

Subject :

Date : 2 Dimensional Frames

Sun Mon Tue Wed Thu Fri Sat

Problem 10 Find out the pin reactions at A & B and the force of the member CF & DE force number(s).

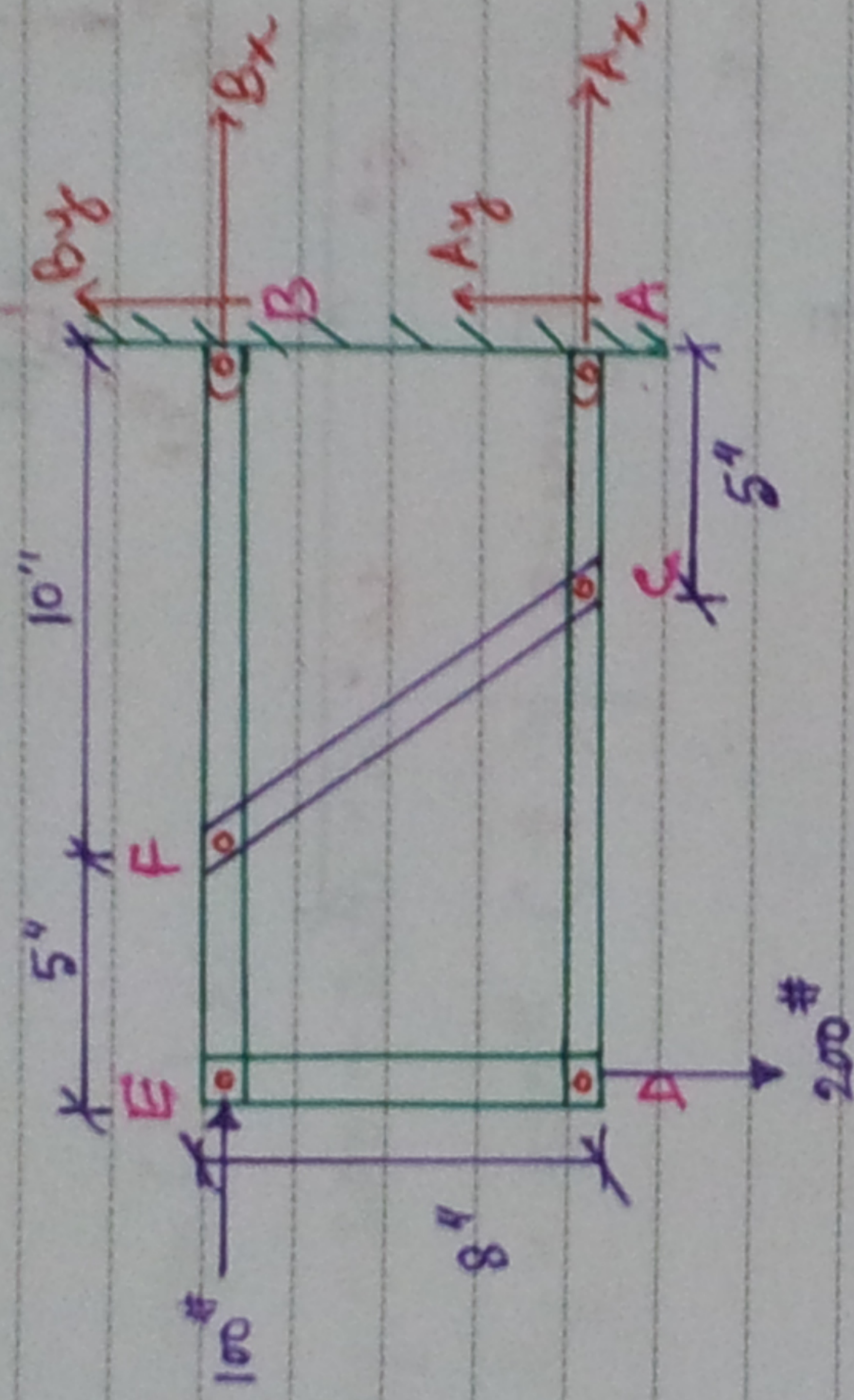


Figure-1

Sol<sup>n</sup>: From figure-1,

$$\sum F_x = 100 + A_x + B_x = 0 \dots (i)$$

$$\sum F_y = -200 + A_y + B_y = 0 \dots (ii)$$

$$\sum M_B = -200 \times 15 - A_x \times 8 = 0$$

$$\Rightarrow A_x = -375 \# \quad (\leftarrow)$$

from eqn (i),  $B_x + 100 - 375 = 0$

$$\therefore B_x = 275 \# \quad (\rightarrow)$$

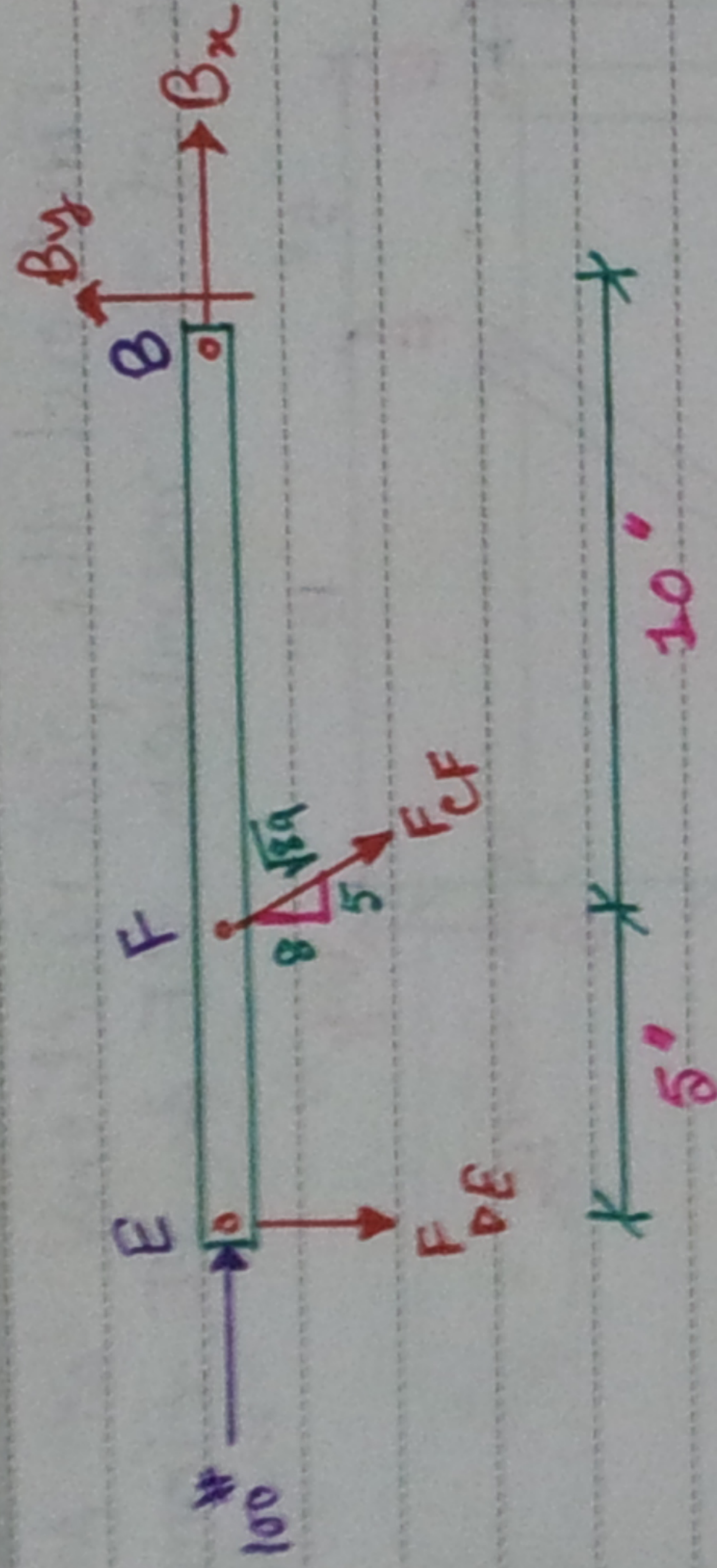


Figure-2

From figure-2,

$$\sum F_x = 100 + B_x + \frac{F_{CF}}{\sqrt{89}} \times 5 = 0$$

$$\Rightarrow 100 + 275 + \frac{F_{CF}}{\sqrt{89}} \times 5 = 0$$

$$\therefore F_{CF} = -707.55 \# \quad (c)$$

$$\sum F_y = -F_{DE} - \frac{F_{CF}}{\sqrt{89}} \times 8 + B_y = 0 \quad \dots (iii)$$

$$\& \sum M_B = -F_{DE} \times 15 - \frac{F_{CF}}{\sqrt{89}} \times 8 \times 10 = 0$$

$$\Rightarrow -F_{DE} \times 15 + \frac{707.55}{\sqrt{89}} \times 80 = 0$$

$$\therefore F_{DE} = 400 \# (T)$$

Now, from eq (iii),

$$B_y - 400 + \frac{707.55}{\sqrt{89}} \times 8 = 0$$

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$$\therefore B_y = -200 \text{ \# } (\downarrow)$$

From eqn (ii),

$$A_y - 200 - 200 = 0$$

$$\therefore A_y = 400 \text{ \# } (\uparrow)$$

$$\text{Ans: } A_x = 375 \text{ \# } (\leftarrow); A_y = 400 \text{ \# } (\uparrow); B_x = 275 \text{ \# } (\rightarrow);$$

$$B_y = 200 \text{ \# } (\downarrow); F_{DE} = 400 \text{ \# } (\rightarrow); F_{CF} = 707.55 \text{ \# } (\leftarrow)$$



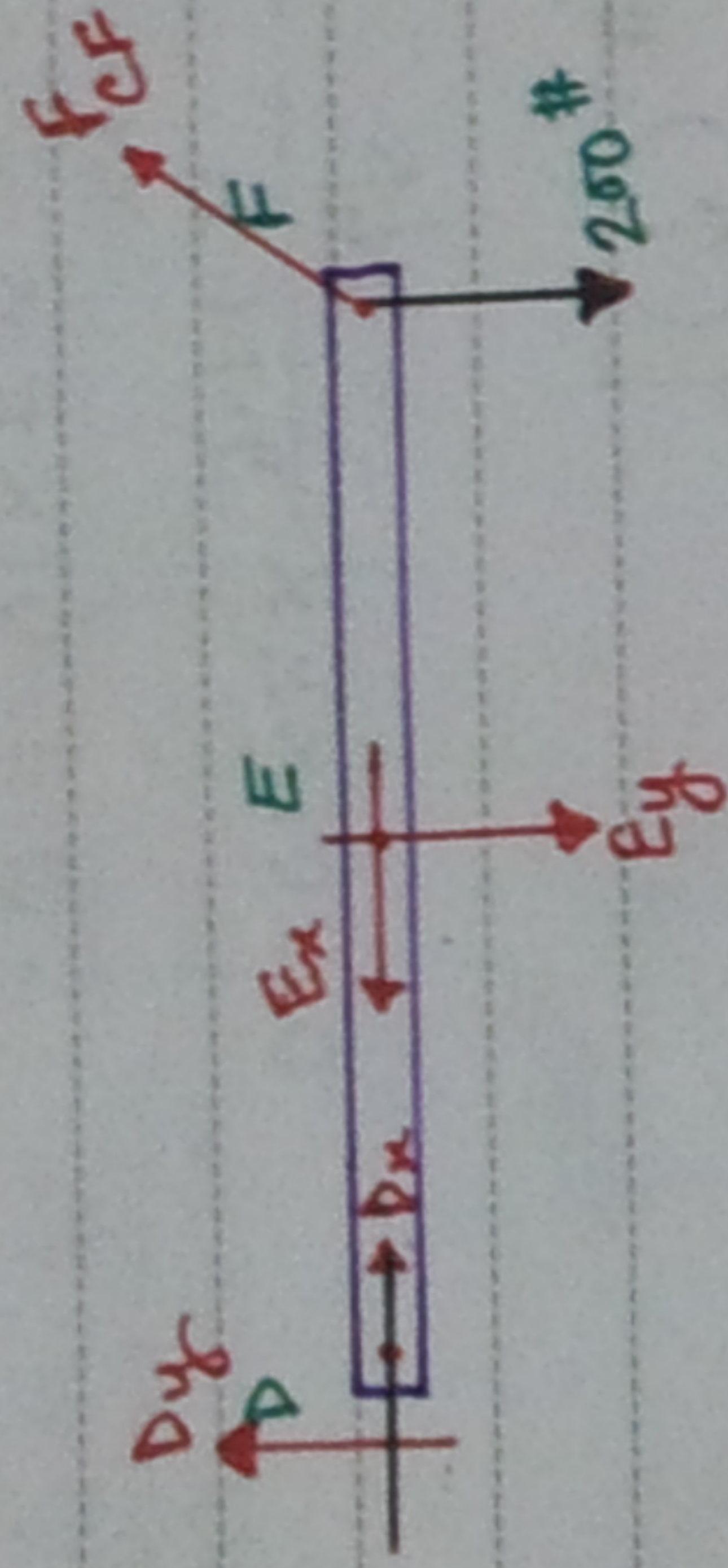


Figure - 1

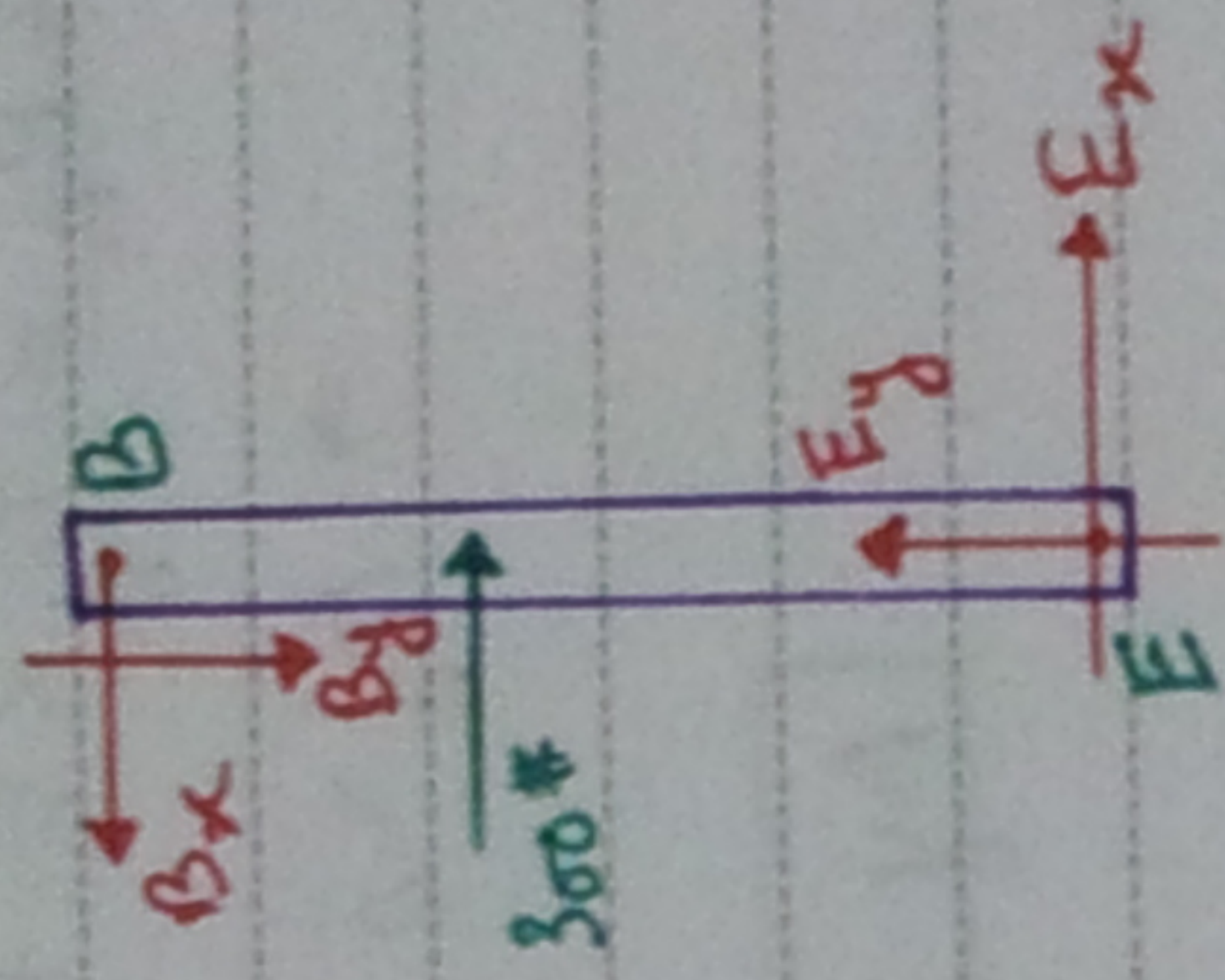


Figure - 2

From figure - 1,

$$\sum M_E = 300 \times 4 - B_x \times 7 = 0$$

$$\therefore B_x = 171.43 \# \quad (\leftarrow)$$

$$\sum F_x = -B_x + E_x + 300 = 0$$

$$\Rightarrow -171.43 + E_x + 300 = 0$$

$$\therefore E_x = -128.57 \# \quad (\leftarrow)$$

$$\sum F_y = -B_y + E_y = 0$$

$$\Rightarrow B_y = E_y \quad \dots (i)$$

From figure - 2,

$$\sum F_x = A_x + B_x + 400 - \frac{F_{CF}}{\sqrt{14}} \times 5 = 0$$

$$\Rightarrow -1500 + 171.43 + 400 - \frac{F_{CF}}{\sqrt{14}} \times 5 = 0$$

$$\therefore F_{CF} = -1597.6 \# \quad (C)$$

$$\sum M_B = A_y \times 5 + 300 \times 10 + \frac{F_{CF}}{\sqrt{74}} \times 7 \times 10 = 0$$

$$\Rightarrow A_y \times 5 + 300 \times 10 + \frac{1597.6}{\sqrt{74}} \times 7 \times 10 = 0$$

$$\therefore A_y = 2000.04 \# (\downarrow)$$

$$\sum F_y = A_y + B_y - 300 - \frac{F_{CF}}{\sqrt{74}} \times 7 = 0$$

$$\Rightarrow 2000.04 + B_y - 300 + \frac{1597.6}{\sqrt{74}} \times 7 = 0$$

$$\therefore B_y = -3000 \# (\downarrow)$$

From equation (i), we get,

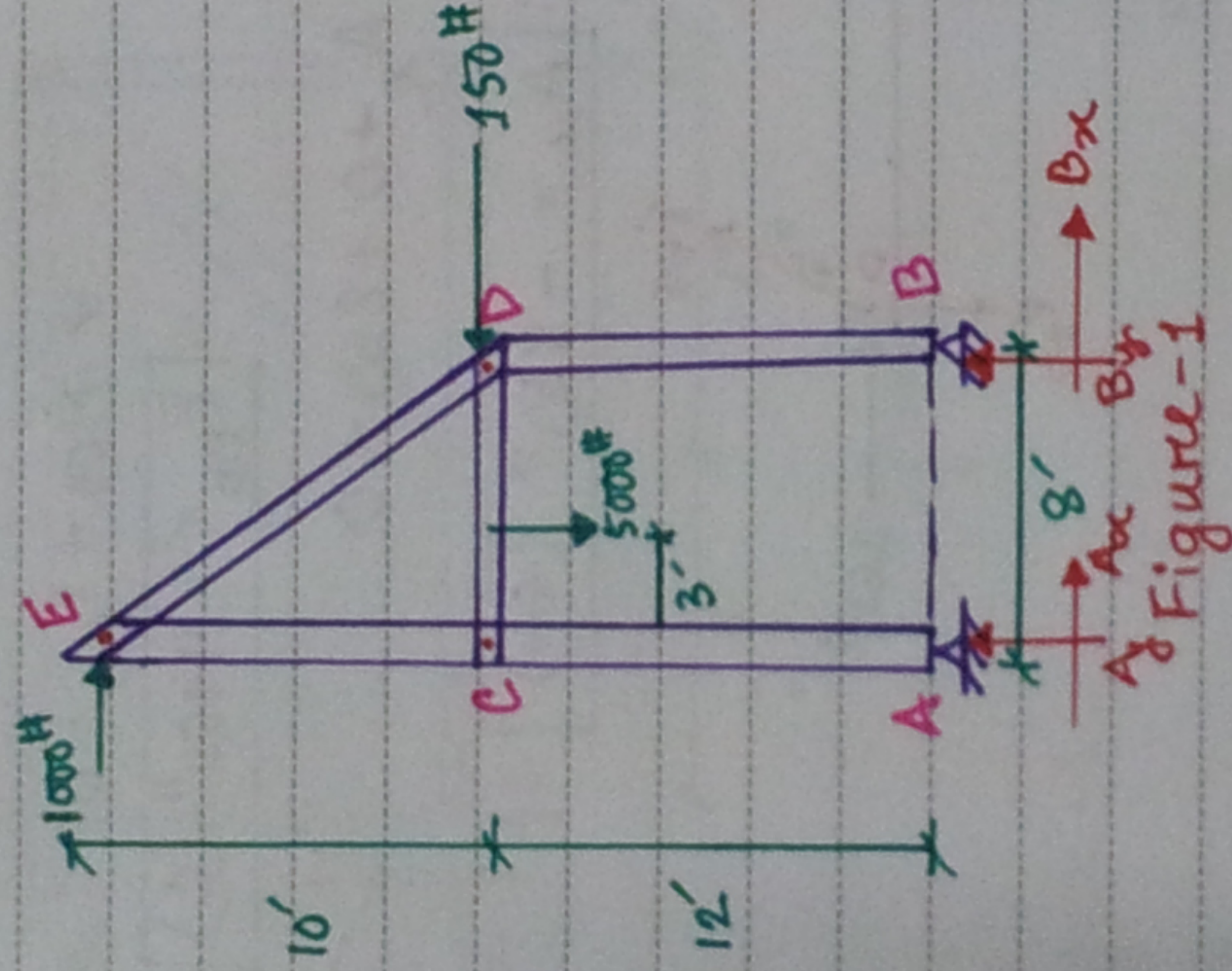
$$E_y = -3000 \# (\downarrow)$$

$$\text{Ans: } A_x = 1500 \# (\leftarrow); A_y = 2000.04 \# (\downarrow); B_x = 171.43 \# (\rightarrow)$$

$$B_y = 3000 \# (\downarrow); E_x = 128.57 \# (\leftarrow); E_y = 3000 \# (\downarrow)$$

$$F_{CF} = 1597.6 \# (c)$$

Problem: 12 Identify the pin reaction at A, the two force member(s) and the force of them.



Solution: Here, two force members are DE & BD.

From fig-1,

$$\sum M_B = A_y \times 8 - 5000 \times 5 - 150 \times 12 + 1000 \times 22 = 0$$

$$\therefore A_y = 600 \# (\uparrow)$$

$$\sum F_y = A_y + B_y - 5000 = 0$$

$$\Rightarrow 600 - 5000 + B_y = 0$$

$$\therefore B_y = 4400 \# (\uparrow)$$

$$\sum F_x = A_x + B_x + 1000 - 150 = 0 \Rightarrow A_x + B_x + 850 = 0 \dots \dots (i)$$

From fig-2,  $\sum F_x = B_x = 0$

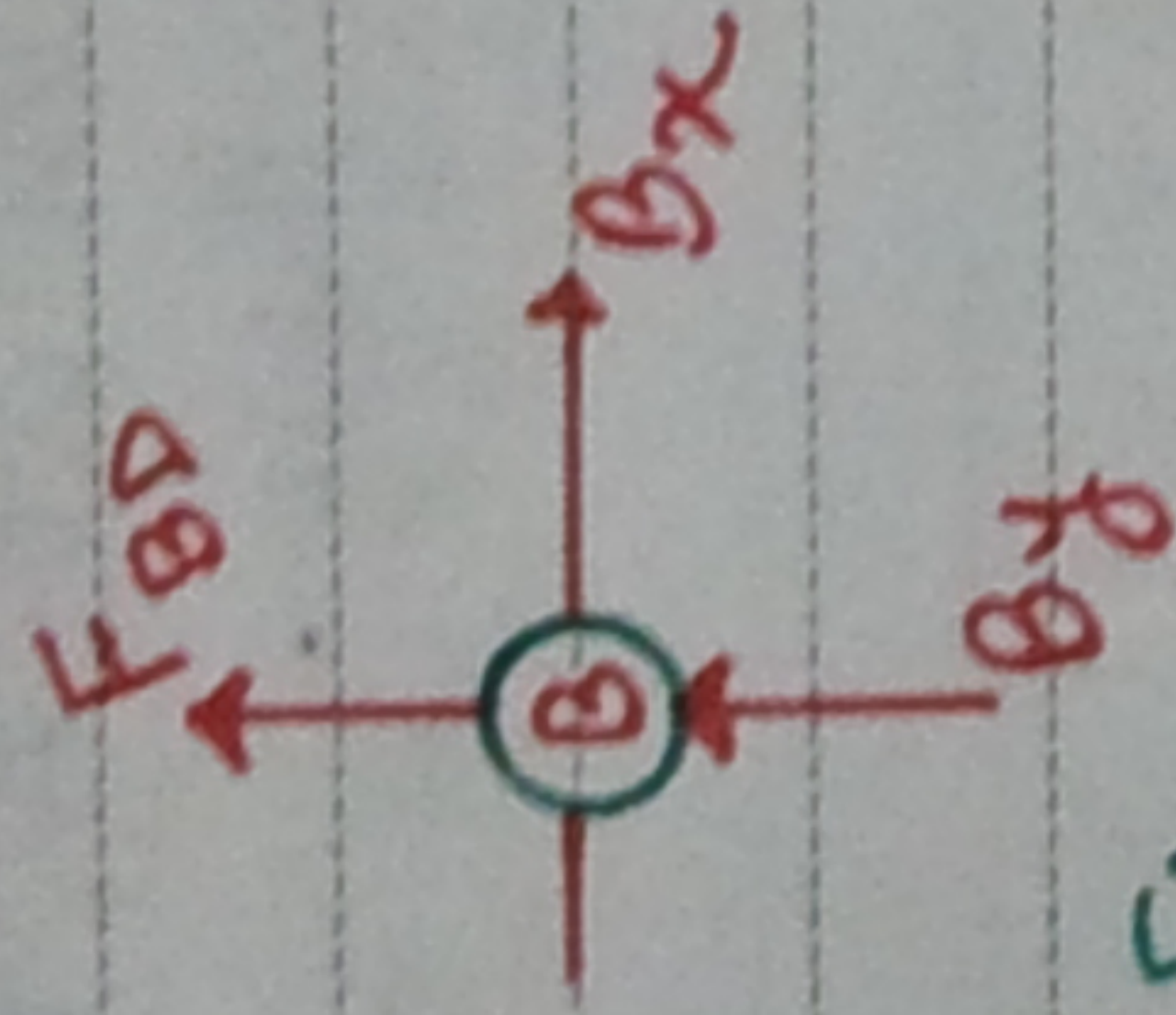


Fig-2

&  $\sum F_y = B_y + F_{BD} = 0$

$\Rightarrow 4400 + F_{BD} = 0$

$\therefore F_{BD} = -4400 \# \text{ (C)}$

From eqn (i), we get,  $A_x + 0 + 850 = 0$

$\therefore A_x = -850 \# \text{ (←)}$

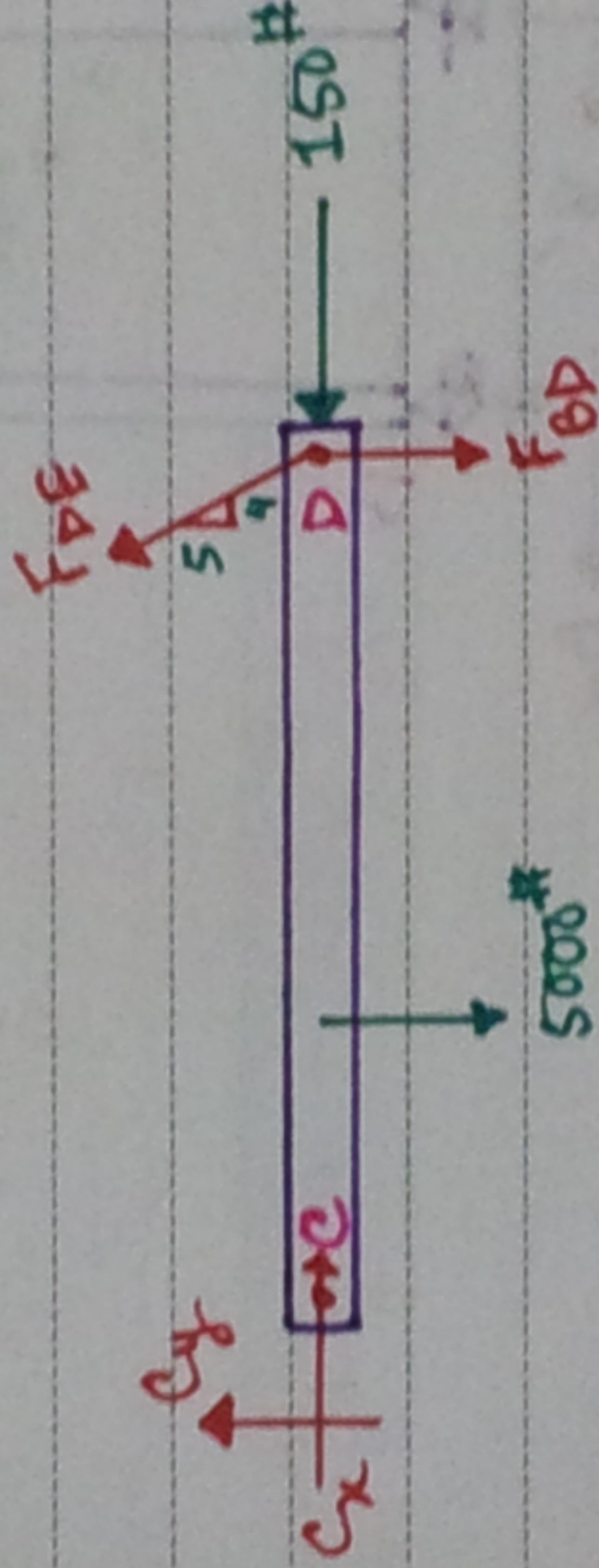


Fig-3

From fig-3,

$\sum M_c = +5000 \times 3 + F_{BD} \times 8 - F_{DE} \times \frac{5}{\sqrt{41}} \times 8 = 0$

$\Rightarrow 5000 \times 3 + (-4400) \times 8 - F_{DE} \times \frac{5}{\sqrt{41}} \times 8 = 0$

$\therefore F_{DE} = -3233.57 \# \text{ (C)}$

Ans:  $A_x = 850 \# \text{ (←)}$  ;  $A_y = 600 \# \text{ (↑)}$

$F_{DE} = 3233.57 \# \text{ (C)}$  ;  $F_{BD} = 4400 \# \text{ (C)}$

Problem: 13 Find the reactions at pin A & B and force in the two force members.

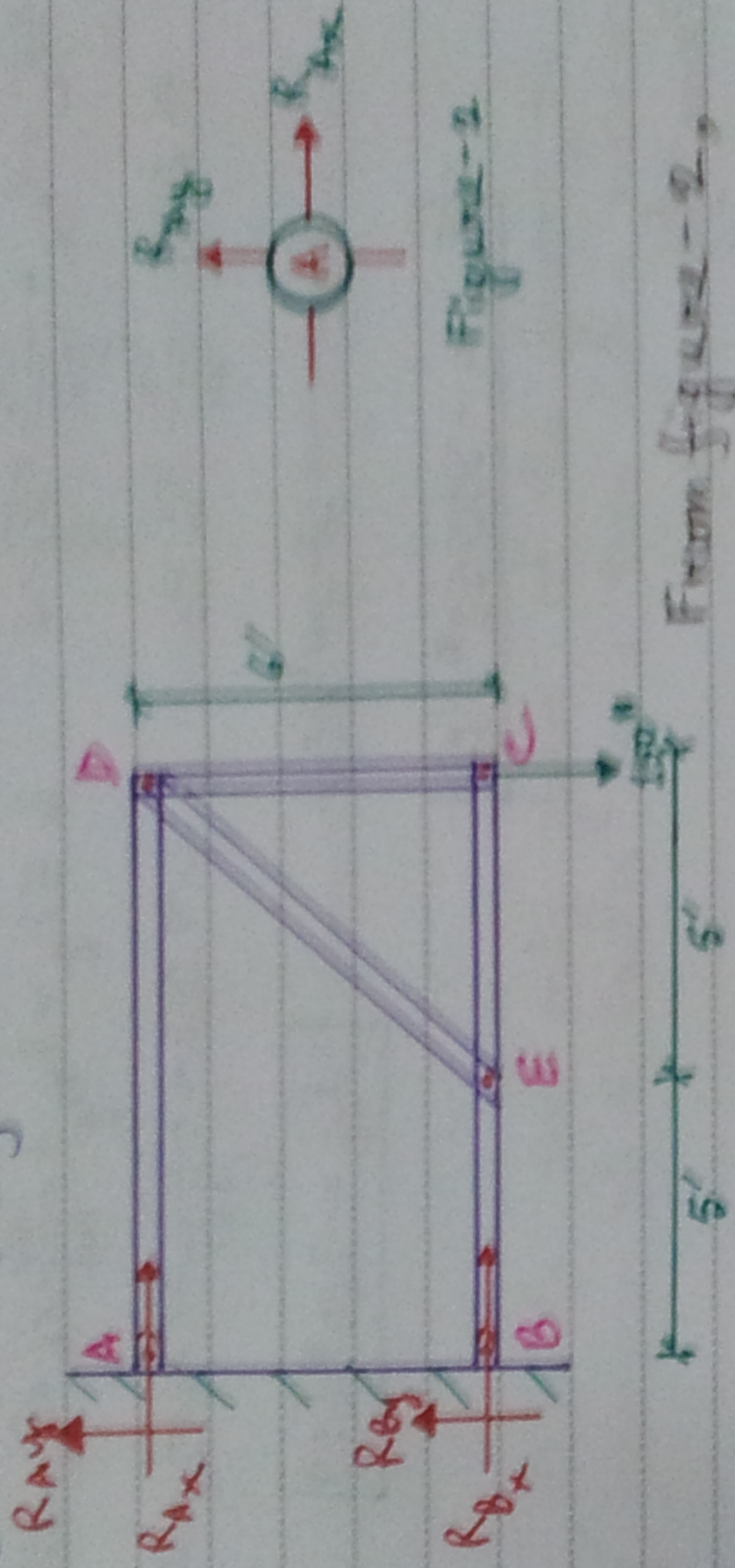


Figure-2

From figure-2,  
 $\Sigma F_y = R_{Ay} = 0^*$

From figure-1,

$\Sigma M_B = R_{Ax} \times 6 + 150 \times 10 = 0$  &  $\Sigma F_x = R_{Ax} + R_{Bx} = 0$   
 $\therefore R_{Ax} = -250^* (\leftarrow)$   
 $\Rightarrow -250 + R_{Bx} = 0$

$\therefore R_{Bx} = 250^* (\rightarrow)$

$\Sigma F_y = R_{By} + R_{Ay} - 150 = 0$   
 $\rightarrow R_{By} + 0 - 150 = 0 \quad \therefore R_{By} = 150^* (\uparrow)$

Here two force members are AD, CD & DE.

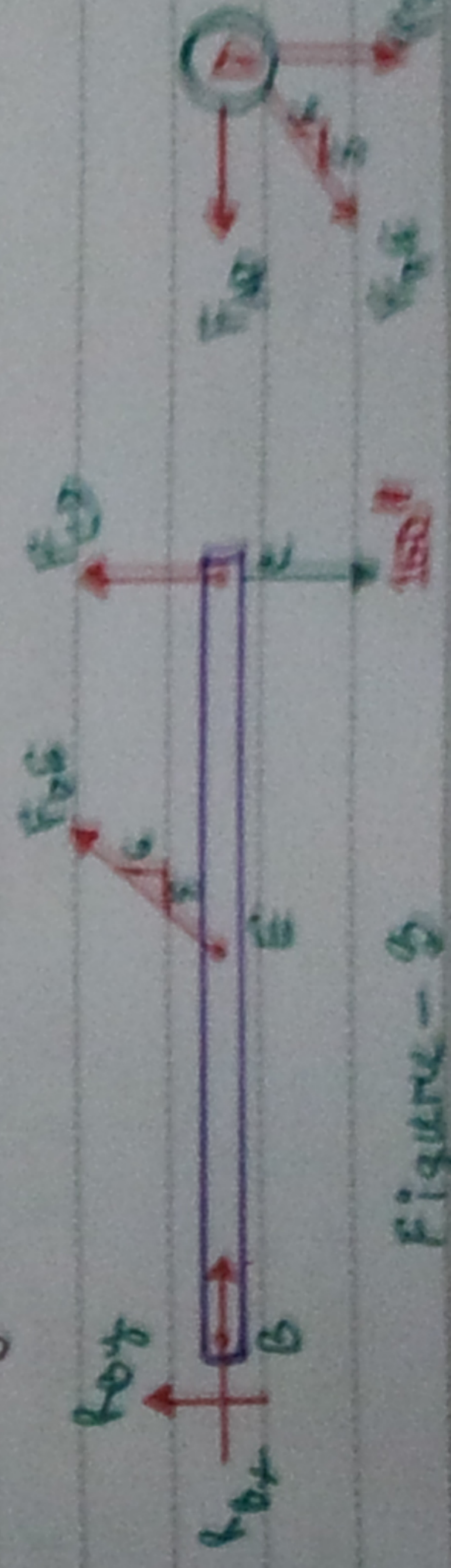


Figure-3

Figure-4

From figure-3,

$$\sum F_x = R_{Bx} + \frac{F_{DE}}{\sqrt{61}} \times 5 = 0 \quad \& \quad \sum F_y = R_{By} + \frac{F_{DE}}{\sqrt{61}} \times 6 + F_{CD} - 150 = 0$$

$$\Rightarrow 250 + \frac{F_{DE}}{\sqrt{61}} \times 5 = 0 \quad \Rightarrow 150 + \frac{(-390.51)}{\sqrt{61}} \times 6 + F_{CD} - 150 = 0$$

$$\therefore F_{DE} = -812.27 \# (C)$$

$$\therefore F_{CD} = 300 \# (T)$$

$$\therefore F_{DE} = -390.51 \# (C)$$

From figure-4,

$$\sum F_x = -F_{AD} + \frac{F_{DE}}{\sqrt{61}} \times 5 = 0$$

$$\Rightarrow F_{AD} = \frac{390.51}{\sqrt{61}} \times 5$$

$$\therefore F_{AD} = +250 \# (T)$$

$$\text{Ans: } R_{Ax} = 250 \# (\leftarrow); R_{Ay} = 0 \# (\uparrow); R_{Bx} = 250 \# (\rightarrow)$$

$$R_{By} = 150 \# (\uparrow); F_{AD} = 250 \# (T); F_{DE} = 390.51 \# (C)$$

$$F_{CD} = 300 \# (T)$$

Trusses :-

## • Characteristics -

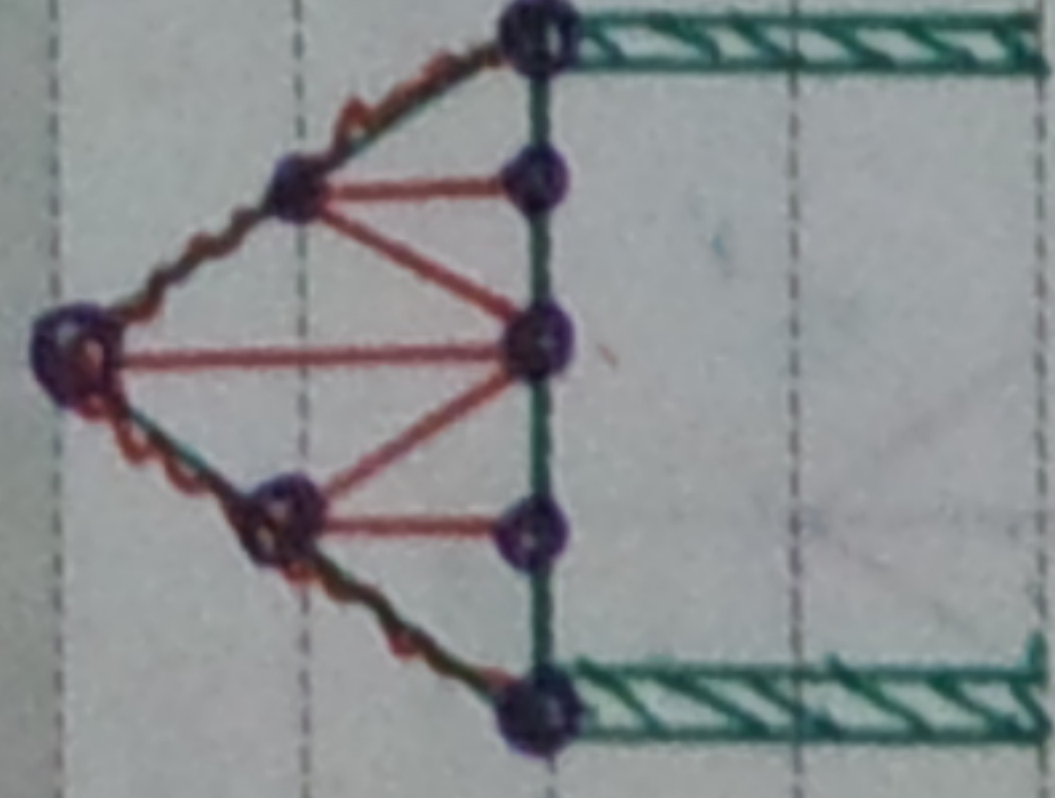


Fig - Truss

- 1) All the members of a truss are weightless.
- 2) Members are connected with frictionless pins.
- 3) Loads are only given at the joints, so every member of a truss is a two force member.

• There are two methods for calculating forces in a truss -

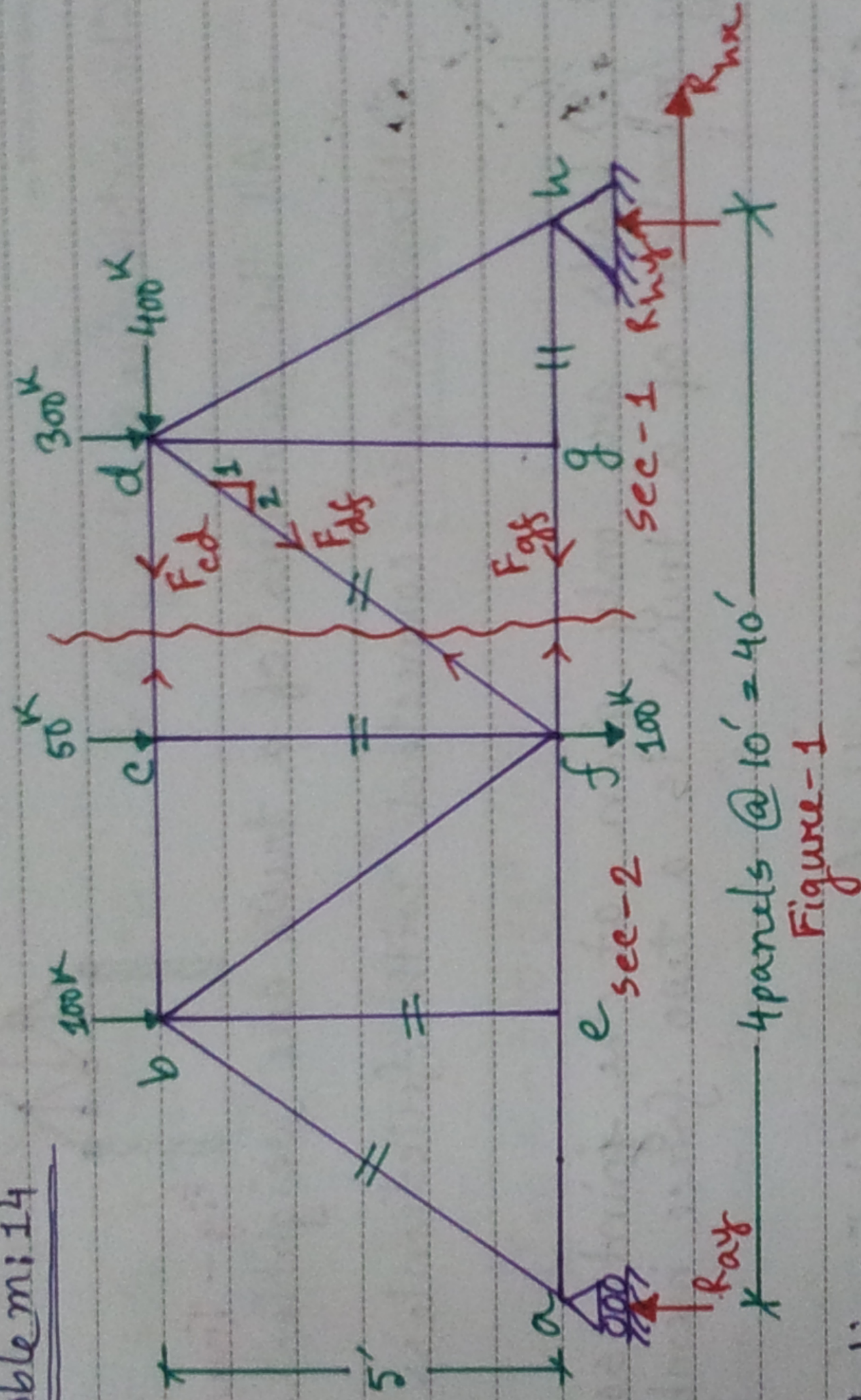
- 1) Joint Method
- 2) Section Method.

# Support VR અને SR member માટે ત્રણ કોણ joint method use થઈ શકે છે.

# કોણ joint - 1) 2જા member hor. + 1જા member ver. / 2જા member ver. + 1જા member hor. અને કોણ joint method use થઈ શકે છે.

# Section method - 1) પૂર્ણ truss કે અંતર્ગત 2જા section વડે કાપી શકે છે અને minimum member કોણ માટે.

# Moment કોણ કોણ point section - 1) કોણ / કોણ માટે શક્ય છે.

Problem 14Solution:

From figure-1,

$$\text{Here, } \sum M_h = R_{ay} \times 40 - 100 \times 30 - 50 \times 20 - 100 \times 20 - 300 \times 10 - 400 \times 5 = 0$$

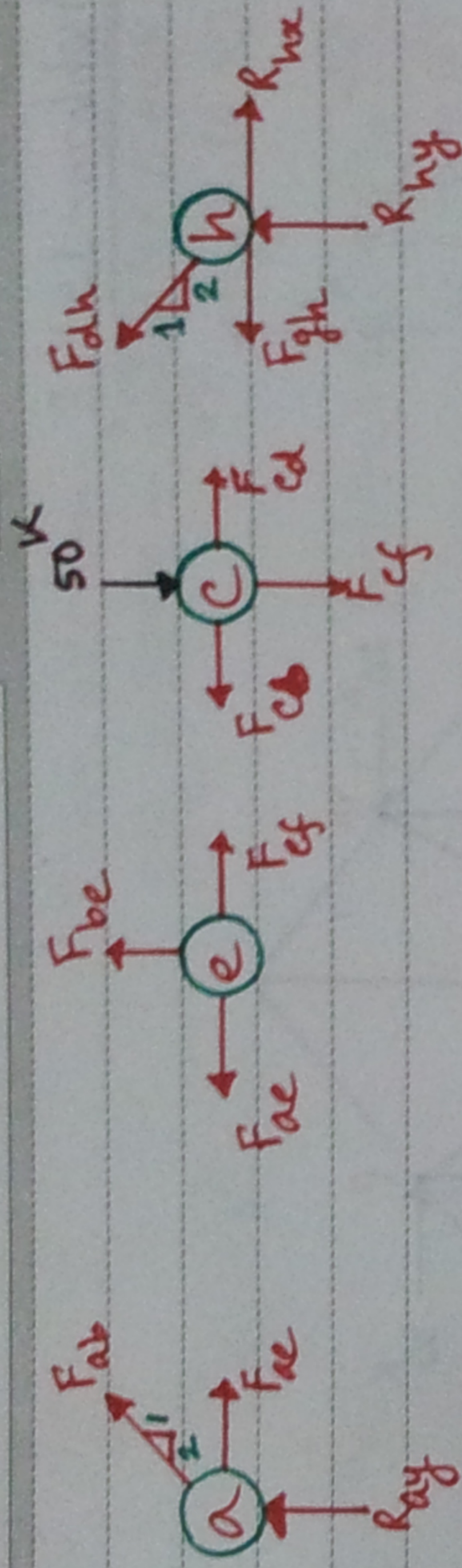
$$\therefore R_{ay} = 275 \text{ k } (\uparrow)$$

$$\sum F_y = R_{ay} - 100 - 50 - 100 - 300 + R_{hy} = 0$$

$$\Rightarrow 275 - 100 - 50 - 100 - 300 + R_{hy} = 0$$

$$\therefore R_{hy} = 275 \text{ (}\uparrow\text{)}$$

$$\sum F_x = R_{hx} - 400 = 0 \Rightarrow R_{hx} = 400 \text{ k } (\rightarrow)$$



From joint a,

$$\sum F_y = R_{ay} + \frac{F_{ab}}{\sqrt{5}} \times 1 = 0$$

$$\therefore \Rightarrow 275 + \frac{F_{ab}}{\sqrt{5}} \times 1 = 0 \quad \therefore F_{ab} = -614.92 \text{ k (c)}$$

From joint e,  $\sum F_y = F_{be} = 0$

$$\therefore F_{be} = 0 \text{ k}$$

From joint c,  $\sum F_y = -50 - F_{cf} = 0$

$$\therefore F_{cf} = -50 \text{ k (c)}$$

From joint h,  $\sum F_y = R_{hy} + \frac{F_{dh}}{\sqrt{5}} \times 1 = 0 \Rightarrow 275 + \frac{F_{dh}}{\sqrt{5}} \times 1 = 0$

$$\therefore F_{dh} = -614.92 \text{ k (c)}$$

&  $\sum F_x = R_{hx} - F_{gh} - \frac{F_{dh}}{\sqrt{5}} \times 2 = 0 \Rightarrow 400 - F_{gh} + \frac{614.92}{\sqrt{5}} \times 2 = 0$

$$\therefore F_{gh} = 950 \text{ k (T)}$$

From sec-1 of figure-1,  $\sum F_y = -300 - \frac{F_{df}}{\sqrt{5}} \times 1 + R_{hy} = 0$

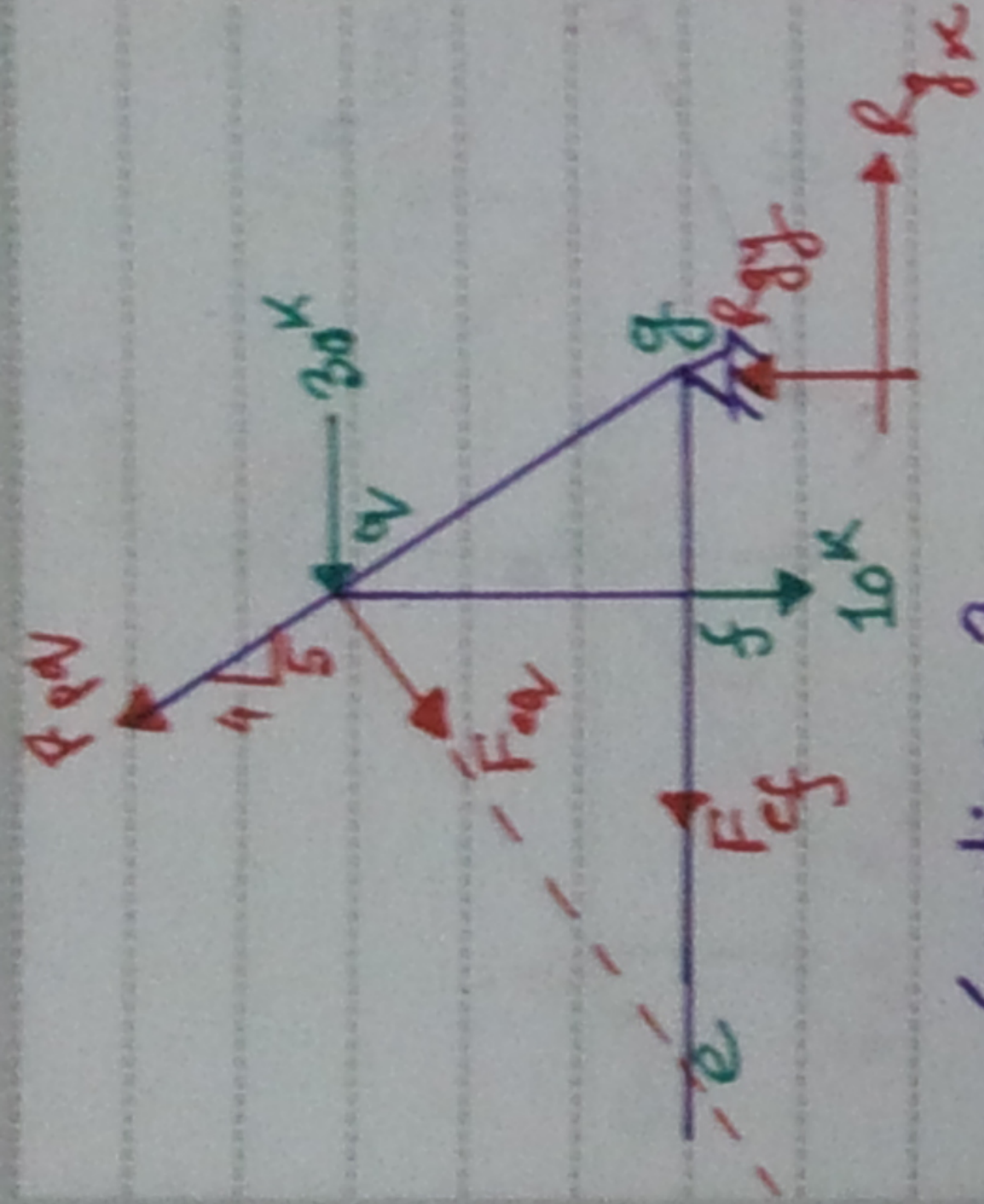
$$\therefore F_{df} = -55.9 \text{ k (c)}$$

(Ans)



From section - 3,  
 $\sum M_e = -30 \times 4 - \frac{F_{PQ}}{\sqrt{41}} \times 4 \times 10 + 10 \times 5$   
 $- R_{PQ} \times 10 = 0$   
 $\Rightarrow F_{PQ} = (-120 + 50 - 85) \times \frac{\sqrt{41}}{40}$  ; [from (ii)]

$\therefore F_{PQ} = -24.81 \text{ k (c)}$



Section - 3

From figure - 1,

$\sum H_a = -R_{gY} \times 30 + 20 \times 4 + 20 \times 8 - 30 \times 4 - 30 \times 8 + 10 \times 5$   
 $+ 5 \times 15 + 10 \times 25 = 0$

$\therefore R_{gY} = 8.5 \text{ k (}\uparrow\text{)}$  ----- (i)

From joint 'g' in figure - 2,

$\sum F_y = R_{gY} + \frac{F_{gq}}{\sqrt{41}} \times 4 = 0$

$\therefore F_{gq} = -13.61 \text{ k (c)}$

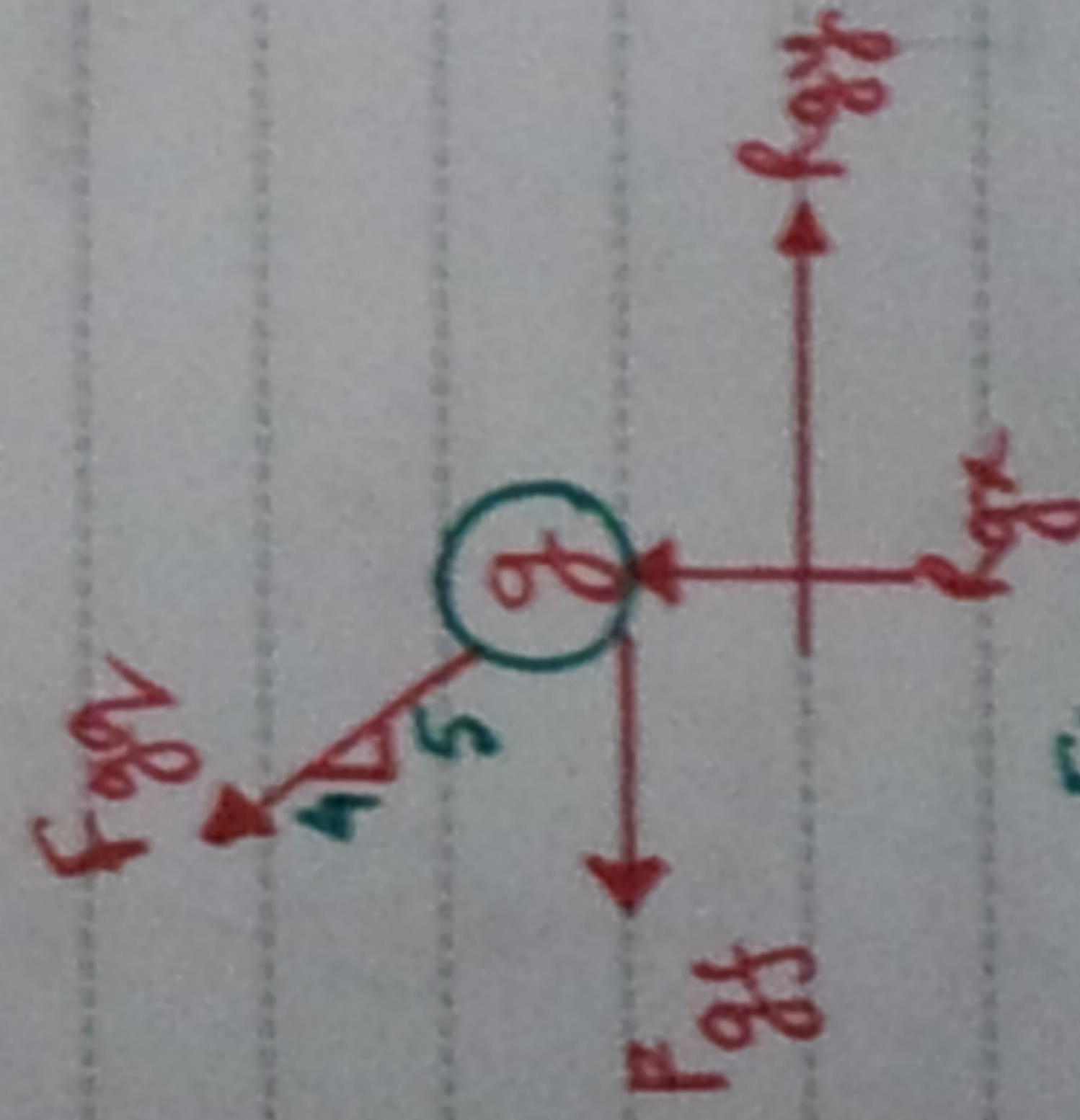


Figure - 2

$\sum F_x = R_{gX} - F_{gS} - \frac{F_{gq}}{\sqrt{41}} \times 5 = 0$

$\therefore F_{gS} = 30.63 \text{ k (T)}$

(Ans)



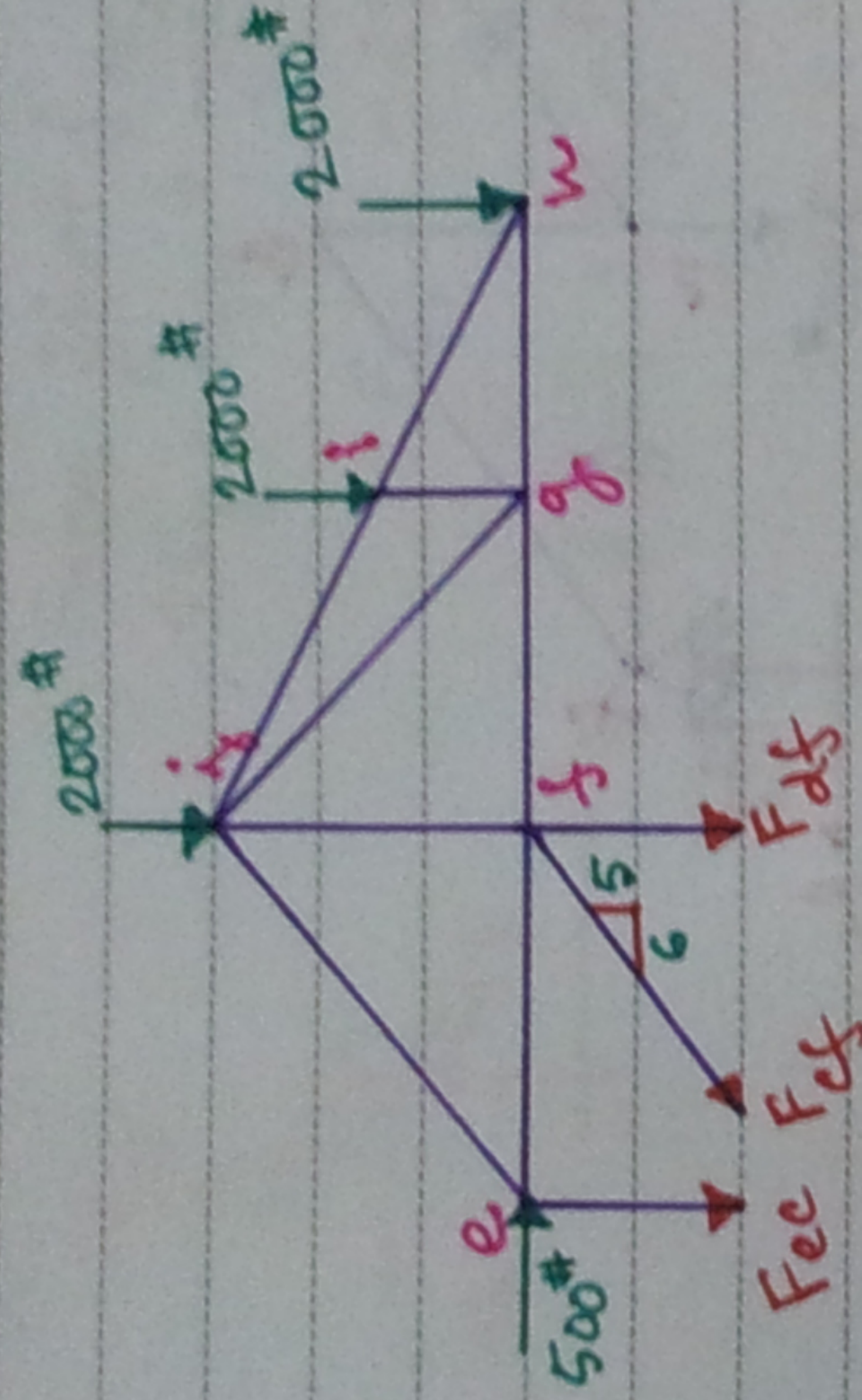


Figure-3-section-1

From the whole diagram,

$$\sum M_b = R_{ay} \times 6 + 500 \times 5 + 500 \times 10 + 2000 \times 6 + 2000 \times 12 = 0$$

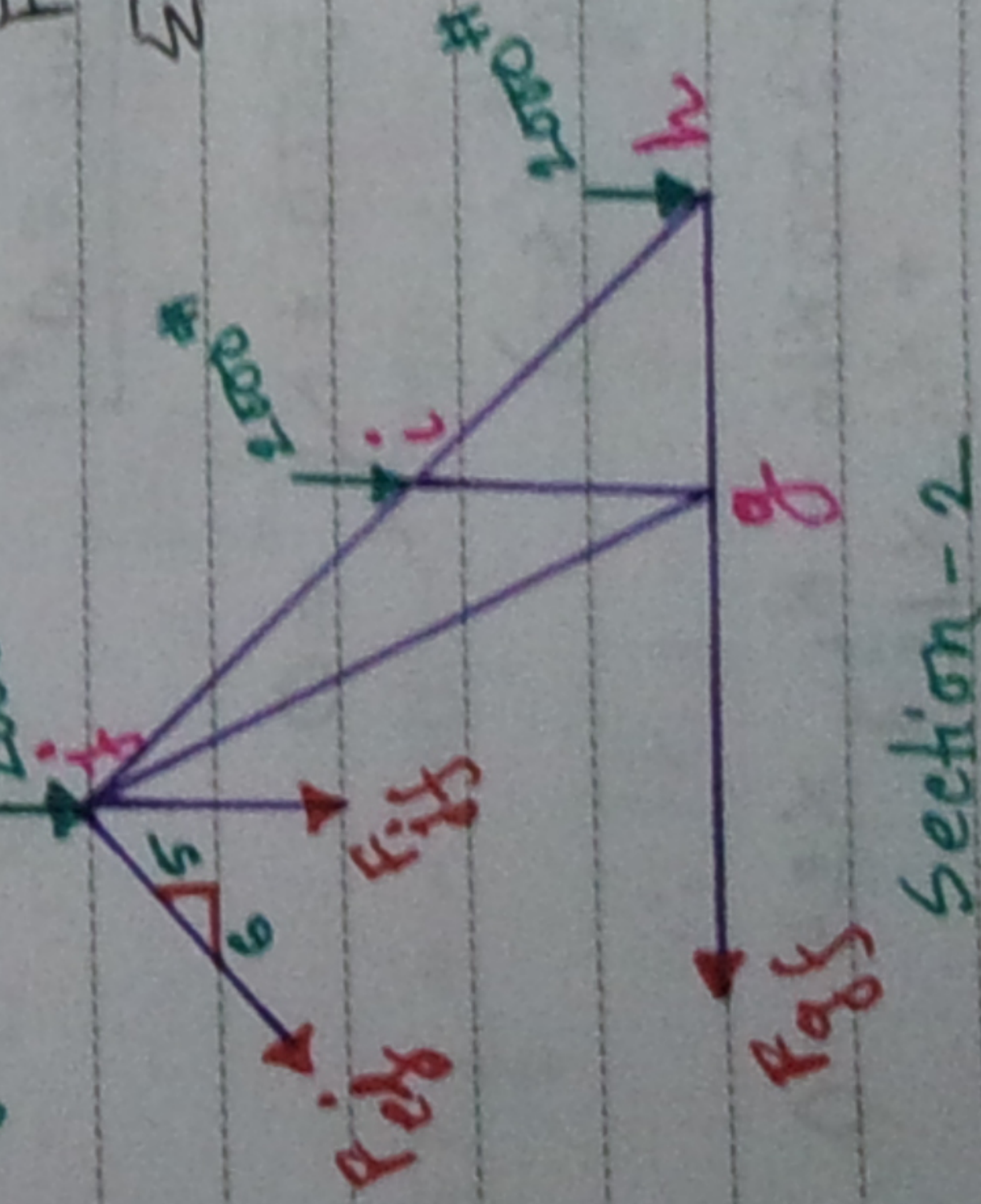
$$\therefore R_{ay} = -7250 \# (\downarrow)$$

From joint a in figure-4,

$$\sum F_y = F_{ae} + R_{ay} = 0$$

$$\therefore F_{ae} = +7250 \# (T)$$

Figure-4



Section-2

From section-1,

$$\sum F_x = 500 - \frac{F_{cf}}{\sqrt{61}} \times 6 = 0$$

$$\therefore F_{cf} = 650.85 \# (T)$$

From sec-2,

$$\sum M_g = 2000 \times 6 + 2000 \times 12 - \frac{F_{ej}}{\sqrt{61}} \times 5 \times 6 = 0$$

$$\therefore F_{ej} = 9372.3 \# (T)$$

(Ans)

# Problem 17

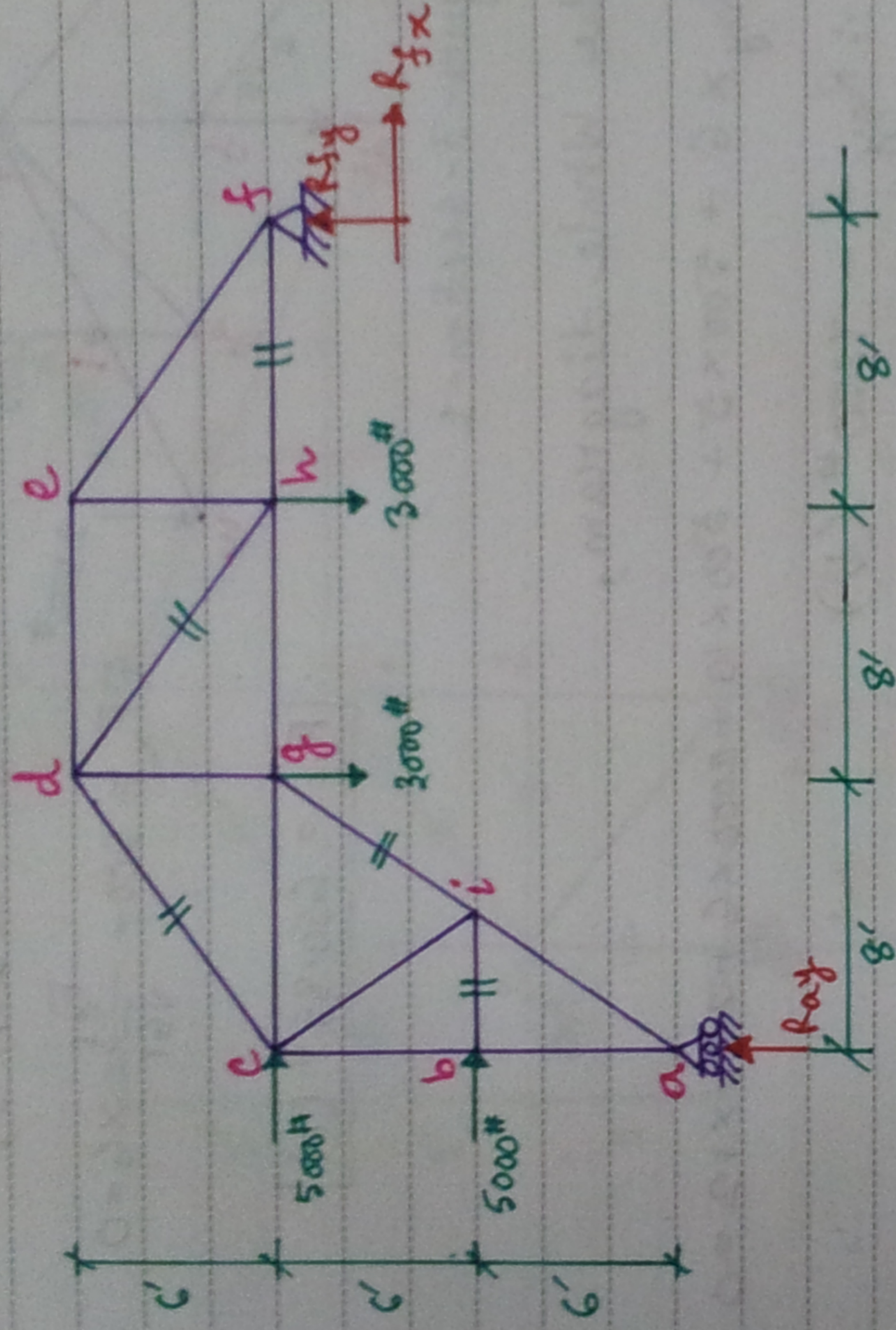
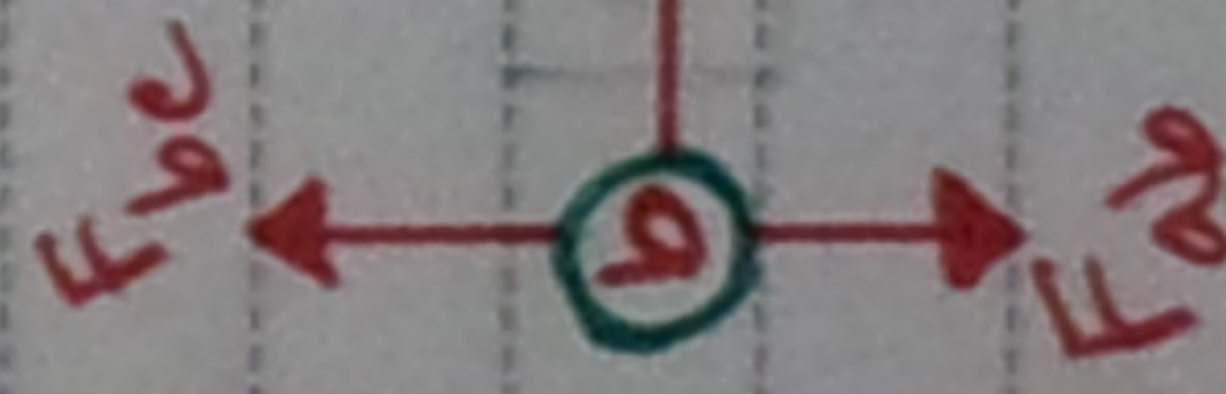


Figure-1

## Solution:



From joint b,

$$\sum F_x = F_{bi} = 0$$

$$\therefore F_{bi} = 0 \#$$

From figure -1,  $\sum F_x = 5000 + 5000 + R_{fx} = 0$

$$\therefore R_{fx} = -10000 \# (\leftarrow)$$

$$\& \sum M_a = 5000 \times 6 + 5000 \times 12 + 3000 \times 8 + 3000 \times 16 - R_{fy} \times 24 = 0$$

$$+ R_{fx} \times 12$$

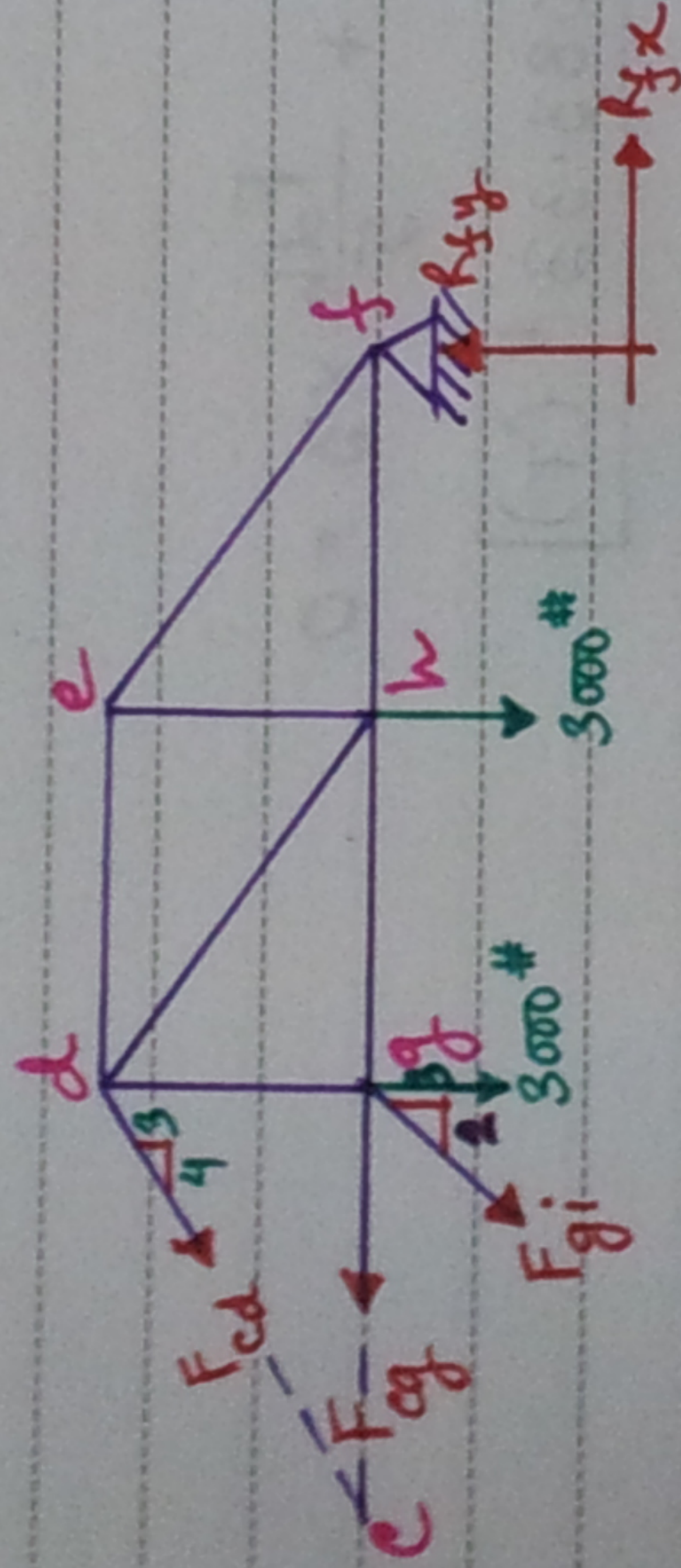
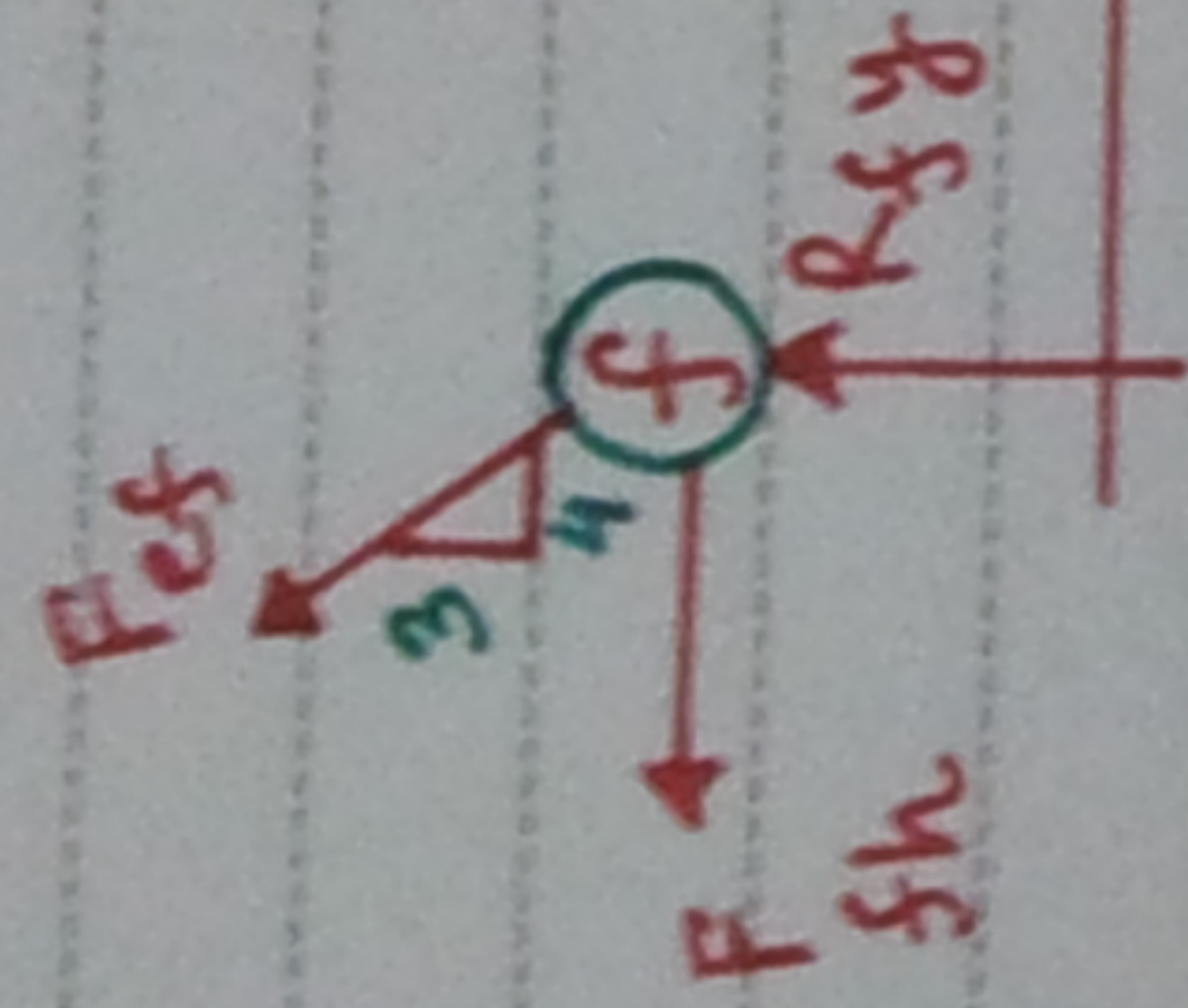
$$\therefore R_{fy} = 1750 \# (\uparrow)$$

From joint f,  $\sum F_y = R_{fy} + \frac{F_{ef}}{\sqrt{25}} \times 3 = 0$

$\therefore F_{ef} = -2916.67 \# (c)$

$\sum F_x \text{ \& \; } \sum F_y = R_{fx} - F_{fh} - \frac{F_{ef}}{5} \times 4 = 0$

$\therefore F_{fh} = -12333.34 \# (c)$



Section - 1

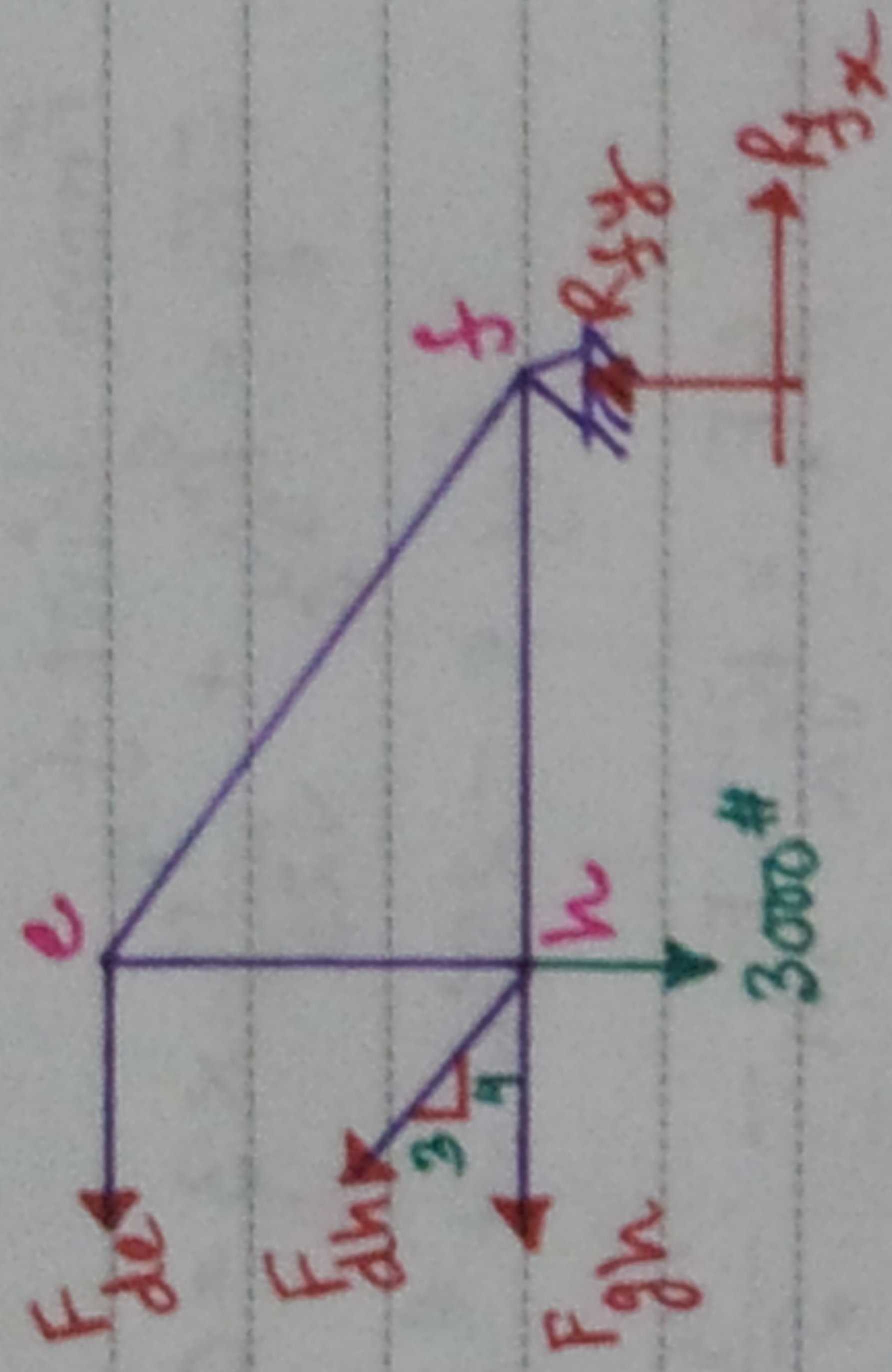
From section - 1,

$\sum M_c = \frac{F_{gi}}{\sqrt{13}} \times 3 \times 8 + 3000 \times 8 + 3000 \times 16 - R_{fy} \times 24 = 0$

$\therefore F_{gi} = -4506.94 \# (c)$

$\& \sum F_y = -3000 - 3000 + R_{fy} - \frac{F_{gi}}{\sqrt{13}} \times 3 - \frac{F_{cd}}{5} \times 3 = 0$

$\therefore F_{cd} = -833.33 \# (c)$



Section - 2

From section - 2,

$$\sum F_y = R_{fy} - 3000 + \frac{F_{dh}}{5} \times 3 = 0$$

$$\therefore F_{dh} = 2083.33 \text{ N (T)}$$

(Ans)