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Section A

Subject = Structure Analysis 1

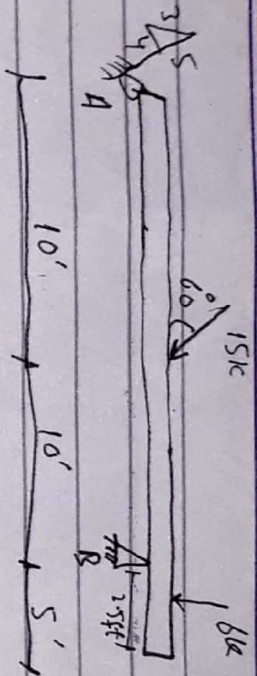
Teacher = Engr. Sajid Khan

Exam = Mid Term

Date = 22/08/2020

(1)

Q no 1



Support reaction = ?

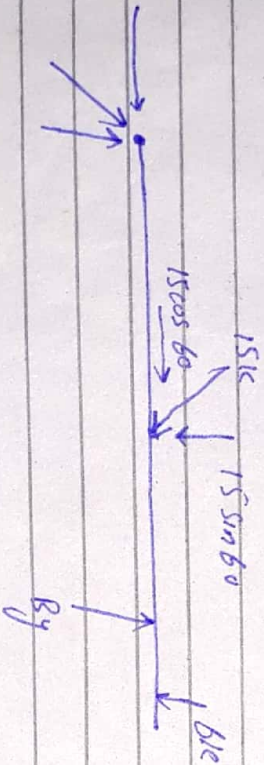
"Using equations of equilibrium"

"Steps"

1 Draw Free Body diagram

Identify the type of supports provided.

Resolve the inclined force into its component.



"Now using Equation of Equilibrium"

As,

$$\tan \theta = \left(\frac{3}{4}\right)$$

$$\theta = \tan^{-1} \left(\frac{3}{4}\right)$$

$$\theta = 36^\circ$$

$$\sum F_y = 0 \rightarrow + \uparrow$$

$$A_y + B_y - 15 \sin 60 - 6 = 0$$

$$A_y + B_y - 12.99 - 6 = 0$$

$$A_y + B_y = 18.99k$$

(2)

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

$$+ A_x + 15 \cos 60 = 0$$

$$A_x = -7.5 \text{ k}$$

Opposite to the assume direction

$$\sum M_B = 0 \quad \curvearrowright \quad \curvearrowleft$$

$$A_y \cos 36(20) - 15 \sin 60(10) + 6(2.5) = 0$$

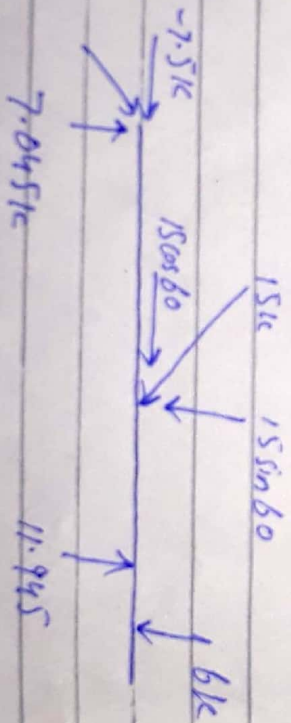
$$A_y (16.18) - 129 + 15 = 0$$

$$A_y = 114/16.18$$

$$A_y = 7.045 \text{ k}$$

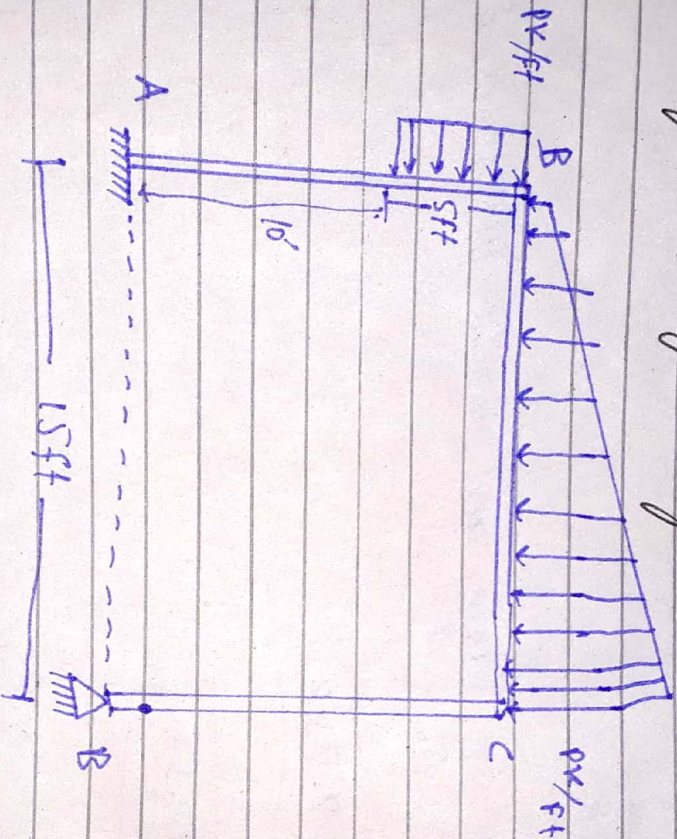
By Putting in eq (2)

$$B_y = 11.945 \text{ k}$$



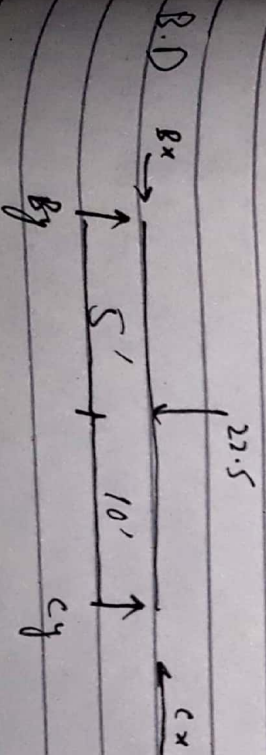
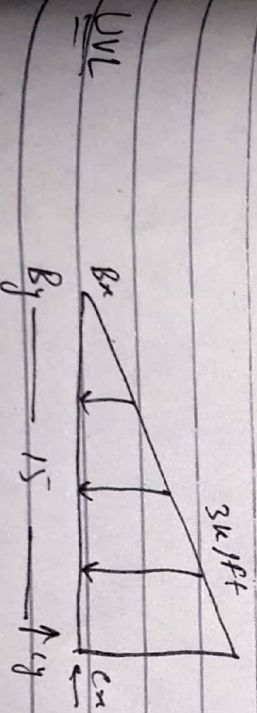
(3)

QNO 2 ⇒ Determine the support reactions of the given frame in Figure 2. Where the support reaction at Point A is Fixed and Point B, C, D are all Pin Support and the value of P is the last digit of your registration number is 7.



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Free body diagram



(4)

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

$$= \frac{1}{2} (15 \times 8)$$

$$= 52.5 \text{ k}$$

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

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

$$A_x - (x = 0 - \text{a})$$

Now

② $\sum F_y = 0 \uparrow \downarrow$

$$A_y + C_y - 52.5 = 0$$

$$A_y + C_y = 52.5 \text{ k} \quad \text{①}$$

③ $\sum M_A = 0 \rightarrow +$

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

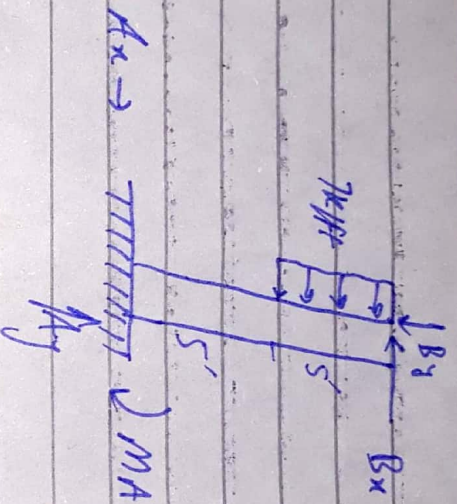
$$C_y = 17.5 \text{ k}$$

Put the value in ①

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

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

(5)



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

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

$$A_x - B_x = -35 \rightarrow \text{①}$$

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

$$A_y - B_y = 0 \rightarrow \text{②}$$

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

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

$$262.5 - 10 B_x = 0$$

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

Put the value of B_x in ①

$$A_x - 26.25 = -35$$

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

(18)

Put the value of A_y in eq (2)

$$70 - B_y = 0$$

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

Put the value of A_x in eq (1)

$$8.75 - C_x = 0$$

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

Since D is hinge and in the projection of Point C thus

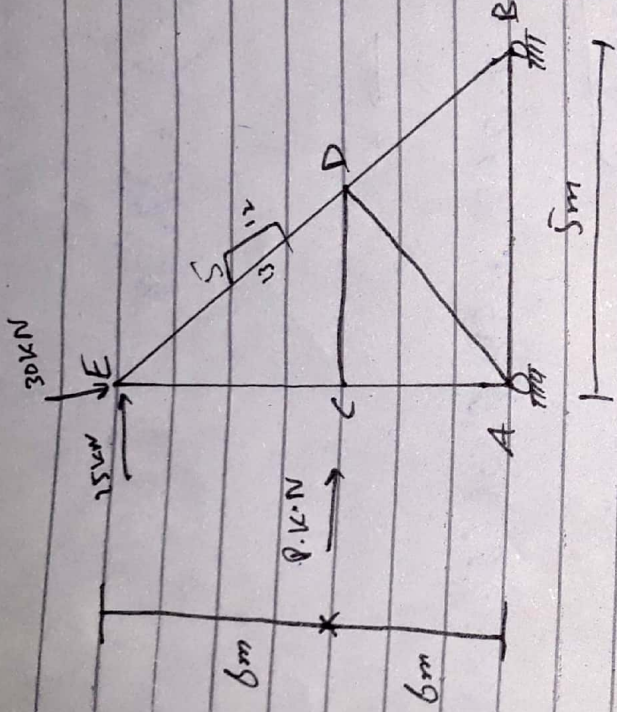
$$D_x = 8.75 \text{ k}$$

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

(7)

Q NO 3

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Sol

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

$$-5B_y + 77 \times 6 + 25 \times 12 = 0$$

$$B_y = 152.4 \text{ kN}$$

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

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

$$A_y = 30 - B_y$$

$$= 30 - 152.4$$

$$A_y = -122.4 \text{ kN}$$

$$\sum F_x = 0$$

$$A_x = 25 + 77 = 102 \text{ kN}$$

$$A_x = 102 \text{ kN}$$

$$Q = ?$$

$$\tan \phi = \frac{12}{5} \Rightarrow \phi = \tan^{-1} \left(\frac{12}{5} \right) = 67.38^\circ$$

$$\phi = 67.38^\circ$$

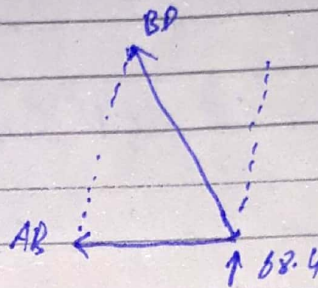
Using Method of Joint:

Joint B

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

$$152.4 + BD \sin \phi = 0$$

$$\Rightarrow BD = \frac{152.4}{\sin(67.38)} = \frac{152.4}{0.923} = 165 \text{ kN}$$



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

$$-AB - AD \cos \phi = 0$$

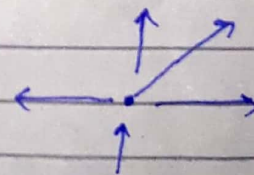
$$\Rightarrow AB = -BD \cos \phi = -(165) (\cos(67.38)) = -63 \text{ kN}$$

$$AB = 63 \text{ kN}$$

$$AB = 0.063$$

Joint A

Let ϕ is the angle btw AD and AB



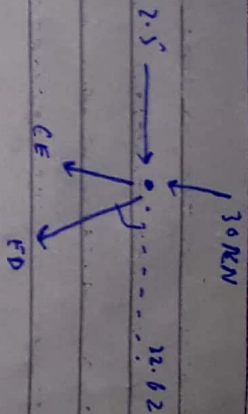
(19)

Joint E

$$\sum F_x = 0$$

$$25 + ED \cos(22.62) = 0$$

$$ED = -27.08 \text{ kN}$$



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

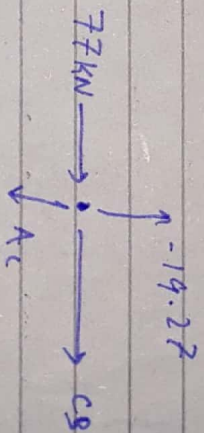
$$-30 - CE - ED \sin(22.62) = 0$$

$$-30 - CE - (-27.08) \sin 22.62 = 0$$

$$CE = -19.58 \text{ kN}$$

Joint C

$$\sum F_x = 0$$



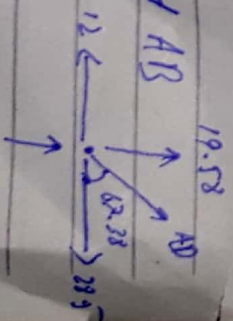
$$CD = -77 \text{ kN}$$

$$\sum F_y = 0$$

$$AC = -19.58 \text{ kN}$$

Joint A

Let ϕ is angle b/w AD and AB



$$\frac{S}{12} = \frac{x}{k}$$

$$x = 2.5$$

$$\tan \phi = \frac{6}{2.5}$$

$$\Rightarrow \phi = \tan^{-1} \left(\frac{6}{2.5} \right) = 67.38^\circ$$

Now

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

$$-102 + 0.063 + AD \cos(67.38) = 0$$

$$AD = -264.77$$

So the forces in each member are calculate

