

MID TERM

SUMMER

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Section: "B"

Semester: 6th

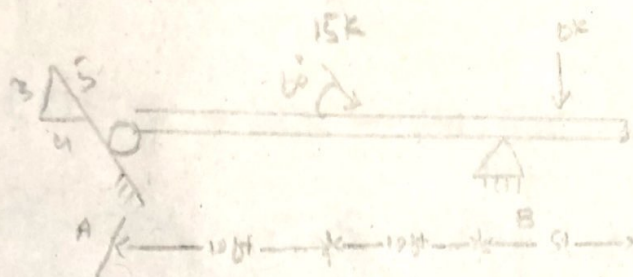
Subject: Structure Analysis - I

Instructor: Engr Muhammad Saqib

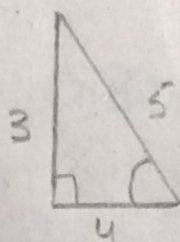
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Question #01



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



\therefore using Trigonometry

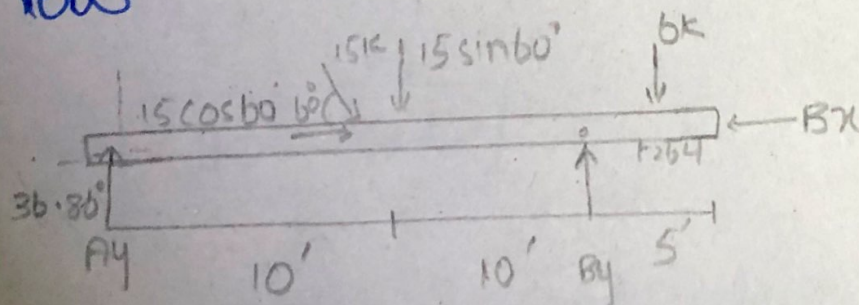
$$\sin \theta = \frac{P}{H}$$

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

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

$$\theta = 36.86^\circ$$

so now



$$\underline{1.} \quad \sum \rightarrow \leftarrow = 0 \quad \xrightarrow{+} \xleftarrow{-}$$

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

$$7.5 - Bx - 0.599Ay = 0 \quad \text{--- (1)}$$

$$\underline{2.} \quad \sum \uparrow \downarrow = 0 \quad \uparrow + \downarrow -$$

$$Ay \cos 36.86^\circ + By - 6k - 15 \sin 60^\circ = 0$$

$$0.80Ay + By - 18.99 = 0$$

$$0.80Ay + By = 18.99 \quad \text{--- (2)}$$

$$\underline{3.} \quad \sum M_B = 0 \quad \curvearrowright + \curvearrowleft -$$

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

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

$$16Ay = 175 = 0$$

$$Ay = \frac{176}{16}$$

$$\boxed{Ay = 10.9375k}$$

Put the values in equation (2)

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Question # 01

$$0.80(10.9375) + B_4 = 18.99$$

$$8.75 + B_4 = 18.99$$

$$B_4 = 18.99 - 8.75$$

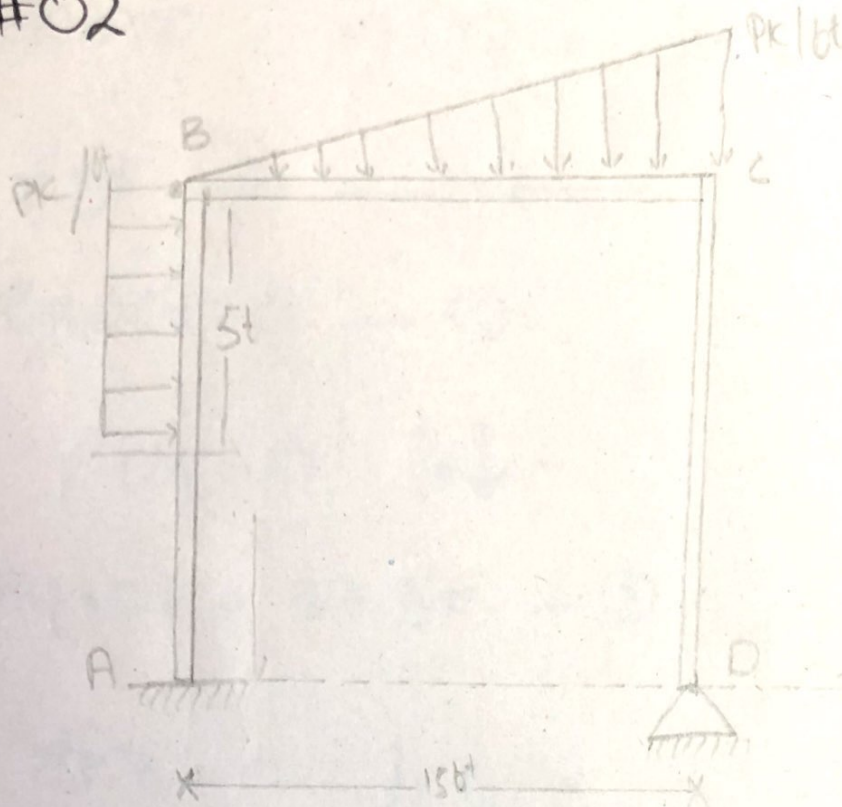
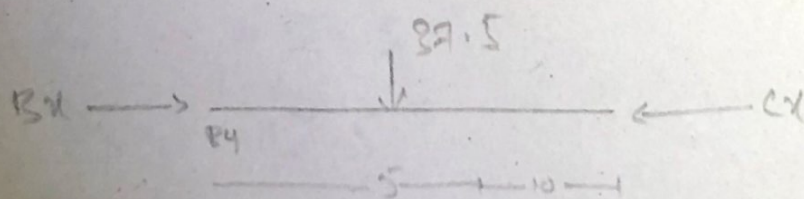
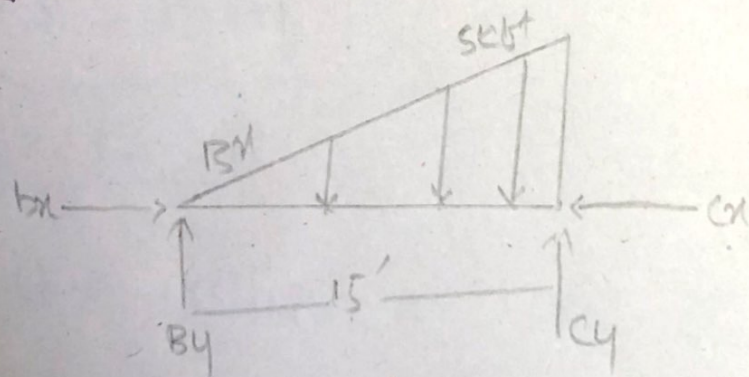
$$B_4 = 10.25K$$

Put the values of A_4 in eq ①

$$7.5 - B_1 - 0.599(10.9375) = 0$$

$$B_1 = 0.9375K$$

Q#02

Solution:

$$\text{Area} = \frac{1}{2} (15 \times 5) \\ = 37.5$$

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

$$\text{i} - \sum B_x = 0 \quad \rightarrow + \leftarrow -$$

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

$$\text{ii} - \sum B_y = 0 \quad \uparrow + \downarrow -$$

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

$$\text{iii} - \sum M_B = 0 \quad \downarrow + \curvearrowright -$$

$$(37.5)(5) - (C_y + 15) = 0$$

$$187.5 = 15C_y$$

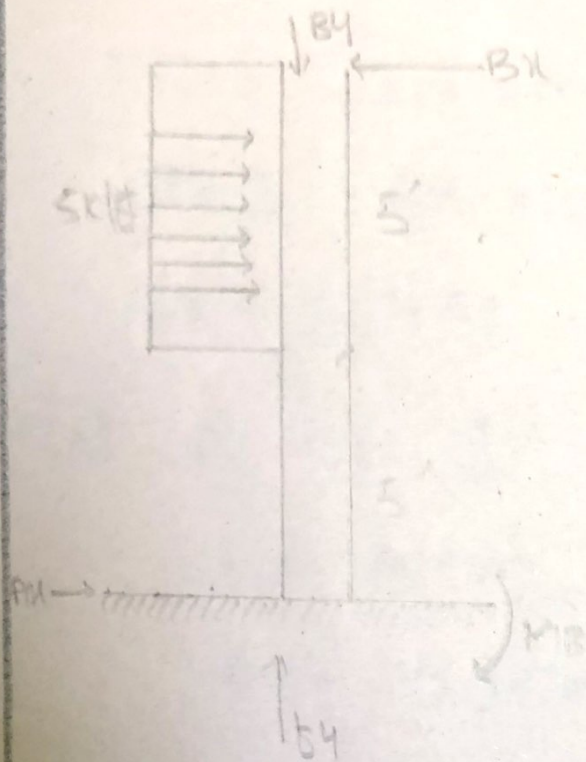
$$\boxed{C_y = 12.5}$$

Put the values in eq. (2)

$$B_y + 12.5 = 37.5$$

$$B_y = 37.5 - 12.5$$

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



$$i) \sum Bx = 0 \quad \rightarrow + \leftarrow -$$

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

$$Ax - Bx = -25 \quad \text{--- (3)}$$

$$ii) \sum By = 0 \quad \uparrow + \downarrow -$$

$$Ay - By = 0 \quad \text{--- (4)}$$

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

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

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Question #02

$$25 \times 7.5 - Bx \times 10 = 0$$

$$187.5 = Bx \times 10 = 0$$

$$187.5 = Bx \times 10$$

$$Bx = 18.75K$$

Put in eq (2)

$$Ax - 18.75 = -25$$

$$Ax = -6.25K$$

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

$$Cy = 12.5K$$

$$\text{so } Dy = -12.5K$$

Put the value of Bx in eq (4)

$$Ay - 25 = 0$$

$$Ay = 25K$$

Put the value of Bx in eq (3)

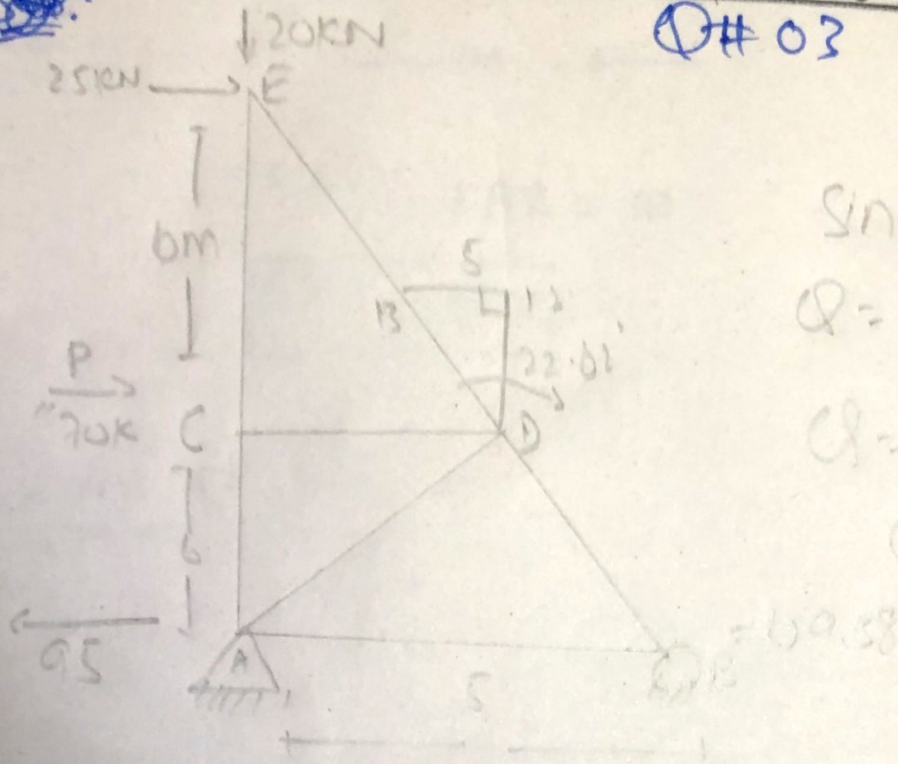
$$18.75 - Cx = 0$$

$$Cx = 18.75K$$

Lies on same plane
so $Dx = 18.75K$

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Question # 03
Q# 03

$$\sin Q = P/H$$

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

$$Q = 22.62$$

$$Q = 67.38$$

Sol:

$$\sum M_A = 0 \uparrow +$$

$$(25 \times 12) - (B_y \times 5) + (55 \times 6) = 0$$

$$300 + 330 = 5B_y$$

$$B_y = 126 \text{ N}$$

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

$$A_y + B_y - 30 = 0$$

$$A_y + 126 - 30 = 0$$

$$A_y = -126 \text{ N}$$

a

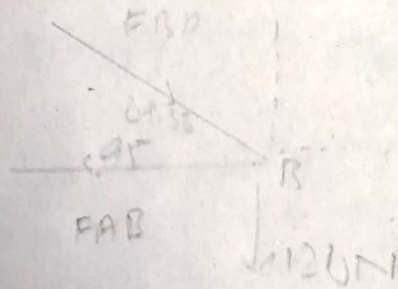
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Question #05

$$\sum \mathcal{M}_x = 0 \quad \rightarrow + \quad \leftarrow -$$

$$25 + 55 + Ax = 0$$

$$\boxed{Ax = -80}$$

Joint B

$$\sum \mathcal{M}_x = 0 \quad \rightarrow + \quad \leftarrow -$$

$$-70 + FAB = 0$$

$$\boxed{FAB = 70 \text{ N}}$$

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

$$-FBD \cos 69.38 - 126 = 0$$

$$0.35 FBD = -126.0$$

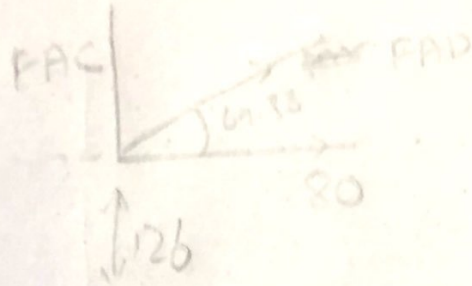
$$\boxed{FBD = -325.71}$$

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Question #03

Joint A



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

$$F_{AD} \sin 38^\circ + 80 = 0$$

$$0.94 F_{AD} = -80$$

$$F_{AD} = -107.1 \text{ N}$$

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

$$-126 + F_{AC} + F_{AD} \cos 38^\circ = 0$$

$$F_{AC} + 126 - 107.1 \times 0.35 = 0$$

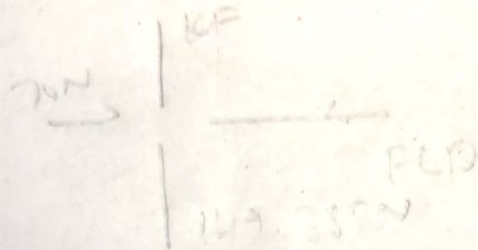
$$F_{AC} = 149.385 \text{ N} \quad \textcircled{A}$$

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Question # 03

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Joint c



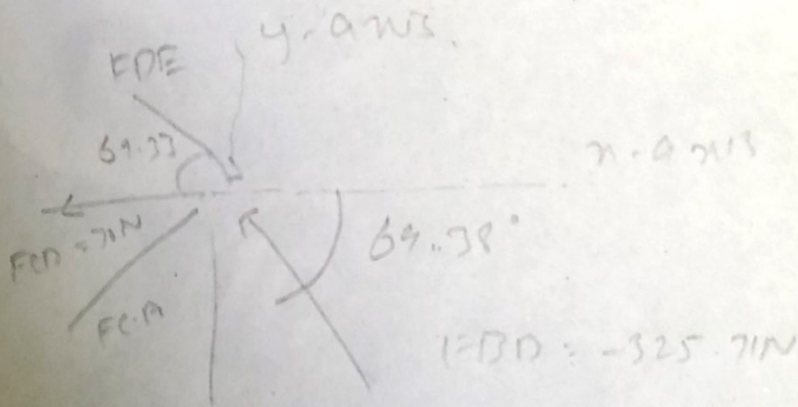
$$\sum F_x = 0 \quad \rightarrow + \leftarrow -$$

$$F_{CD} = 70N$$

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

$$F_{CE} = -149.385N \quad \text{①}$$

Joint D



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

$$-70 + F_{DE} \sin 69.38 - 325.71 + F_{CD} \cos 69.38 = 0$$

$$F_{DE} \times 0.94 = 184.70$$

$$F_{DE} = 196.5N$$