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Section # A

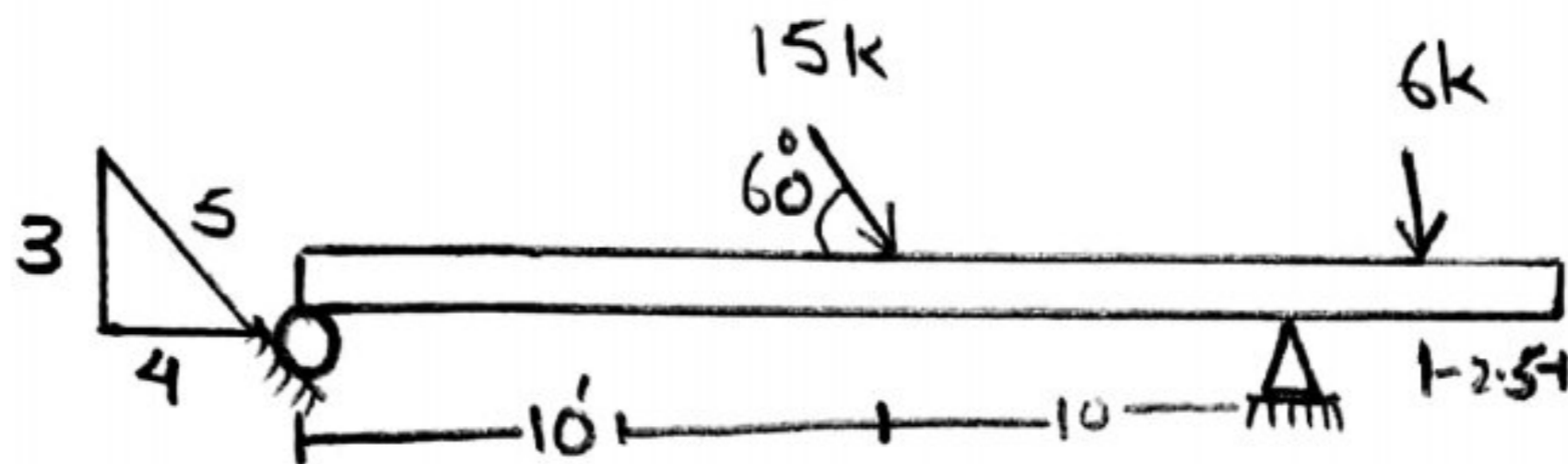
Subject # Structure Analysis 1

Submitted to # Saqib Khan

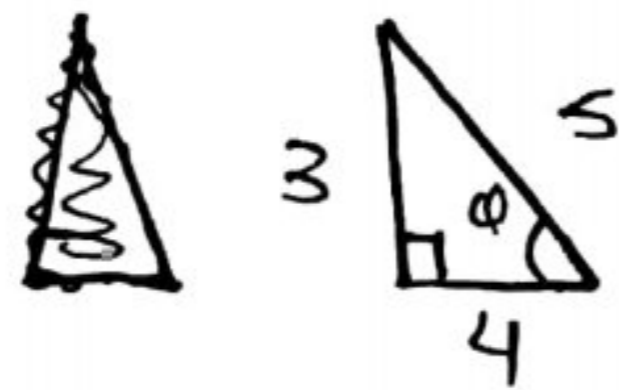
Exam # Mid Term

Q1) Determine the support reactions in the beam given below in figure . . . . . ?

Solution:-



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



∴ Using Trigonometry

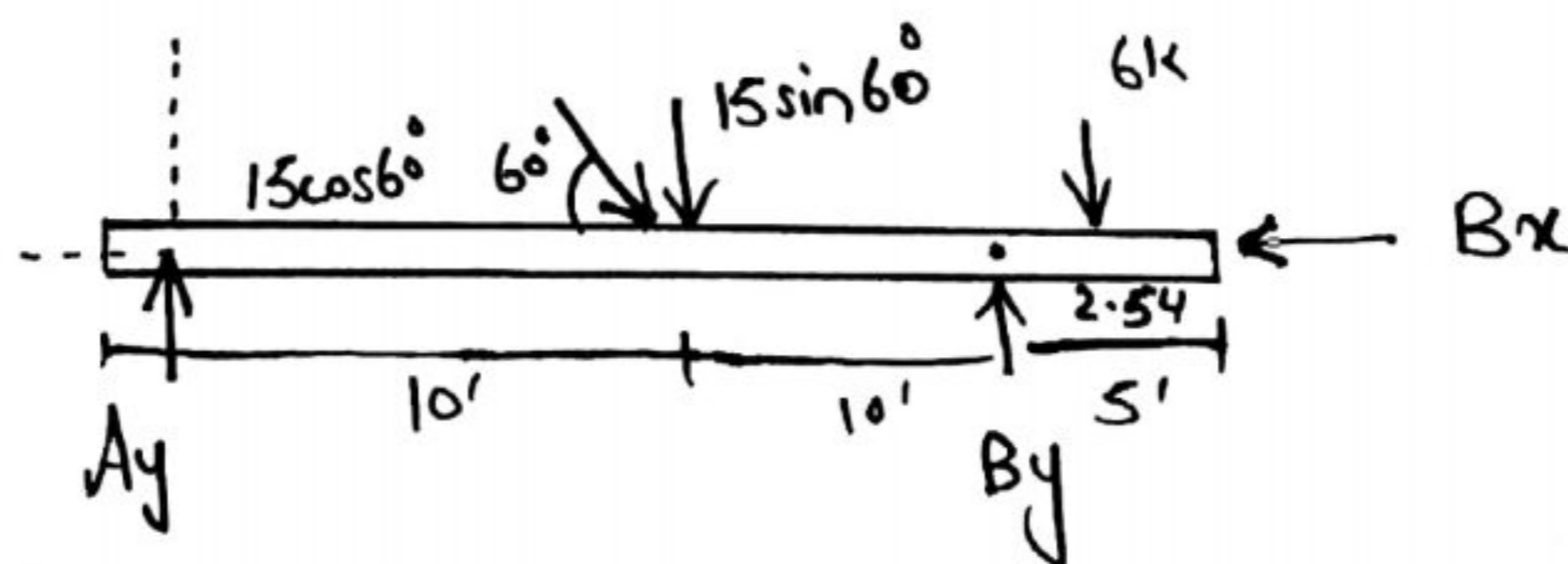
$$\sin \phi = P/H$$

$$\sin \phi = 3/5$$

$$\phi = \sin^{-1}(3/5)$$

$$\phi = 36.86^\circ$$

So Now,



$$1) \sum F_x = 0 \quad \begin{matrix} + \\ \rightarrow \end{matrix} \quad \begin{matrix} - \\ \leftarrow \end{matrix}$$

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

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



$$2) \sum F_y = 0 \quad \uparrow + \downarrow -$$

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

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

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

$$3) \sum M_B = 0 \quad \curvearrow + \curvearrow -$$

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

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

$$16 A_y - 175 = 0$$

$$A_y = 175/16$$

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

Put the value in eq (2)

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

$$8.75 + B_y = 18.99$$

$$B_y = 18.99 - 8.75$$

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

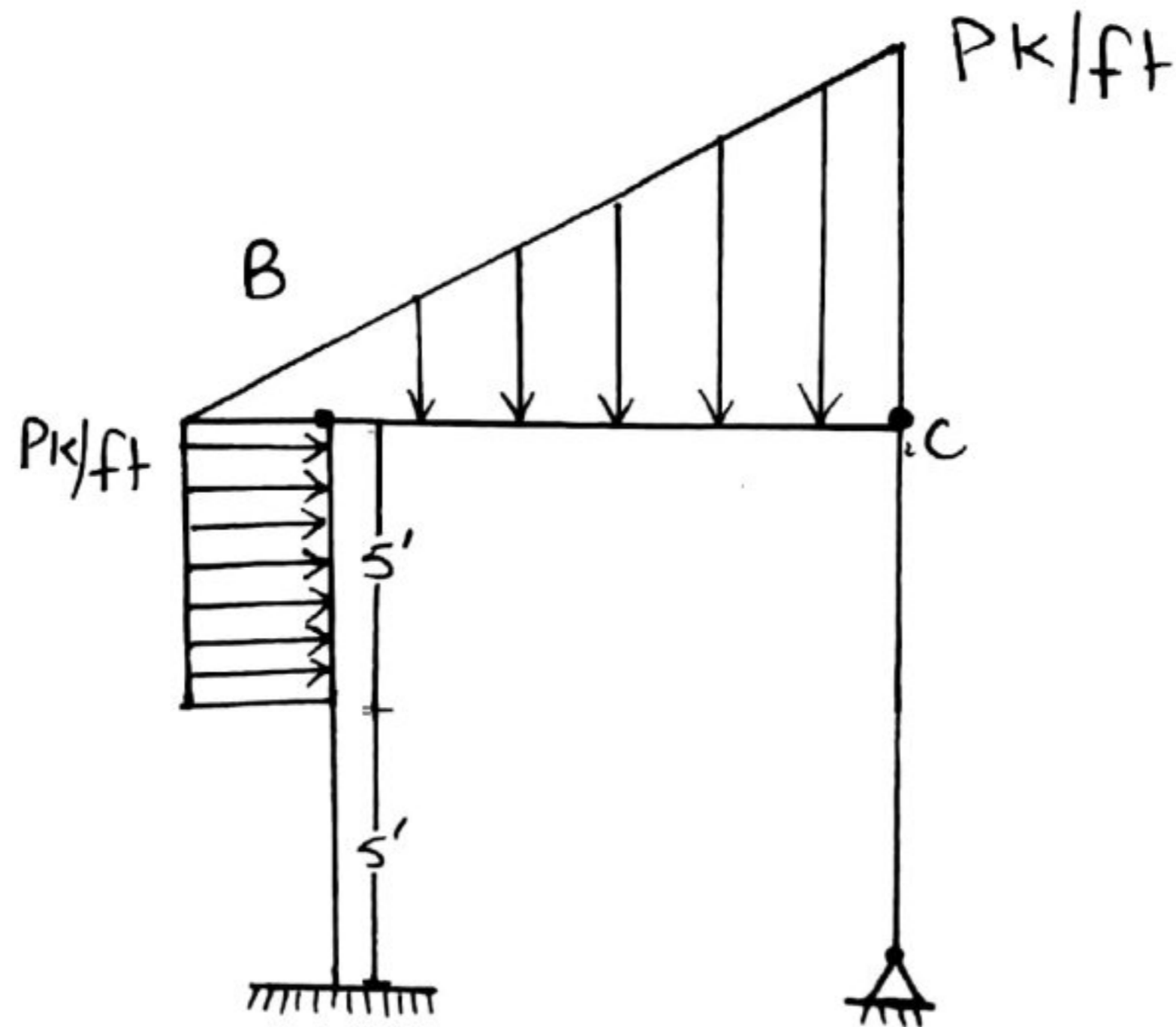
Put the value of  $A_y$  in eq (1)

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

$$\boxed{B_x = 0.9375 \text{ k}} \quad \text{Ans}$$

Question No 2:-

Solution:-

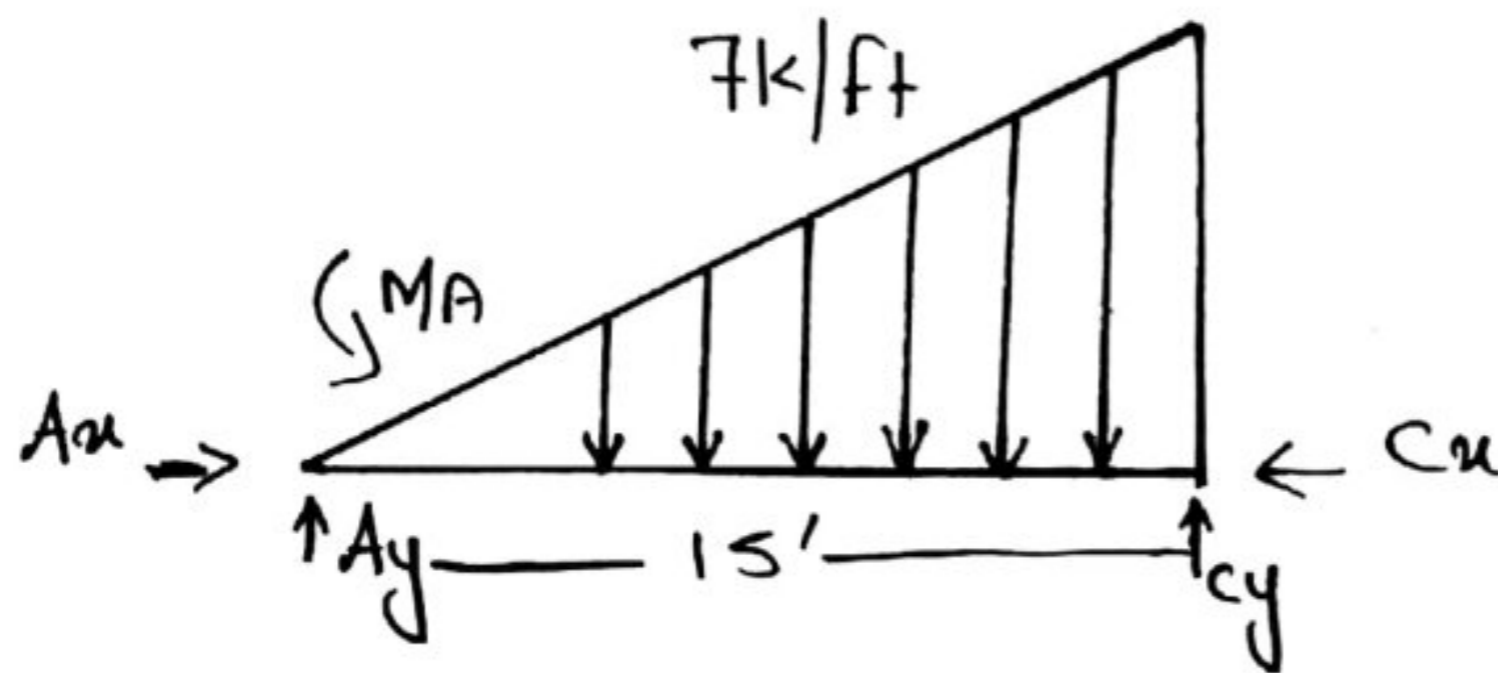


Now

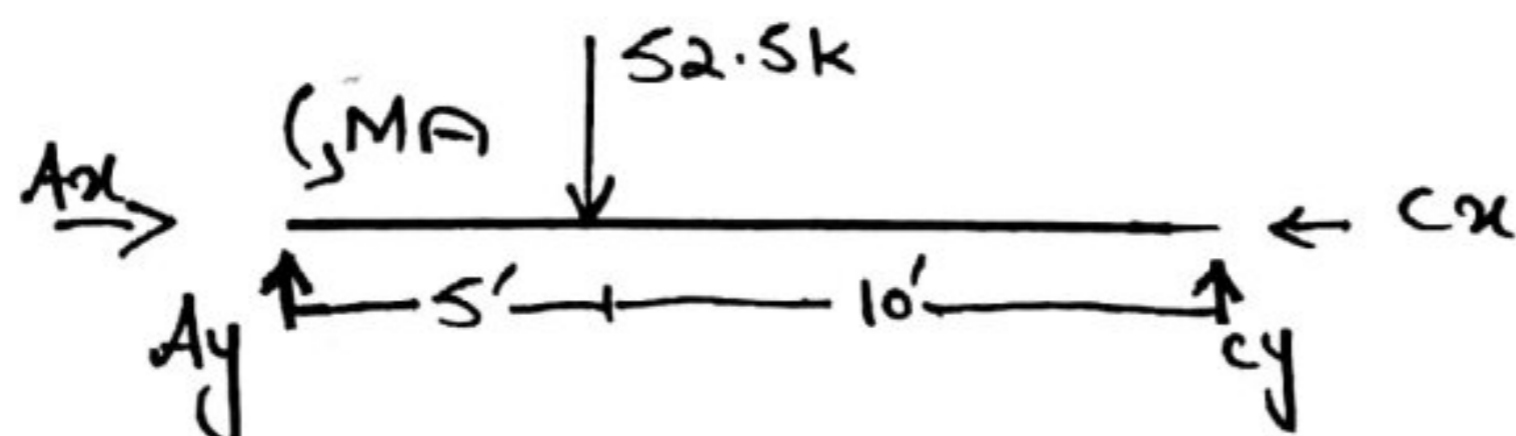
ID - 7797

So  $P = 7$ 

Free body diagram



F.B.D



$$\text{Area: } - \frac{1}{2} bh = \frac{1 \times 15 \cdot 7}{2} = 52.5 \text{ k}$$



$$\begin{aligned} \text{Distance} &= \frac{1}{3} (b) \\ &= \frac{1}{3} (15)^2 \\ &= 5' \end{aligned}$$

$$(i) \sum f_x = 0 \rightarrow + \leftarrow -$$

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

Now.

$$(ii) \sum f_y = 0 \uparrow + \downarrow -$$

$$A_y + C_y - 52.5 = 0$$

$$A_y + C_y = 52.5 \text{ k}$$

$$(iii) \sum M_A = 0 \curvearrowright +$$

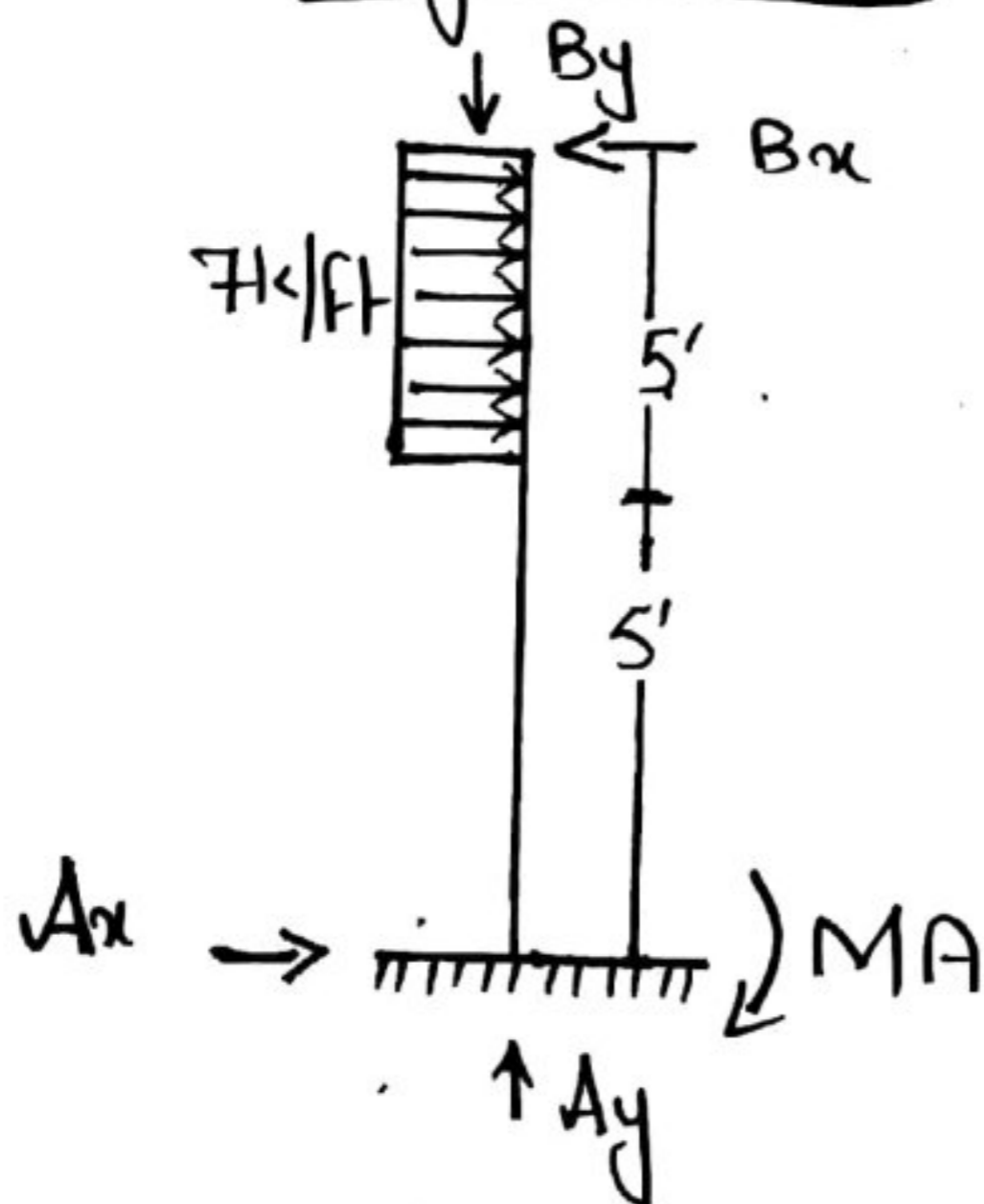
$$(52.5 \times 5) - C_y \times 15 = 0$$

$$C_y = -17.5 \text{ k}$$

Put the value in (1)

$$A_y - 17.5 = 52.5 \text{ k}$$

$$A_y = 70 \text{ k}$$



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

$$A_x + (7 \times 5) - B_x = 0$$

$$A_x - B_x = -35 \quad \text{--- (1)}$$

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

$$A_y - B_y = 0 \quad \text{--- (2)}$$

$$(iii) \sum MA = 0 \curvearrowright + \curvearrowleft -$$

$$(7 \times 5) \times (2.5 + 5) - B_x \times 10 = 0$$

$$262.5 - 10 B_x = 0$$

$$\boxed{B_x = 26.25 \text{ k}}$$

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

$$A_x - 26.25 = -35$$

$$\boxed{A_x = 8.75 \text{ k}}$$

Put the value of  $A_y$  in eq (2)

$$70 - B_y = 0$$

$$\boxed{B_y = 70 \text{ k}}$$

Put the value of  $A_x$  in eq (3)

$$8.75 - C_x = 0$$

$$C_x = 8.75 \text{ k}$$

Since D is hinge & in the projection of point C thus.

$$\boxed{D_x = -8.75 \text{ k}}$$

$$\boxed{D_y = 17.5 \text{ k}}$$



$$MB = 0 \quad \checkmark$$

$$-(7 \times 5)(2 \times 5) - (875 \times 10) + MA = 0$$

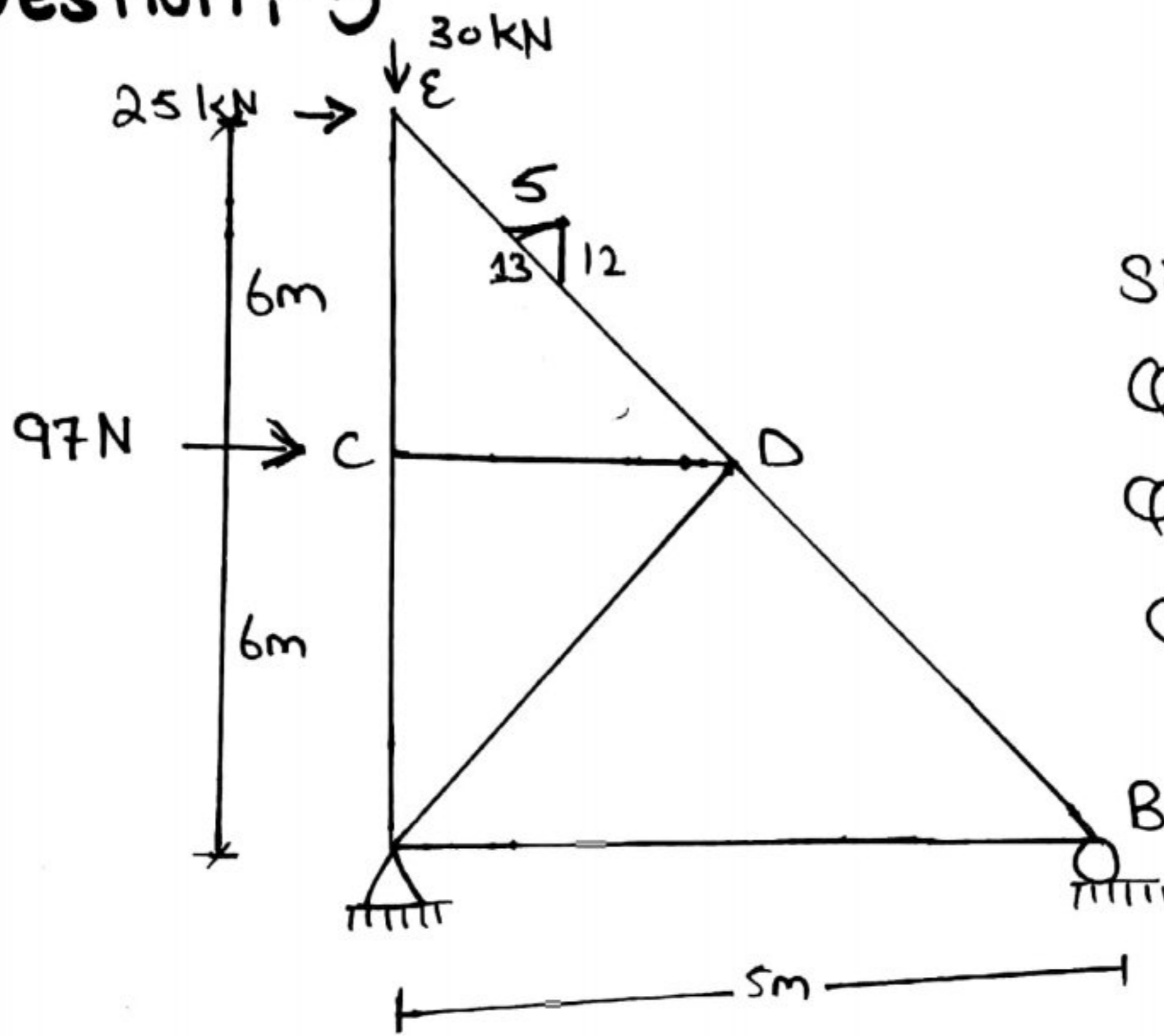
$$(-875) + 875 + MA = 0$$

$$\boxed{MA = 0} \quad \text{Ans}$$

# Question: 3

7797

Page (7)



$$\sin \phi = P/H$$

$$\phi = \sin^{-1}(5/13)$$

$$\phi = 22.62^\circ$$

$$\phi = ?$$

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

$$(25 \times 12) - (B_y \times 5) + (97 \times 6) = 0$$

$$= 300 + 582 = 5 B_y$$

$$= 176.4 \text{ k}$$

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

$$A_y + B_y - 30 = 0$$

$$A_y + 176.4 - 30 = 0$$

$$A_y = -146.4 \text{ k}$$

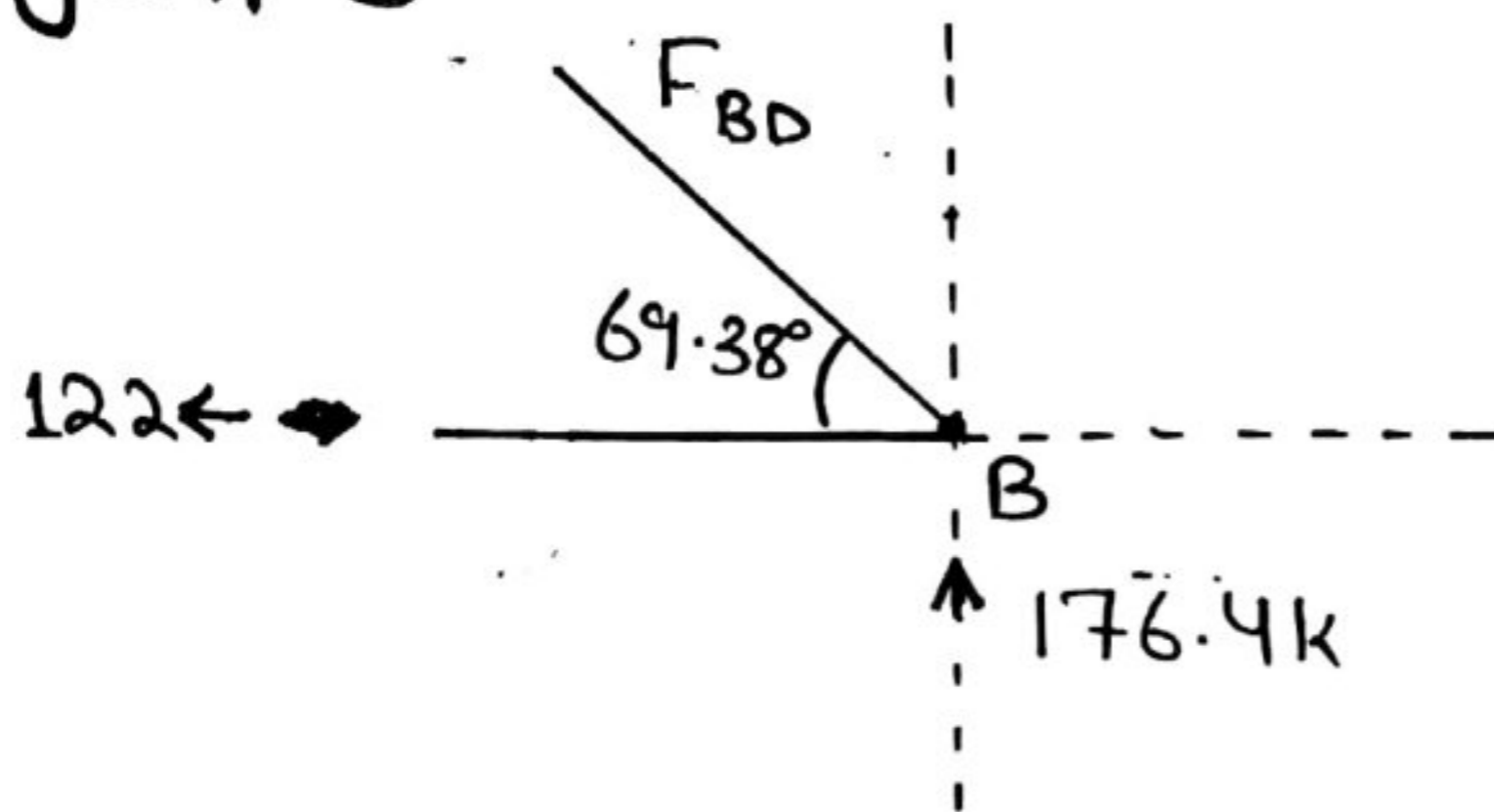
$$\sum F_x = 0 \quad \rightarrow + \quad \leftarrow -$$

$$= 25 + 97 + A_x = 0$$

$$A_x = -122 \text{ k}$$



Joint B =



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

$$= 122 - F_{AB} = 0$$

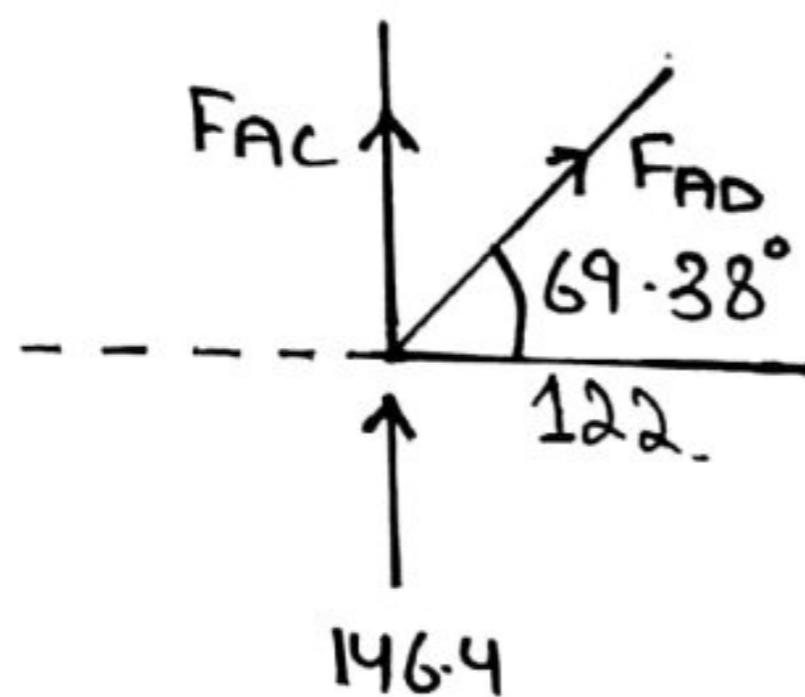
$$F_{AB} = 122 \text{ k}$$

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

$$- F_{BD} \cos 69.38^\circ + 176.4 = 0$$

$$= \boxed{F_{BD} = 504}$$

Joint A:-



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

$$= 122 + F_{AD} \sin 69.38^\circ = 0$$

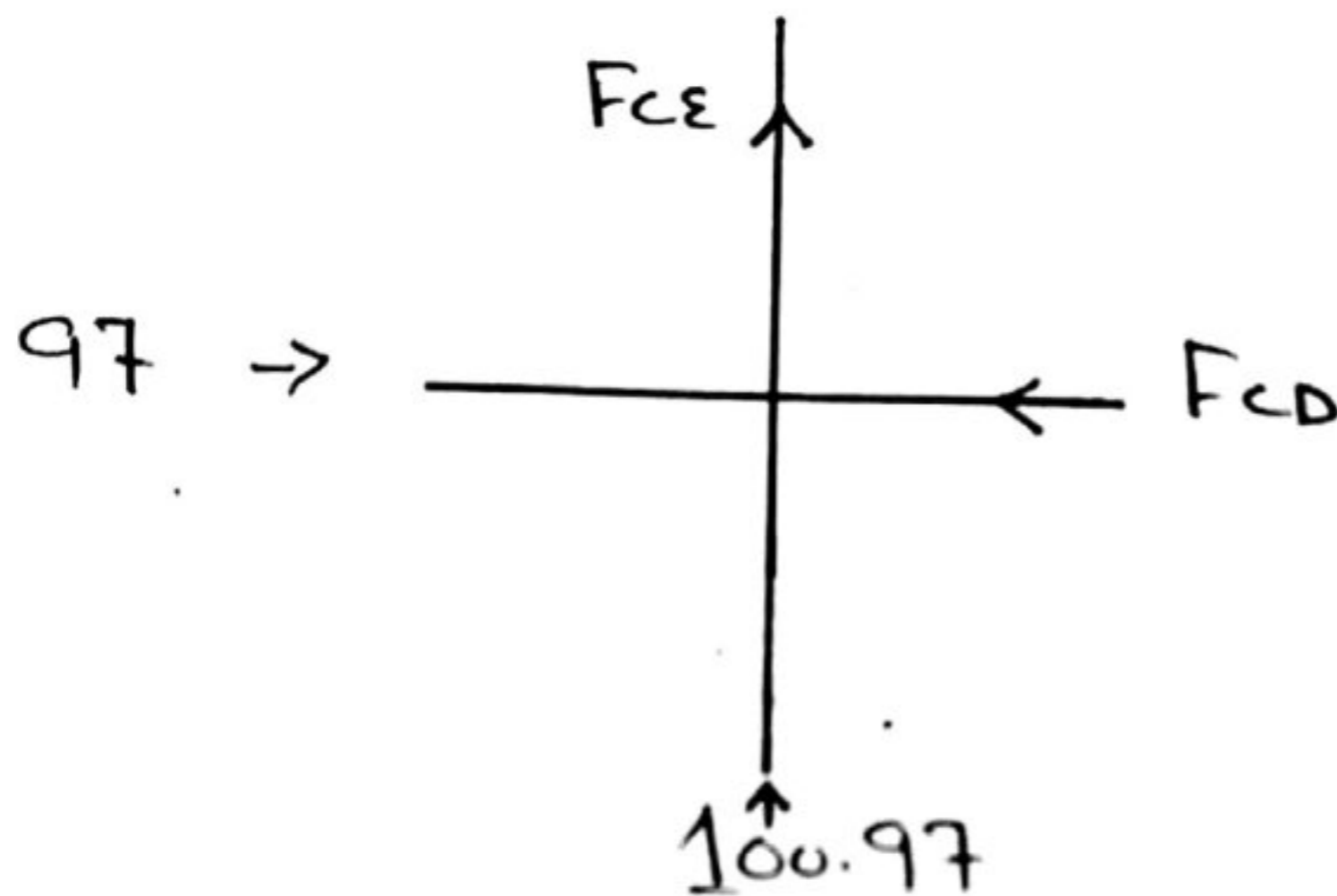
$$\boxed{F_{AD} = -129.78}$$

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

$$-146.4 + FAC - FAD \cos 69.38 = 0$$

$$FAC = 100.97 \text{ N}$$

Joint :- C



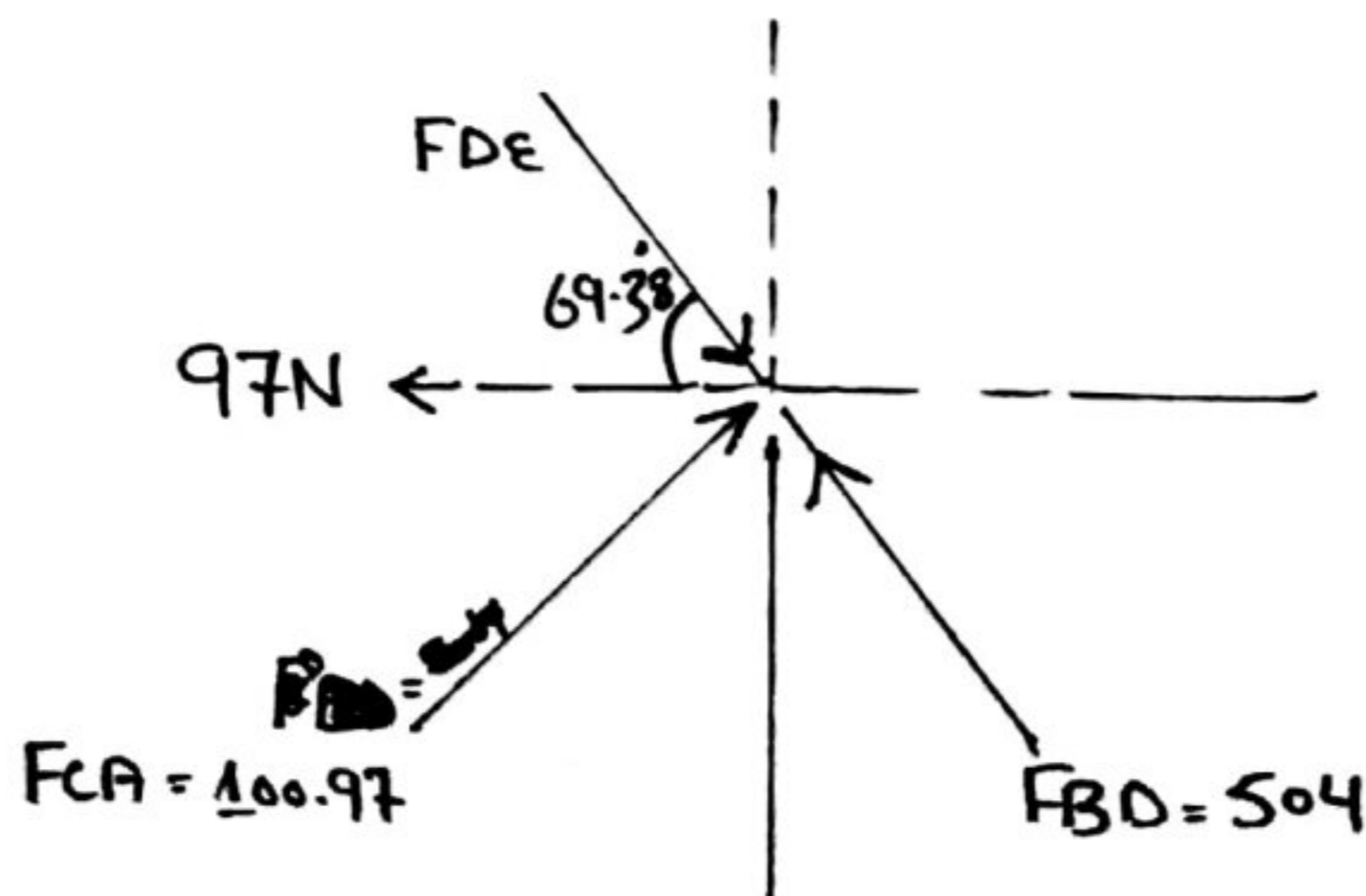
$$\sum F_x = 0 \quad \rightarrow + \quad \leftarrow -$$

$$F_{CD} = 97$$

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

$$F_{CE} = -100.97$$

Joint :- D





7797

Page 10

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

$$= 97 + F_{DE} \sin 69.38 - 504 \cos 69.39$$

$$= \boxed{F_{DE} = 290.85 \text{ N}} \quad \text{Ans}$$



1