \quad \curvearrowright \curvearrowleft$$

$$(9 \times 5) \times (2.5 + 5) - B_x \times 10 = 0$$

$$45 \times 7.5 = B_x \times 10 = B_x = \frac{337.5}{10}$$

$$\boxed{B_x = 33.75}$$

Putting the value in eq (3)

$$A_x - 33.75 = -45$$

$$\boxed{A_x = -11.25 \text{ k}}$$

Now since C and D are at same line that

$$C_y = 7.2 \text{ K}$$

$$\text{So } \boxed{D_y = -7.2 \text{ K}}$$

Put the value of  $B_y$  in (2)

$$A_y - 15 = 0$$

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

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

$$33.75 - C_x = 0$$

$$\boxed{C_x = 33.75 \text{ K}}$$

$$\text{So } \boxed{D_x = 33.75 \text{ K}}$$

$$M_B = 0 \quad \curvearrowright$$

$$- (9 \times 5) (2.5) - (A_x \times 10) + M_A = 0$$

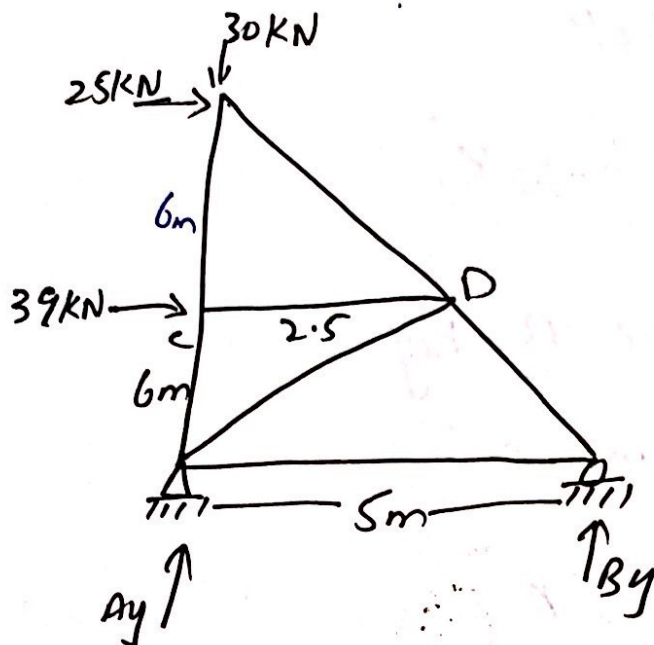
$$- (45) \times (2.5) - (11.25 \times 10) + M_A = 0$$

$$- 112.5 + 112.5 + M_A = 0$$

$$\boxed{M_A = 0}$$



Q No 3 :-



$$\sum M_A = 0 \quad \curvearrowright +$$

$$\Rightarrow 25 \times 12 + 39 \times 6 = B_y \times 5$$

$$300 + 234 = B_y \times 5$$

$$534 = B_y \times 5$$

$$\boxed{B_y = 106.8 \text{ kN}}$$

Now

$$A_y + B_y = 30$$

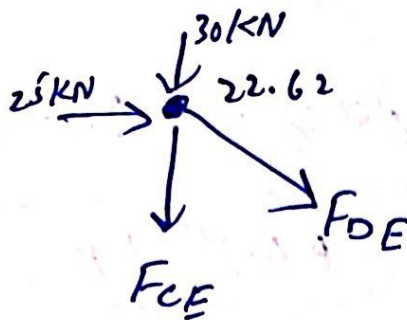
$$A_y = 30 - 106.8$$

$$A_y = -76.8 \quad (\text{mean downward})$$

$$A_x = 25 + 39$$

$$\boxed{A_x = 64 \text{ kN}}$$

Joint E:-



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

$$\Rightarrow 25 + F_{DE} \cos(22.62)$$

$$\Rightarrow F_{DE} = \frac{25}{\cos(22.62)}$$

$$F_{DE} = 27.07 \text{ kN}$$

(Compression)

$$\sum F_y = 0 \quad \uparrow$$

$$\Rightarrow -30 - F_{CE} + \sin 22.62$$

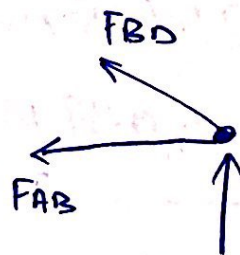
$$\Rightarrow F_{CE} = 30.3 \text{ kN}$$

Now Joint B:-

$$\sum F_y = 0 \quad \uparrow$$

$$\Rightarrow F_{BD} \sin 22.67 =$$

$$\Rightarrow F_{BD} = 0.38 \text{ kN}$$



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

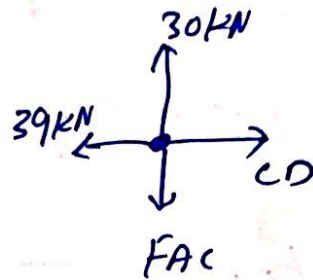
$$\Rightarrow -F_{AB} + 0.38 \times \cos 22.67^\circ = 0$$

$$\Rightarrow F_{AB} = 70.35 \text{ kN}$$

Now Joint C

$$\Rightarrow \sum F_x = 0$$

$$\Rightarrow F_{CD} = 39 \text{ kN}$$



$$\sum F_y = 0$$

$$F_{AC} = 30 \text{ kN}$$

Now Joint D:-

$$\sum F_y = 0 \quad \uparrow$$

$$\Rightarrow 191.1 \times \sin$$

$$= 0.38 + F_{AD} \sin 22.67^\circ$$

$$= 0.38 + F_{AD} 0.38$$

$$= F_{AD} = 1 \text{ kN}$$

