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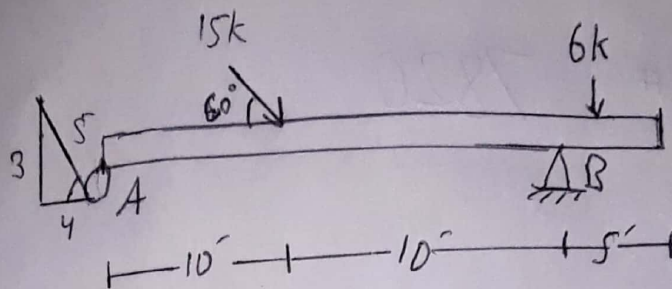
ID # 7820

Section: A

Subject: Structure Analysis - I

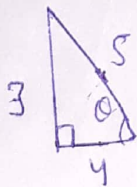
Question No. 7

# Question No. 1:



Solution:

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



Using Trigonometry

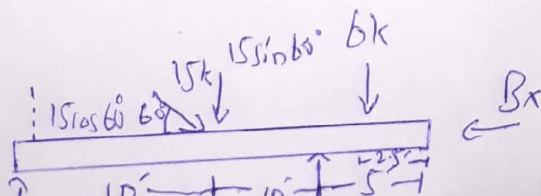
$$\sin \theta = \frac{P}{h}$$

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

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

$$\theta = 36.86^\circ$$

So Now,



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

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

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

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

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

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

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

$$3. \quad \Sigma M_B = 0 \quad \curvearrowright \curvearrowleft$$

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

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

$$16 A_y - 175 = 0$$

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

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

Put the values in eq. (2)

$$\text{eqn 2)} \Rightarrow 0.80(10.9375) + B_y = 18.99$$

$$8.75 + B_y = 18.99$$

$$B_y = 18.99 - 8.75$$

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

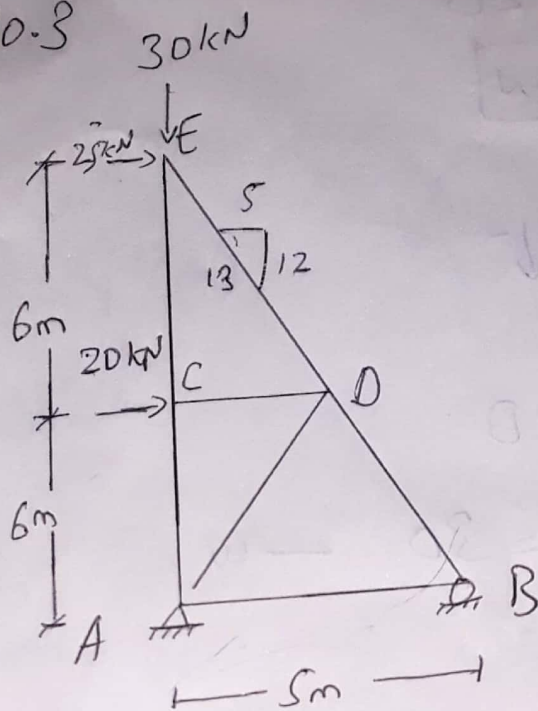
Put the value of  $A_y$  in eqn 1

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

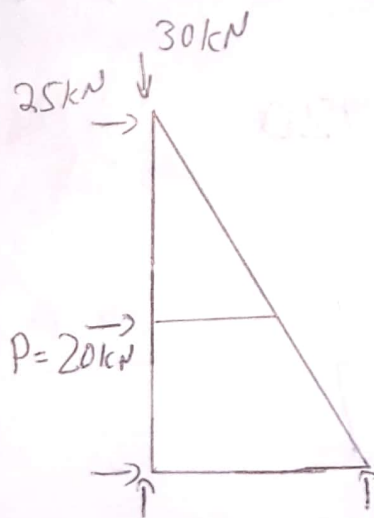
$$\boxed{B_x = 0.9375 \text{ k}}$$



Question No. 3



Solution:



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

$$25 + A_x + P = 0$$

~~25 + A\_x + 20 = 0~~

$$A_x = -25 - 20$$

$$\boxed{A_x = -45 \text{ kN}}$$

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

$$A_y - 30 + B_y = 0$$

$$A_y + B_y = 30 \quad \text{--- (1)}$$

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

$$-(B_y \times 5) + (25 \times 12) + (20 \times 6) = 0$$

$$5 B_y = 300 + 120$$

$$B_y = \frac{420}{5}$$

$$\boxed{B_y = 84 \text{ kN}}$$

$$(1) \Rightarrow A_y = 30 - 84$$

$$\boxed{A_y = -54 \text{ kN}}$$

$$\theta = ?$$

$$\tan \theta = \frac{12}{5} =$$

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

$$\boxed{\theta = 67.38^\circ}$$

Using Method of Joints:

Joint B:

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

$$84 + BD \sin \theta = 0$$

$$\Rightarrow BD = \frac{-84}{\sin(67.38)} = -85.14 \text{ kN}$$

$$\boxed{BD = +85.14 \text{ kN}}$$

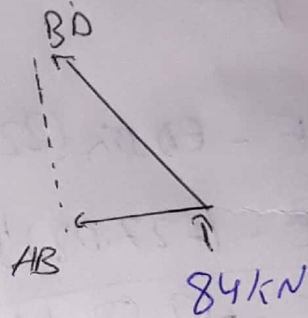
$$\sum F_x = 0 \quad \rightarrow^+$$

$$-AB - BD \cos \theta = 0$$

$$AB = -BD \cos \theta$$

$$= -(-85.14) \cos(67.38)$$

$$AB = +13.42$$



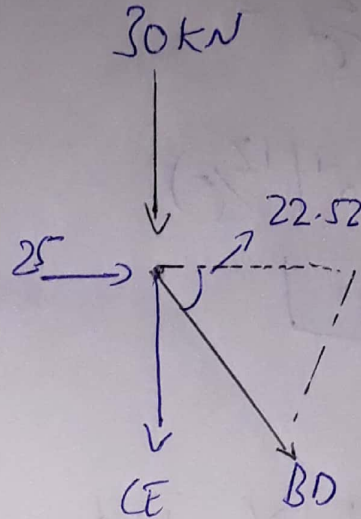


Joint E:

$$\sum F_x = 0$$

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

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



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

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

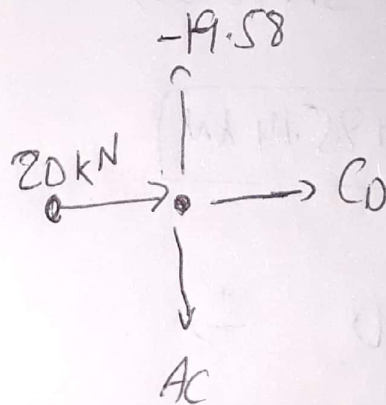
$$-30 - CE - (-27.08) \sin 22.62 = 0$$

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

Joint C :-

$$\sum F_x = 0$$

$$CD = -20 \text{ kN}$$



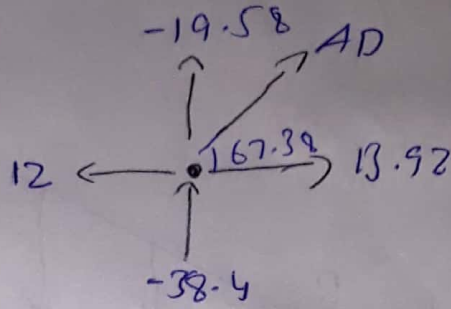
$$\sum F_y = 0$$

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



Joint A,

Let  $\theta$  is the angle b/w  
AD & AB



$$\frac{5}{12} = \frac{x}{6}$$

$$\boxed{x = 2.5}$$

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

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

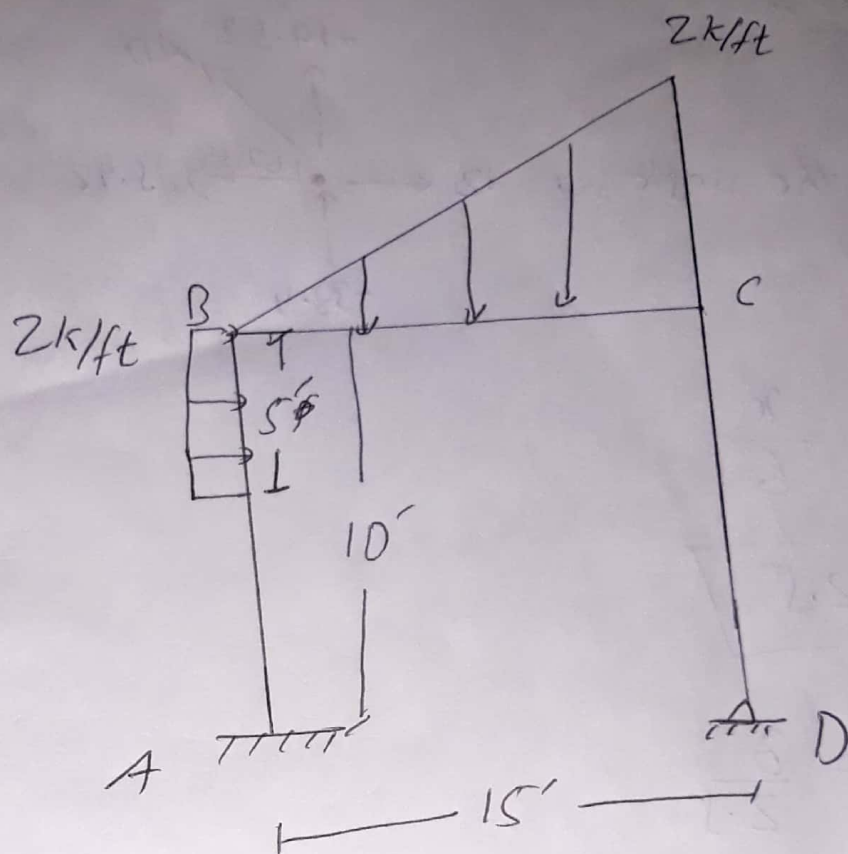
Now  $\Sigma F_x = 0 \rightarrow$

$$-32 + 13.92 + AD \cos(67.38) = 0$$

$$\boxed{AD = +18.24 \text{ kN}}$$

So the forces in each member are  
calculated...

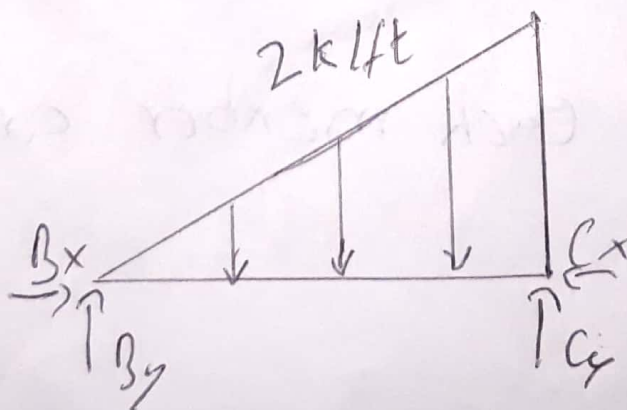
# Question No. 2



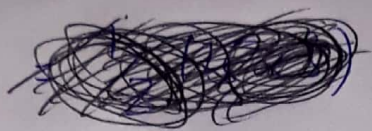
Solution:

1. Free body diagram

UVL



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



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

$$= 15$$

$$\text{Dist} = \frac{1}{2} (b) = \frac{1}{2} (15) = 7.5$$

$$\text{i. } \Sigma F_x = 0 \quad \begin{array}{c} + \\ \rightarrow \quad \leftarrow \end{array}$$

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

$$\text{ii. } \Sigma F_y = 0 \quad \begin{array}{c} \uparrow + \\ \downarrow - \end{array}$$

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

$$\text{iii. } \Sigma M_B = 0 \quad \begin{array}{c} \curvearrowright + \\ \curvearrowleft - \end{array}$$

$$(15 \times 7.5) - C_y \times 15 = 0$$

$$\text{---(3)}$$

$$C_y = 7.5 \text{ k}$$

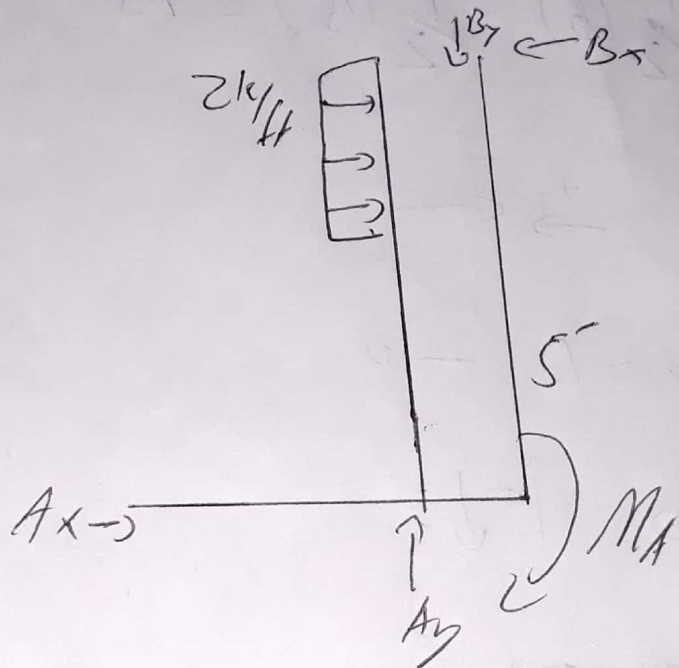


Put the value in eq 2

$$B_y + 5 = 15$$

$$B_y = 15 - 5$$

$$B_y = 10 \text{ k}$$



$$\text{(i) } \sum F_x = 0 \quad \begin{matrix} + \\ \rightarrow \end{matrix}$$

$$A_x + (2 \times 5) - B_x = 0$$

$$A_x - B_x = -10 \quad \rightarrow (3)$$

$$\text{(ii) } \sum F_y = 0 \quad \begin{matrix} \uparrow + \\ \downarrow - \end{matrix}$$

$$A_y - B_y = 0$$

$$\Sigma M = 0 \quad \uparrow + \downarrow -$$

$$(2 \times 5) + (2.5 \times 5) - B_x \times 10 = 0$$

$$10 \times 7.5 = 10 B_x$$

$$\boxed{B_x = 7.5 \text{ k}}$$

Put the value in eqn

$$A_x - 7.5 = -10$$

$$\boxed{A_x = -2.5}$$

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

$$C_y = 5 \text{ k}$$

$$\text{So } \boxed{D_y = 5 \text{ k}}$$

Put the value of  $B_y$  in (ii)

$$A_y - 10 = 0$$

$$\boxed{A_y = 10 \text{ k}}$$

Put the value of  $B_x$  in eqn

$$75 - C_x = 0$$

$$\boxed{C_x = 7.5 \text{ k}}$$

So,  $\boxed{D_x = 7.5 \text{ k}}$