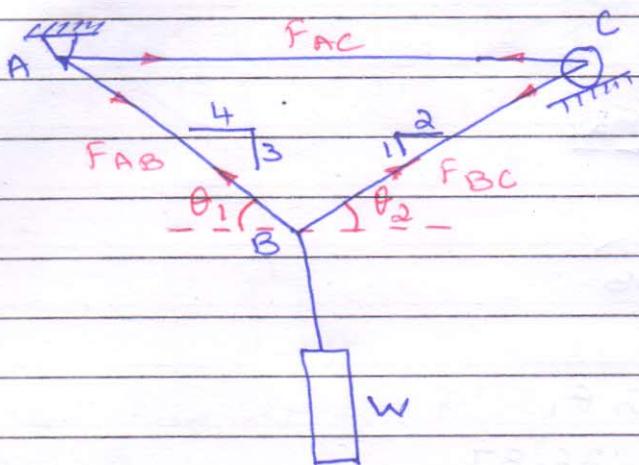


41)



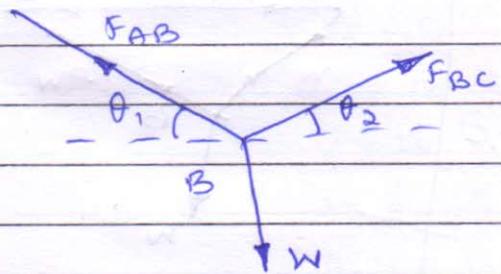
$$\tan \theta_1 = \frac{3}{4}$$

$$\theta_1 = 36.87^\circ$$

$$\tan \theta_2 = \frac{1}{2}$$

$$\theta_2 = 26.57^\circ$$

Joint B



$$\sum F_x = 0$$

$$F_{AB} \cos \theta_1 = F_{BC} \cos \theta_2$$

$$F_{BC} = F_{AB} \frac{\cos 36.87}{\cos 26.57}$$

$$F_{BC} = 0.90 F_{AB}$$

$$\sum F_y = 0$$

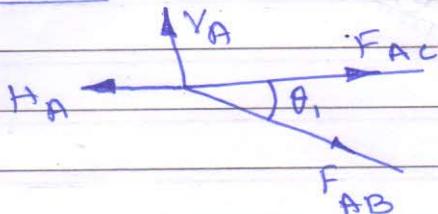
$$F_{AB} \sin \theta_1 + F_{BC} \sin \theta_2 = W$$

$$F_{AB} \sin 36.87 + 0.9 F_{AB} \sin 26.57 = W$$

$$F_{AB} = W / (\sin 36.87 + 0.9 \sin 26.57) = W$$

$$\therefore F_{BC} = 0.9 \times W$$

$$= 0.9W$$

Joint A

$$\sum F_y = 0$$

$$V_A = F_{AB} \sin \theta_1$$

$$= W \sin 36.87$$

$$= 0.6W$$

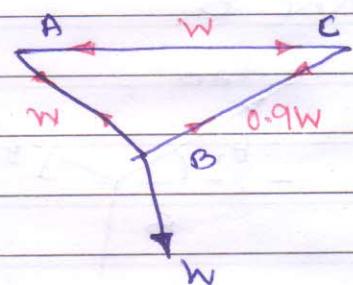
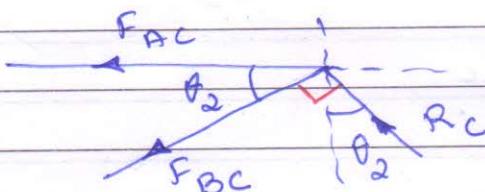
$$\sum F_x = 0$$

$$H_A - F_{AC} - F_{AB} \cos \theta_1 = 0$$

$$H_A - F_{AC} = F_{AB} \cos \theta_1$$

$$= W \cos 36.87$$

$$H_A - F_{AC} = 0.8W$$

Joint B

$$\sum F_y = 0$$

$$R_C \cos \theta_2 = F_{BC} \sin \theta_2$$

$$R_C = 0.9W \frac{\sin 26.57}{\cos 26.57}$$

$$= 0.45W$$

$$\sum F_x = 0$$

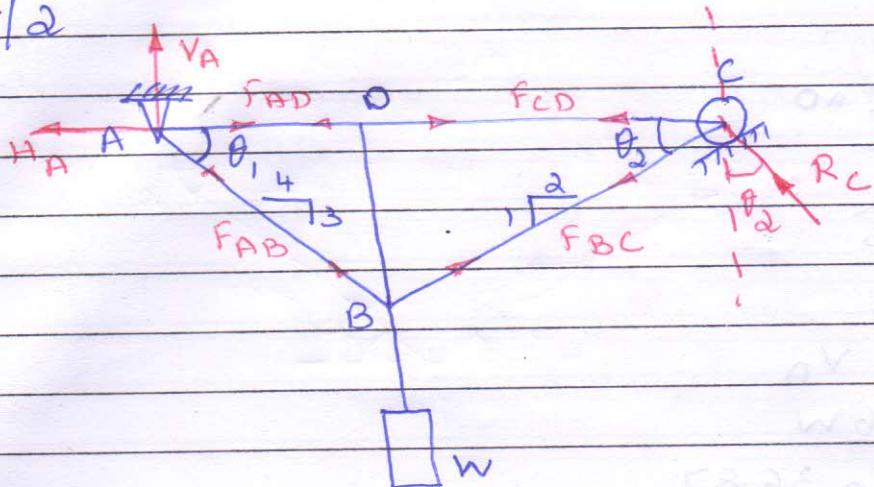
$$F_{AC} = -R_C \sin \theta_2 - F_{BC} \cos \theta_2$$

$$= -0.45W \sin 26.57 - 0.9W \cos 26.57$$

$$F_{AC} = -W$$

DATE

4/2



$$\text{let } AD = 4$$

$$BD = 3$$

$$\therefore \frac{BD}{CD} = \frac{1}{2} = \frac{3}{6}$$

$$\therefore CD = 3 \times 2 = 6$$

$$AC = AD + CD$$

$$= 4 + 6$$

First find Support reaction

$$\tan \theta_1 = \frac{3}{4}$$

$$\theta_1 = \tan^{-1} \frac{3}{4} = 36.87$$

$$\tan \theta_2 = \frac{1}{2}$$

$$\theta_2 = \tan^{-1} \frac{1}{2} = 26.57$$

$$\Sigma M_A = 0$$

$$+W \times AD = R_C \cos \theta_2 \times AC$$

$$R_C = \frac{W \times AD}{AC \times \cos \theta_2}$$

$$= \frac{W \times 4}{10 \times \cos 26.57}$$

$$= 0.45 W$$

$$\Sigma F_x = 0$$

$$-H_A - R_C \sin \theta_2 = 0$$

$$H_A = -0.45 W \sin 26.57$$

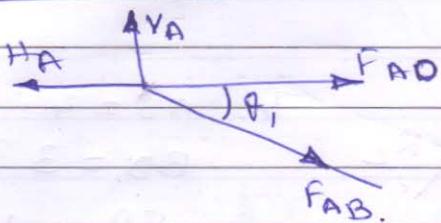
$$= -0.2 W$$

$$\Sigma F_y = 0$$

$$V_A - W + R_C \cos \theta_2 = 0$$

$$V_A = W - 0.45 W \cos 26.57$$

$$= 0.6 W$$

Joint A

$$\Sigma F_y = 0$$

$$F_{AB} \sin \theta_1 = V_A$$

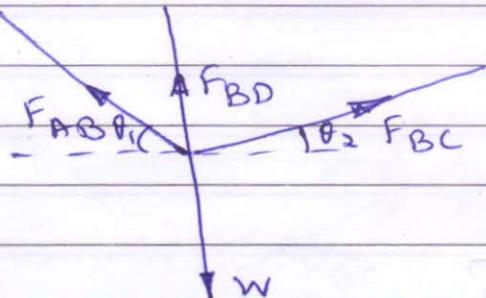
$$F_{AB} = \frac{0.6W}{\sin 36.87}$$

$$F_{AB} = 1W$$

$$\Sigma F_x = 0$$

$$H_A - F_{AC} - F_{AB} \cos \theta_1 = 0$$

$$F_{AO} = -0.2W - W \cos 36.87 \\ = -1.0W$$

Joint B

$$\Sigma F_x = 0$$

$$F_{AB} \cos \theta_1 = F_{BC} \cos \theta_2$$

$$F_{BC} = \frac{W \cos 36.87}{\cos 26.57} \\ = 0.9W$$

$$\Sigma F_y = 0$$

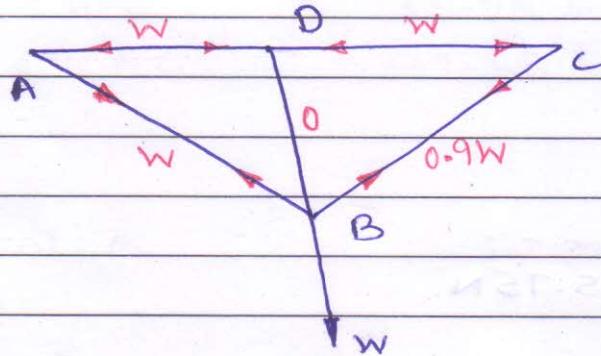
$$F_{BD} = W - F_{AB} \sin \theta_1 - F_{BC} \sin \theta_2$$

$$= W - W \sin 36.87 - 0.9W \sin 26.57$$

$$F_{AO} = 0$$

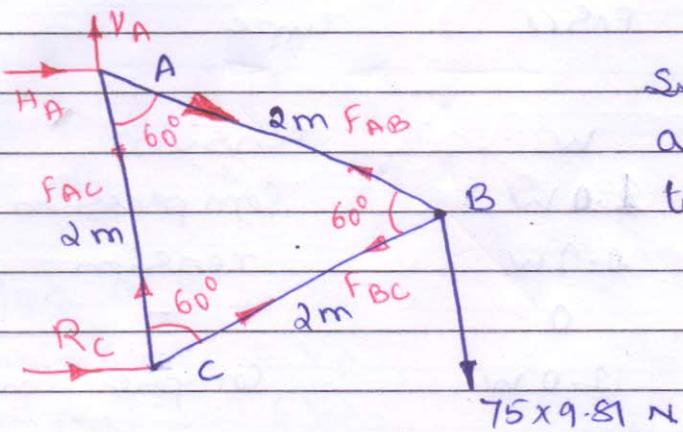
DATE

SL NO	Member	Force	Type
1	AB	W	Tension
2	AD	1.0 W	Compression
3	BC	0.9 W	Tension
4	BD	0	-
5	DC	1.0 W	Compression (Since $F_{BD} = 0$)



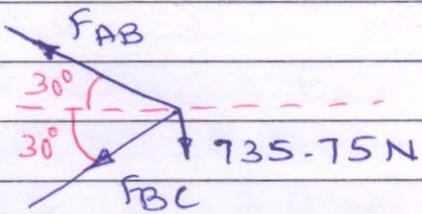
DATE

4/3



Since it an equilateral triangle
all angles will be equal
to $\frac{180^\circ}{3} = 60^\circ$

Joint B



$$\sum F_x = 0$$

$$-F_{AB} \cos 30^\circ - F_{BC} \cos 30^\circ = 0$$

$$\therefore F_{AB} = -F_{BC}$$

$$\sum F_y = 0$$

$$F_{AB} \sin 30^\circ - F_{BC} \sin 30^\circ + 735.75 = 0$$

$$2F_{AB} = +\frac{735.75}{\sin 30^\circ}$$

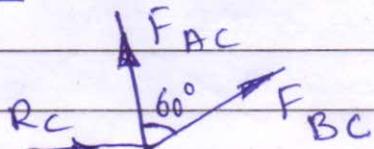
$$F_{AB} = +735.75 \text{ N}$$

$$\therefore F_{BC} = -F_{AB}$$

$$= -(+735.75)$$

$$= -735.75 \text{ N}$$

Joint C



$$\Sigma F_y = 0$$

$$F_{AC} + F_{BC} \cos 60^\circ = 0$$

$$F_{AC} = -F_{BC} \cos 60^\circ$$

$$= -(-735.75) \times \cos 60^\circ$$

$$= +367.88 \text{ N}$$

SL NO.	Member	Force	Type
1	BC	735.75 N	Compression
2	AB	735.75 N	Tension
3	AC	367.88 N	Tension

Check

From joint C

$$\Sigma F_x = 0$$

$$R_C = -F_{BC} \sin 60^\circ$$

$$= -(-735.75) \sin 60^\circ$$

$$= +637.178 \text{ N}$$

$$\therefore R_C = 637.178 \text{ N} \rightarrow$$

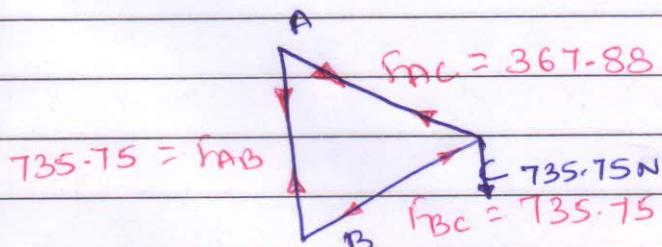
$$\Sigma M_A = 0$$

$$R_C \times 2 = 735.75 \times 2 \sin 60^\circ$$

$$R_C = \frac{1274.35}{2}$$

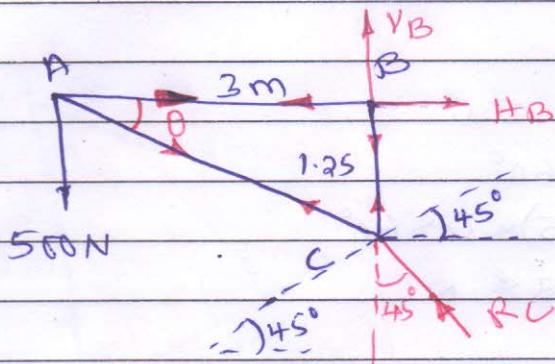
$$= 637.178 \text{ N}$$

\therefore It matches the values & thus checked.



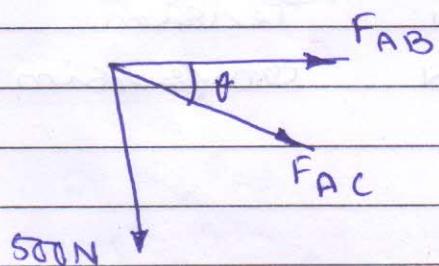
DATE

4/4



$$\tan \theta = \frac{1.25}{3}$$

$$\theta = 22.62^\circ$$

Joint A

$$\sum F_y = 0$$

$$F_{AC} \sin \theta = -500$$

$$F_{AC} = \frac{-500}{\sin 22.62}$$

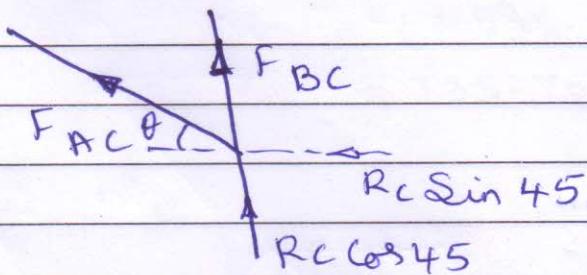
$$= -1300 \text{ N}$$

$$\sum F_x = 0$$

$$F_{AC} \cos \theta + F_{AB} = 0$$

$$F_{AB} = -(-1300) \cos 22.62$$

$$= 1200 \text{ N}$$

Joint CPES
UNIVERSITY

DATE

$$\Sigma F_x = 0$$

$$F_{AC} \cos \theta + R_c \sin 45 = 0$$

$$R_c = - \frac{F_{AC} \cos 22.62}{\sin 45}$$

$$= - \frac{(-1300) \times 0.923}{0.707}$$

$$= + 1697 \text{ N}$$

$$\Sigma F_y = 0$$

$$F_{AC} \sin \theta + F_{BC} + R_c \cos 45 = 0$$

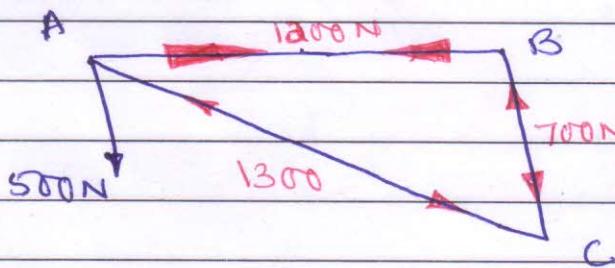
$$F_{BC} = - F_{AC} \sin \theta - R_c \cos 45$$

$$= - (-1300 \sin 22.62) - 1697 \cos 45$$

$$= + 500 - 1200$$

$$= -700 \text{ N}$$

SL NO.	Member	Force	Type
1	AC	1300	compression
2	AB	1200	tension
3	BC	700	compression



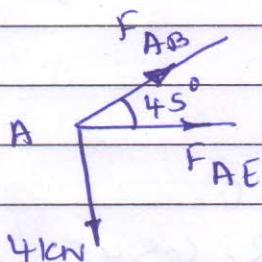
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4/5

$$BE = ?$$

$$BD = ?$$

Joint A



$$\sum F_y = 0$$

$$F_{AB} \sin 45 = 4$$

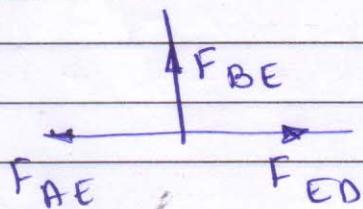
$$F_{AB} = 5.66 \text{ kN}$$

$$\sum F_x = 0$$

$$F_{AE} + F_{AB} \cos 45 = 0$$

$$\begin{aligned} F_{AE} &= -5.66 \cos 45 \\ &= -4 \text{ kN} \end{aligned}$$

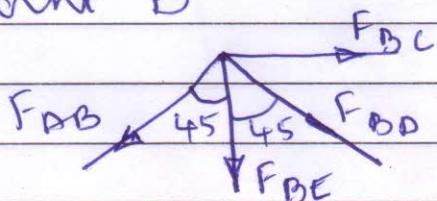
Joint E



$$F_{ED} = F_{AE} = -4 \text{ kN}$$

$$F_{BE} = 0$$

Joint B



DATE

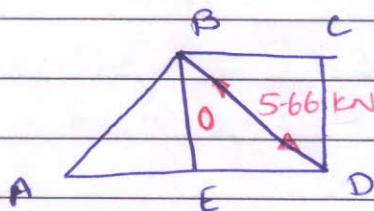
$$\Sigma F_y = 0$$

$$F_{AB} \cos 45 + F_{BE} + F_{BD} \cos 45 = 0$$

$$\cos 45 \times F_{BD} = -5.66 \cos 45 - 0$$

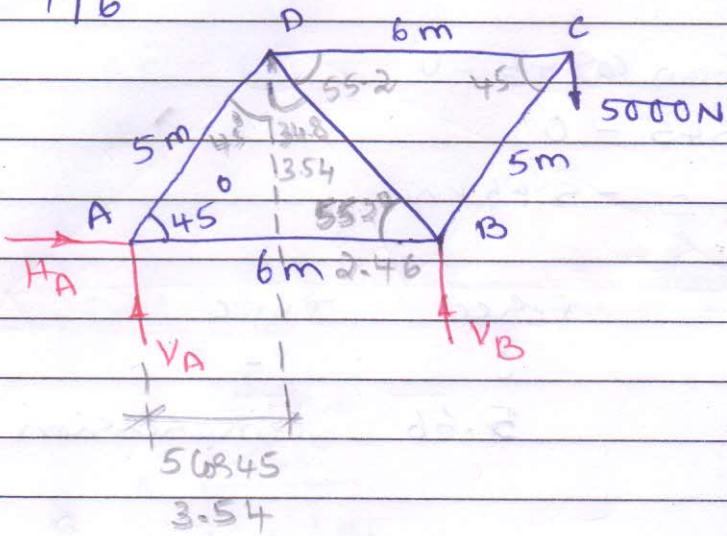
$$= \frac{-4 \text{ kN}}{\cos 45} = -5.66 \text{ kN}$$

SL NO	Member	Force	Type
1	BE	0	-
2	BD	5.66	Compression

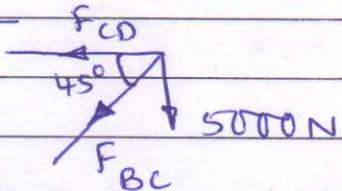


DATE

4 | 6



Joint C



$$\sum F_y = 0$$

$$F_{BC} \sin 45^\circ = -5000$$

$$F_{BC} = -5000$$

Sin 45

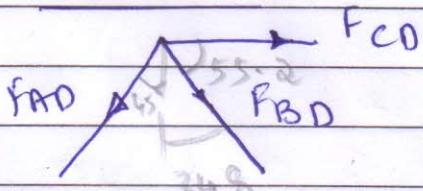
-7071-06 N

$$\varepsilon f_x = 0$$

$$-F_{CD} - F_{BC} \sin 45 = 0$$

$$F_{CD} = -(-7071.06) \sin 45^\circ \\ = 5000 \text{ N}$$

Joint D



$$\sum R_f = 0$$

$$F_{AD} \cos 45 + F_{BD} \cos 34.8 \geq 0$$

$$F_{AD} = -F_{BD} \frac{\cos 34.8}{\cos 45}$$

$$F_{AD} = -1.16 F_{BD}$$

$$\Sigma F_x = 0$$

$$F_{AD} \sin 45^\circ = F_{BD} \sin 34.8^\circ + F_{CD}$$

$$-1.16 F_{BD} \sin 45^\circ = F_{BD} \sin 34.8^\circ + 5000$$

$$F_{BD} = \underline{5000}$$

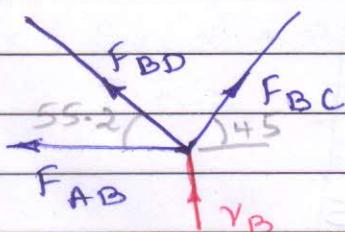
$$(\sin 34.8^\circ - 1.16 \sin 45^\circ)$$

$$= -5000$$

$$F_{BD} = -3592.31 \text{ N}$$

$$\therefore F_{AD} = -1.16 (-3592.31) \\ = 4167 \text{ N}$$

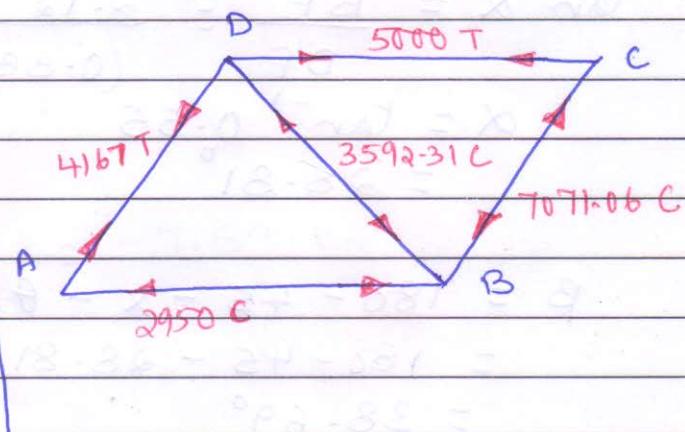
Joint B



$$\Sigma F_x = 0$$

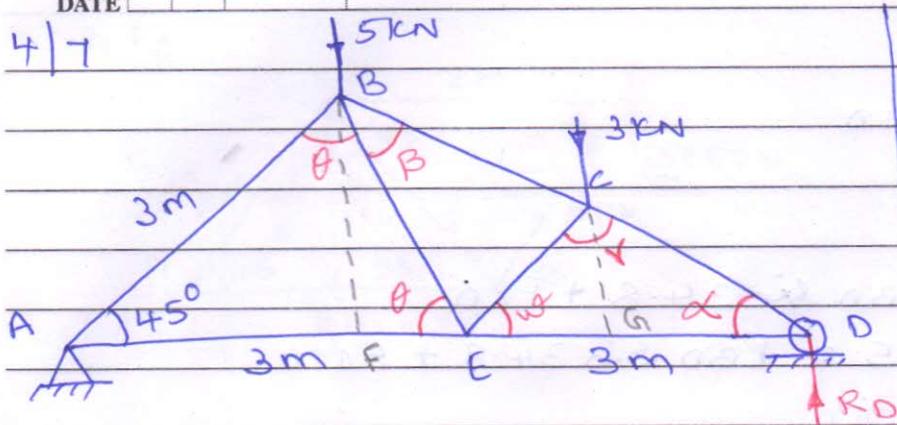
$$F_{AB} = F_{BC} \cos 45^\circ - F_{BD} \cos 55.2^\circ$$

$$= -7071.06 \cos 45^\circ - (-3592.31) \cos 55.2^\circ \\ = -2950 \text{ N}$$



SLNO	Member	Force	Type
1	BC	7071.06	compression
2	CD	5000	tension
3	BD	3592.31	compression
4	AD	4167	tension
5	AB	2950	compression

ANSWER



$$\tan w = \underline{ch}$$

Elo

三 1-07

3 - 1.95

$$w = \tan^{-1} 1.02$$

$$= 45 - 54^\circ$$

$$\overline{BC} = \overline{CD}$$

$$\theta = \frac{180 - 45}{2} = 67.5^\circ$$

$$r = (90 - \alpha) + (90 - \omega)$$

$$= (90 - 28.81) + (90 - 45)$$

$$= 105.65^\circ$$

$$BF = 3 \sin 45^\circ = 2.12 \text{ m}$$

$$EF = 3 - 2.12 = 0.88 \text{ m}$$

$$\tan \alpha = \frac{BF}{DF} = \frac{2.12}{(0.88 + 3)}$$

$$\alpha = \tan^{-1} 0.55 \\ = 28.81^\circ$$

$$\begin{aligned}\beta &= 180 - 45 - \alpha - \theta \\&= 180 - 45 - 28.81 - 67.5 \\&= 38.69^\circ\end{aligned}$$

$$\frac{1}{BD} = \frac{\cos \alpha}{DF}$$

$$= \frac{\log 28.81}{(0.88 + 3)}$$

$$\frac{1}{BD} = 0.226$$

$$BD = 4.43 \text{ m}$$

$$CD = \frac{BD}{2} = \frac{4.43}{2} = 2.22 \text{ m}$$

DATE

$$DG = CD \cos \alpha$$

$$= 2.22 \cos 28.81$$

$$= 1.95 \text{ m}$$

$$CH = CD \sin \alpha$$

$$= 2.22 \sin 28.81$$

$$= 1.07 \text{ m}$$

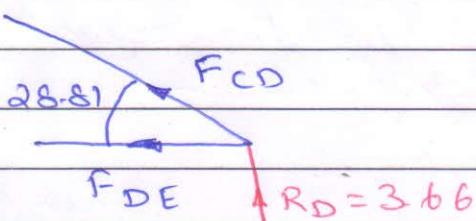
$$\Sigma M_A = 0$$

$$R_D \times 6 = 5 \times AF + 3 \times AG$$

$$R_D = \frac{5 \times 3 \cos 45 + 3 \times (6 - 2.22)}{6}$$

$$= 3.66 \text{ kN}$$

Joint D



$$\Sigma F_y = 0$$

$$F_{CD} \sin \alpha + R_D = 0$$

$$F_{CD} = -\frac{3.66}{\sin 28.81} = -7.59 \text{ kN}$$

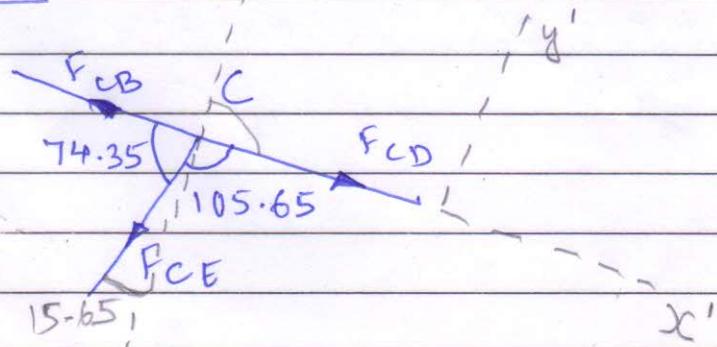
$$\Sigma F_x = 0$$

$$F_{CD} \cos 28.81 + F_{DE} = 0$$

$$F_{DE} = -(-7.59 \times \cos 28.81)$$

$$= 6.65 \text{ kN}$$

Joint C



DATE

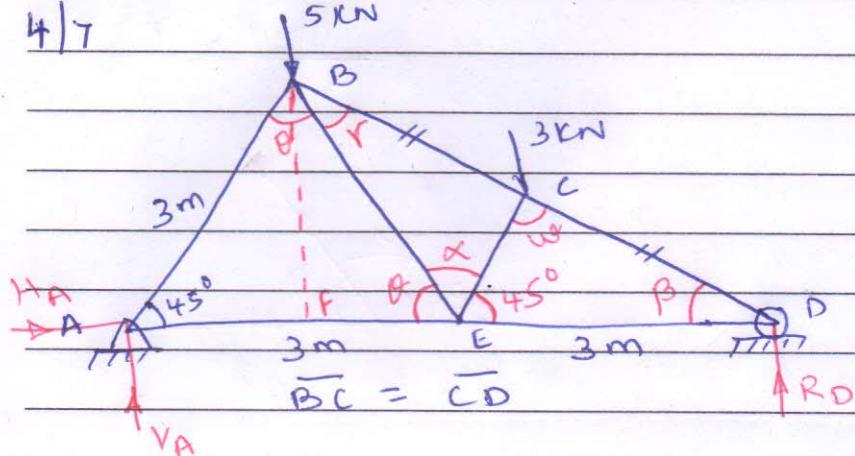
$$\sum F_x = 0$$

$$F_{CD} - F_{CB} - F_{CE} \cos 74.35^\circ = 0$$

$$F_{CE} = \frac{-7.59 - F_{CB}}{\cos 74.35^\circ}$$

$$\sum F_y = 0$$

47



Solution

Since $\overline{BC} = \overline{CD}$

AB is parallel to CE

$\triangle ABE$ is an isosceles triangle as $AE = AB$

$$\therefore \theta = \frac{180 - 45}{2} = 67.5^\circ$$

$$\therefore \alpha = 180 - \theta - 45 = 67.5^\circ$$

$$\tan B = \frac{FB}{DF} = \frac{3 \sin 45}{6 - 3 \cos 45} = \frac{2.1213}{3.8786}$$

$$\beta = \tan^{-1} 0.546$$

$$= 28.67^\circ$$

$$\begin{aligned} \gamma &= 180 - 45 - \beta - \theta \\ &= 180 - 45 - 28.67 - 67.5 \\ &= 38.83^\circ \end{aligned}$$

From Similar triangles ABD & DCE

$$CE = \frac{AB}{2} = \frac{3}{2} = 1.5 \text{ m}$$

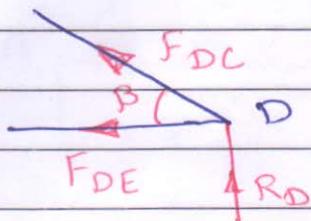
$$\therefore w = 180 - 45 - 28.67 \\ = 106.33^\circ$$

$$\Sigma M_A = 0$$

$$R_D \times 6 = 5 \times 2.1213 + 3(3 + 1.5 \cos 45)$$

$$R_D = 3.80 \text{ kN}$$

Joint D



$$\Sigma F_y = 0$$

$$F_{DC} \sin \beta = -R_D$$

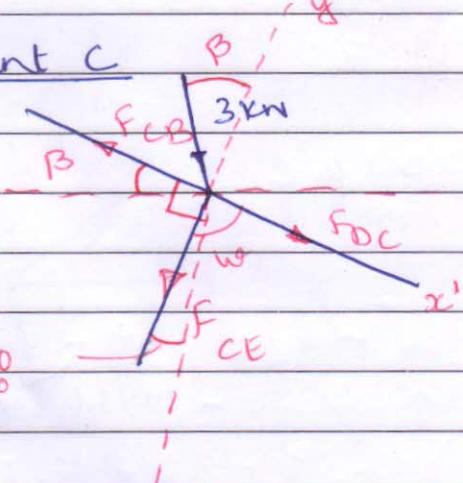
$$F_{DC} = \frac{-3.8}{\sin 28.67} = -7.92 \text{ kN}$$

$$\Sigma F_C = 0$$

$$F_{DC} \cos \beta + F_{DE} = 0$$

$$F_{DE} = -(-7.92 \times \cos 28.67) \\ = 6.95 \text{ kN}$$

Joint C



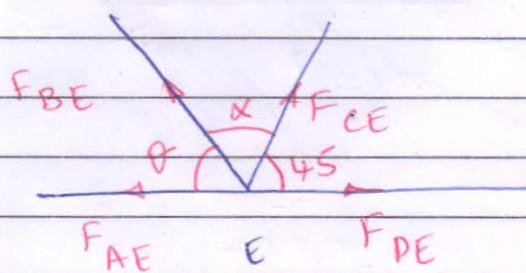
$$106.33 - 90 \\ = 16.33^\circ$$

$$\Sigma F_{y'} = 0$$

$$3 \cos 28.67 + F_{CE} \cos 16.33 = 0$$

$$F_{CE} = \frac{-2.632}{0.959} = -2.74 \text{ kN}$$

DATE

Joint E

$$\sum F_y = 0$$

$$F_{BE} \sin \theta + F_{CE} \sin 45^\circ = 0$$

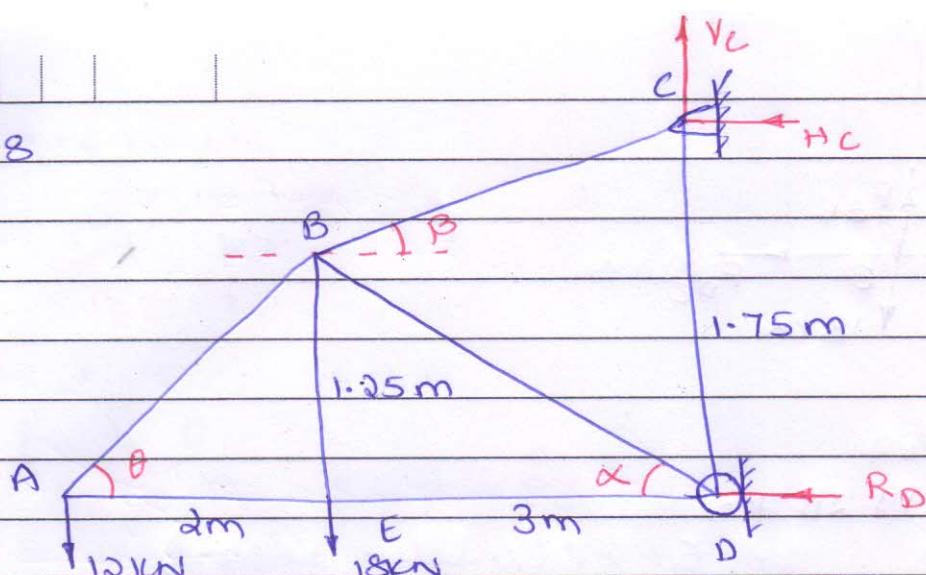
$$F_{BE} = -\frac{(-2.74 \sin 45^\circ)}{\sin 67.5^\circ}$$

$$= 2.10 \text{ kN}$$

SLNO	Member	Force	Type
1	BE	2.10	Tension
2	CE	2.74	Compression

DATE

4/8



Solution

$$\tan \theta = \frac{1.25}{2}$$

$$\theta = 32^\circ$$

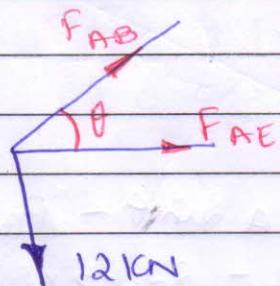
$$\tan \alpha = \frac{1.25}{3}$$

$$\alpha = 22.62^\circ$$

$$\tan \beta = \frac{1.75 - 1.25}{3}$$

$$\beta = 9.46^\circ$$

Joint A



$$\sum F_x = 0$$

$$F_{AE} + F_{AB} \cos \theta = 0$$

$$F_{AE} = -22.65 \times \cos 32^\circ \\ = -19.20 \text{ kN}$$

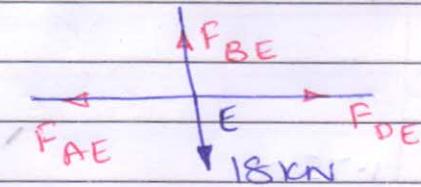
$$\sum F_y = 0$$

$$F_{AB} \sin \theta = 12$$

$$F_{AB} = \frac{12}{\sin 32^\circ}$$

$$= 22.65 \text{ kN}$$

DATE

Joint E

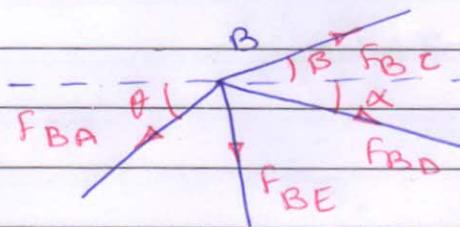
$$\sum F_x = 0$$

$$F_{DE} = F_{AE}$$

$$= -19.20 \text{ kN}$$

$$\sum F_y = 0$$

$$F_{BE} = 18 \text{ kN}$$

Joint B

$$\sum F_x = 0$$

$$F_{BD} \cos \alpha + F_{BC} \cos \beta = F_{BA} \cos \theta$$

$$F_{BD} = \frac{22.65 \times \cos 32^\circ - F_{BC} \times \cos 9.46}{\cos 22.62}$$

$$= \frac{19.21 - 0.99 F_{BC}}{0.92}$$

$$F_{BD} = 20.81 - 1.08 F_{BC}$$

$$\sum F_y = 0$$

$$F_{BC} \sin \beta - F_{BD} \sin \alpha - F_{BA} \sin \theta - F_{BE} = 0$$

$$F_{BC} \times \sin 9.46 - F_{BD} \times \sin 22.62 - 22.65 \times \sin 32 - 18 = 0$$

$$0.16 F_{BC} - (20.81 - 1.08 F_{BC}) \times 0.39 - 12 - 18 = 0$$

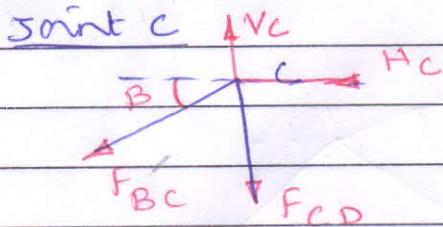
$$0.16 F_{BC} - 8.12 + 0.42 F_{BC} = 30$$

$$F_{BC} (0.16 + 0.42) = 30 + 8.12$$

$$F_{BC} = 65.59 \text{ kN}$$

$$\therefore F_{BD} = 20.81 - 1.08 \times 65.59 = -50 \text{ kN}$$

DATE



$$\sum F_y = 0$$

$$V_C = F_{BC} \sin \beta + F_{CD}$$

$$= 65.59 \times \sin 9.46 + F_{CD}$$

$$V_C = 10.78 + F_{CD}$$

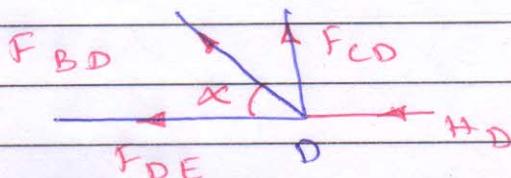
$$\sum F_x = 0$$

$$-F_{BC} \cos \beta - H_C = 0$$

$$H_C = -65.59 \times \cos 9.46$$

$$= -64.70 \text{ kN}$$

Joint D



$$\sum F_x = 0$$

$$-(F_{BD} \cos \alpha + F_{DE}) - H_D = 0$$

$$H_D = -(-50 \times \cos 22.62 + (-19.20))$$

$$= 65.35 \text{ kN}$$

$$\sum F_y = 0$$

$$F_{CD} + F_{BD} \sin \alpha = 0$$

$$F_{CD} = -(-50 \times \sin 22.62)$$

$$= 19.23 \text{ kN}$$

$$\therefore V_C = 10.78 + 19.23 = 30.0 \text{ kN}$$

DATE

Check

$$\Sigma V = 0$$

$$V_C = 12 + 18 = 30 \text{ kN}$$

$$\Sigma H = 0$$

$$H_C = H_D$$

$$+ 64 - 70 = 65 - 35$$

Difference = 0.65 (calculation error)

SL NO	Member	Force	Type
1	AB	22.65	Tension
2	AE	19.20	Compression
3	DE	19.20	Compression
4	BE	18	Tension
5	BC	65.59	Tension
6	BD	50	Compression
7	CD	19.23	Tension