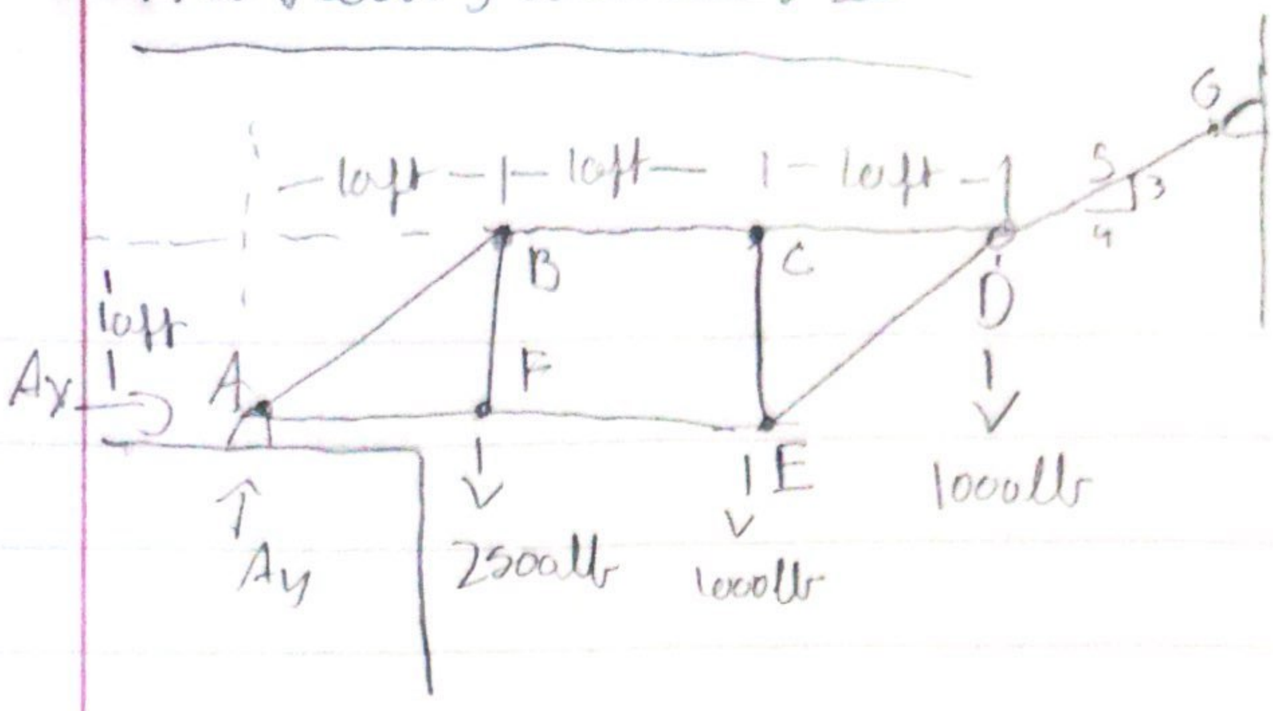
Problem 3 Trusses II



$\Sigma M_A = 0$

$10(2500) + 20(1000) + 30(1000) + \frac{4}{5}DG(10) + \frac{3}{5}DG(30) =$

$25000 + 20000 + 30000 + \frac{4}{5}DG(10) + \frac{3}{5}DG(30) = 0$

$75000 - \frac{3}{5}DG(30) + \frac{4}{5}DG(10) = 0$

$-\frac{3}{5}DG(30)$

$\frac{90}{5} = 18DG$

$\frac{4}{5}(DG)(10)$

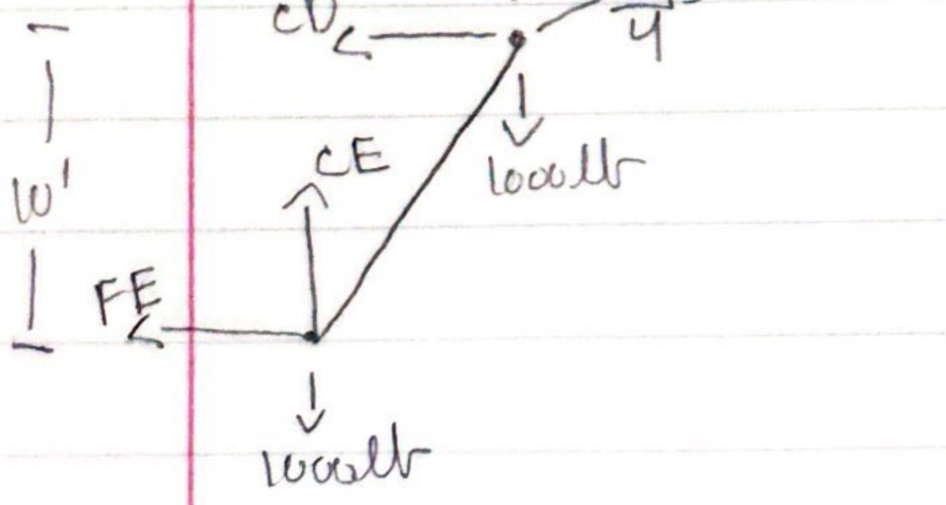
$\frac{40}{5} = 8DG$

$75000 - 18DG + 8DG$

$75000 - 10DG = 0$

$\boxed{DG = 7500\frac{4}{3}}$

FBD



$\uparrow \Sigma F_y = 0$

$\frac{3}{5}(7500) - 1000 - 1000 + CE = 0$

$4500 - 1000 - 1000 + CE$

$\boxed{CE = 2500lb(C)}$

$\Sigma M_D = 0$

$-1000(10) + 10(CE) + 10(FE)$

$-1000(10) + 10(-2500) + 10(FE)$

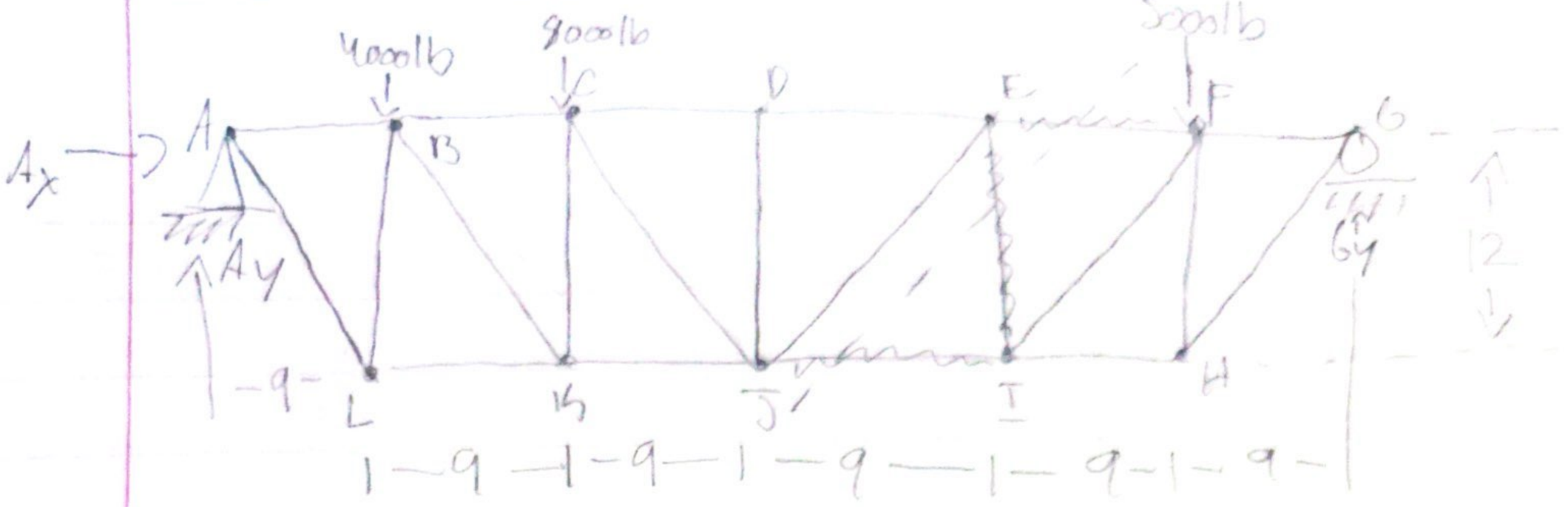
$\boxed{FE = 3500lb(T)}$

$\rightarrow \Sigma F_x = 0$

$-3500 - CD + \frac{4}{5}(7500) = 0$

$\boxed{CD = 2500lb}$ //

Problem 11 Trusses II find forces in EI, IJ, EF

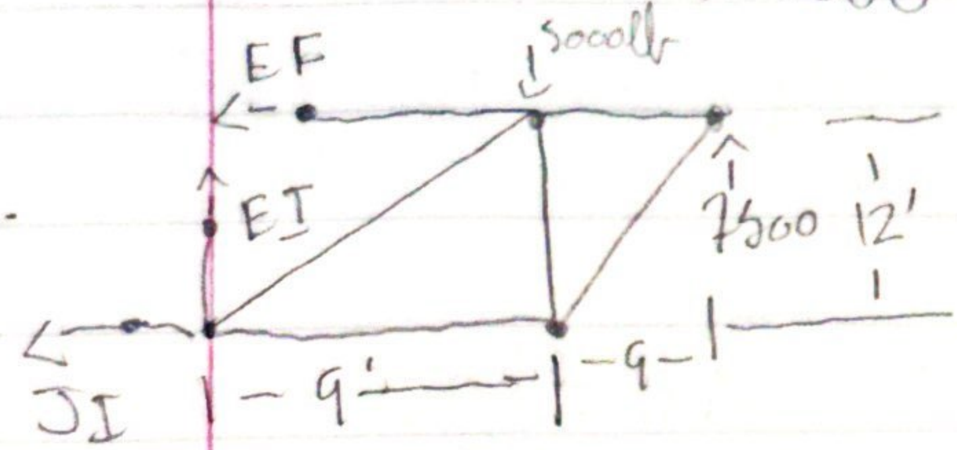


$\Sigma M_A = 0$

$9'(4000lb) + 18'(8000lb) + 45'(5000lb) - 54'G_y = 0$

$36000 + 144000 + 225000 - 54G_y$

$405000 - 54G_y$ $\boxed{G_y = 7500lb \uparrow}$



FBD

$\circlearrowleft \Sigma M_E = 0$

$12JI + 9'(5000lb) - 18(7500lb) = 0$

$12JI + 45000 - 135000 = 0$

$12JI - 90000$ $JI = 7500 = \boxed{7.5kip}$

$\uparrow \Sigma F_y = 0$

$-5000 + EI + 7500 = 0$

$EI = -2500 = \boxed{2.5kip(C)}$

$\rightarrow \Sigma F_x = 0$

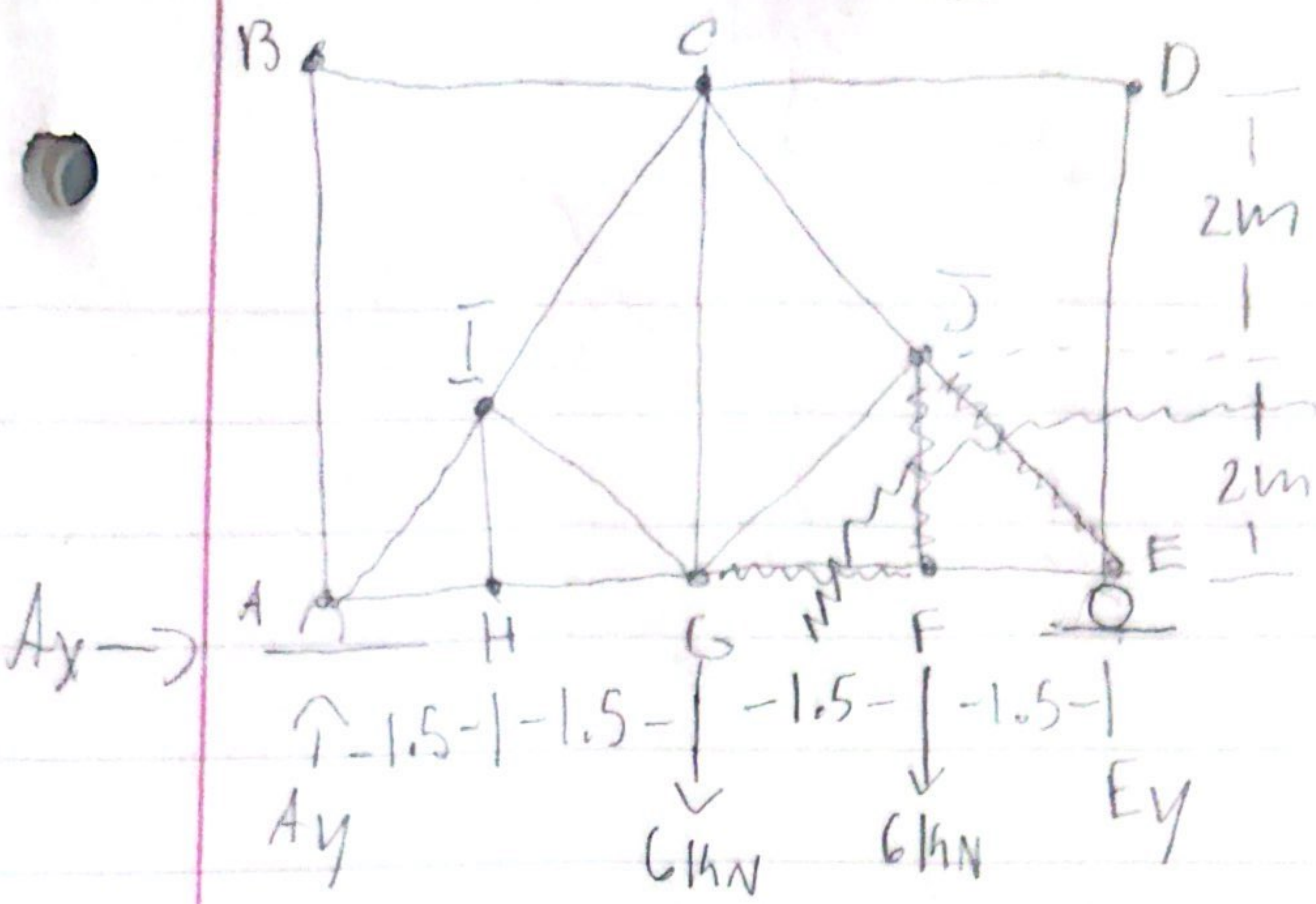
$-JI - EF = 0$

$-7500 - 0 = 0$

$EF = -7500 = \boxed{7.5kip(C)}$

problem I trusses 2:

forces in JE, GF, JF



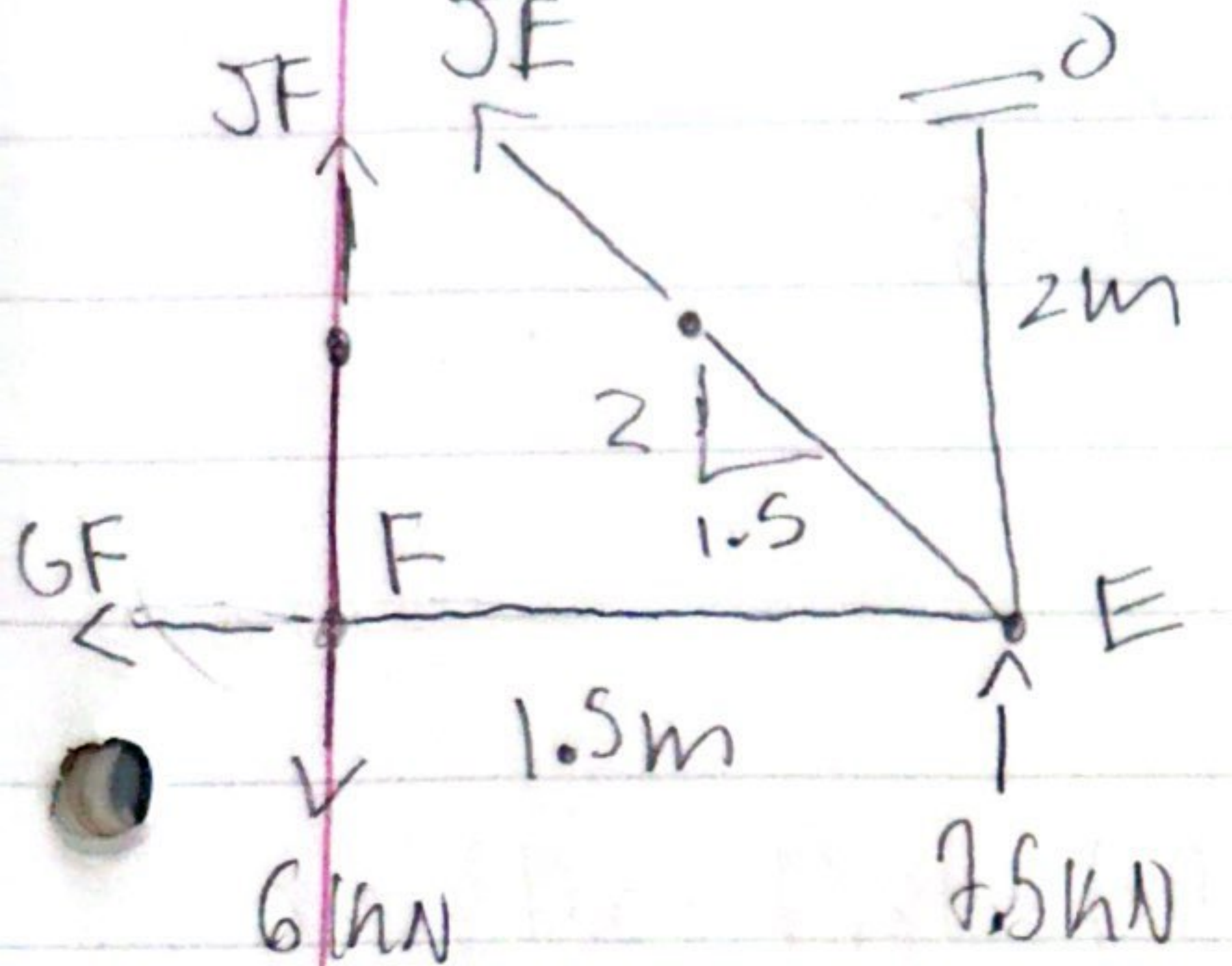
$\circlearrowleft \Sigma M_A = 0$

$3m(6kN) + 4.5(6kN) + 6m E_y$

$18 m \cdot kN + 27 m \cdot kN + 6m E_y$

$\frac{45 mkN}{6} + \frac{6m E_y}{6}$

$\boxed{E_y = 7.5 kN \uparrow}$



$\circlearrowleft \Sigma M_J = 0$

$1.5(7.5kN) + 2m(GF) = 0$

$\frac{11.25}{2m} + \frac{2m GF}{2m} = 0$ $\boxed{GF = 5.625 kN (T)}$

$\rightarrow \Sigma F_x = 0$

$GF - \frac{1.5}{2.5} JE \quad -5.625 - \frac{1.5}{2.5} JE = 0$

$-\frac{1.5}{2.5} JE = -5.625$

$\frac{-2.5}{1.5} \cdot \frac{1.5}{2.5} JE = -5.625 \times \frac{-2.5}{1.5}$ $JE = 9.375$

$\boxed{9.38 (C)}$

$\uparrow \Sigma F_y = 0$

$JF - 6kN + \frac{2}{2.5} JE + 7.5$

$JF - 6kN + \frac{2}{2.5}(-9.38) + 7.5 = 0$

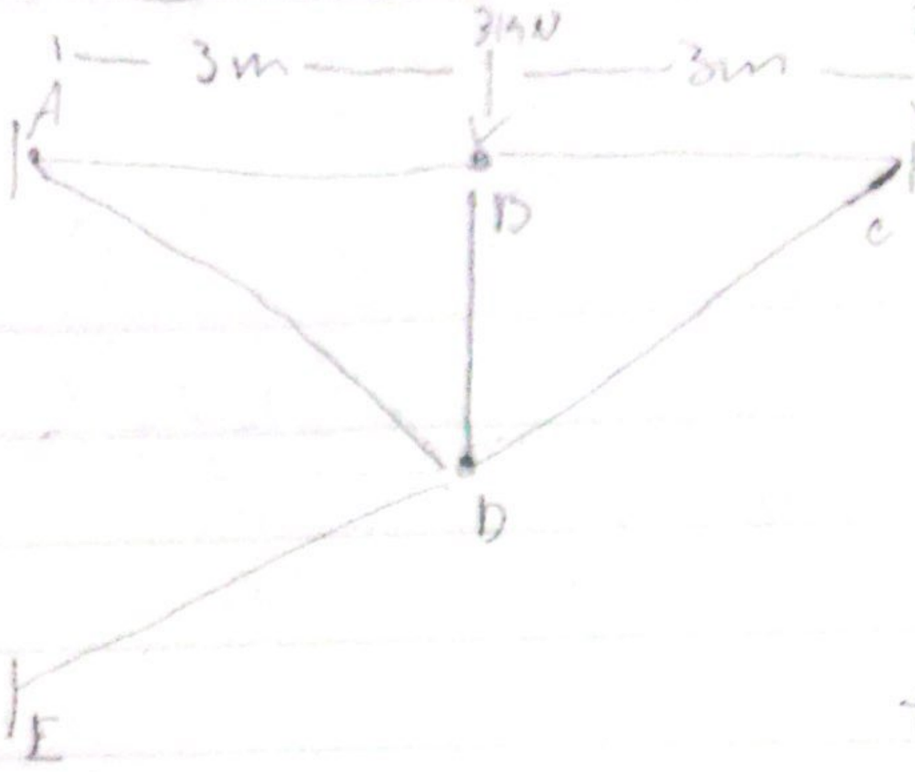
$JF - 6kN - 7.504 + 7.5 = 0$

$JF - 6.004 = 0$

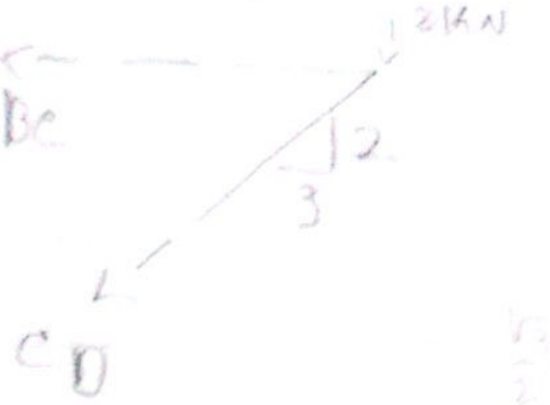
$\boxed{JF = 6 kN (T)}$

Scanned with CamScanner

Problem 3 Trusses 1:



Joint C:



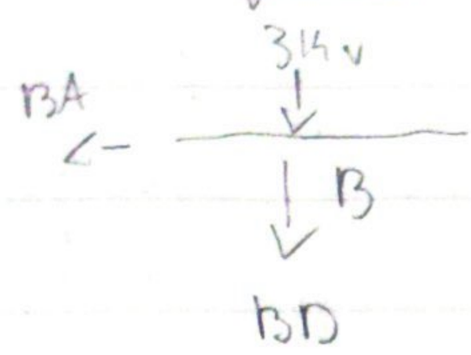
$\uparrow \Sigma F_y = 0 \quad -2 - \frac{2}{\sqrt{3}} CD = 0$ $\quad \frac{\sqrt{3}}{2} \cdot \frac{2}{\sqrt{3}} CD = 2 \cdot \frac{\sqrt{3}}{2}$

$\rightarrow \Sigma F_x = 0 \quad -BC - \frac{3}{\sqrt{2}} CD = 0$

$CD = 3.6 \, (C)$

$BC = 3kN \, (T)$

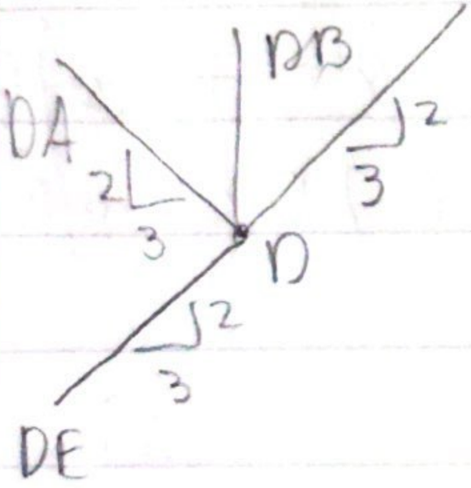
Joint B:



$BA = 3kN \, (T)$

$BD = 3kN \, (C)$

Joint D:



$\rightarrow \Sigma F_x = 0 \quad \frac{-3}{\sqrt{13}} CD - \frac{3}{\sqrt{13}} DA - \frac{3}{\sqrt{13}} DE = 0$

$\frac{-3}{\sqrt{13}} (3.6) - \frac{3}{\sqrt{13}} DA - \frac{3}{\sqrt{13}} DE$

$-10.83 - 3DA + 3DE = 3DE - 3DA = 10.83$

$\uparrow \Sigma F_y = 0 \quad \frac{-2}{\sqrt{13}} (3.61) + \frac{2}{\sqrt{13}} DA - \frac{2}{\sqrt{13}} DE - 3 = 0$

$-0.5554 + \frac{2}{\sqrt{13}} (DA - DE) - 3 = 0$

$3.5554 \Rightarrow DA - DE = \frac{\sqrt{13}}{2} (3.5554) = 23.11$

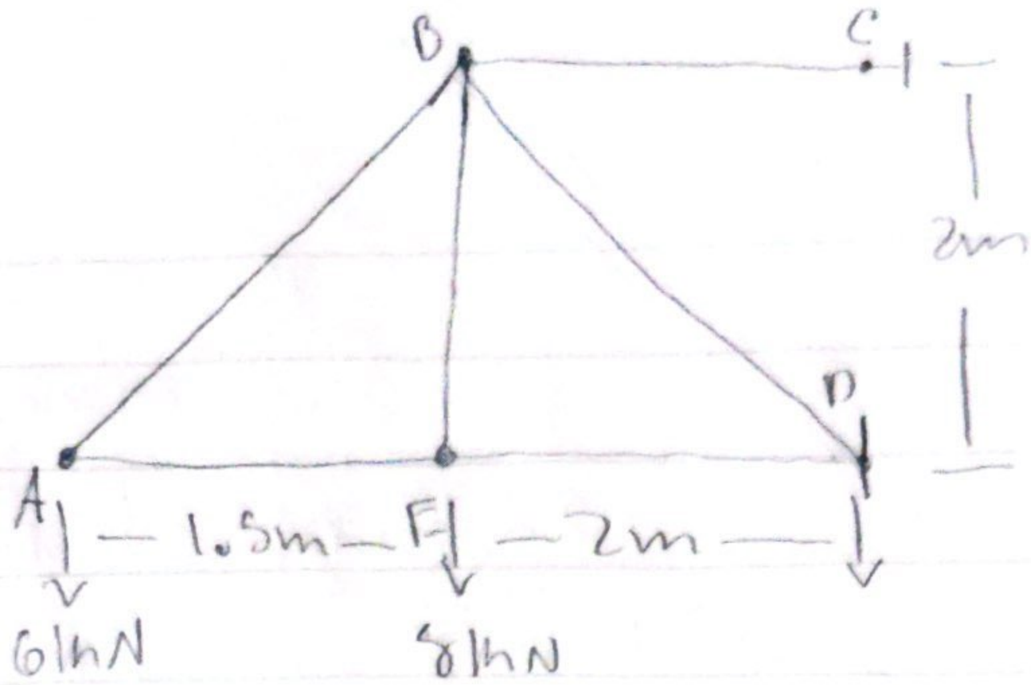
$DA = DE + 23.11$

$3DE - 3(DE + 23.11) = 10.83 \Rightarrow 3DE - 3DE - 69.33 = 10.83$

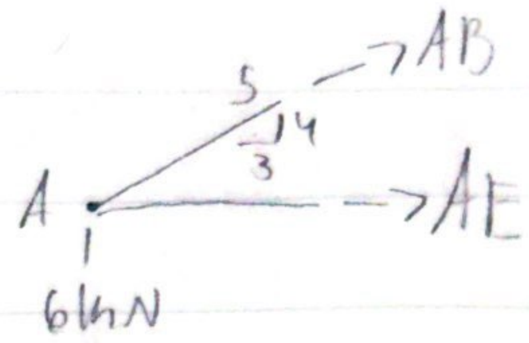
$3DA - 3DE = 10.83 \Rightarrow DA - DE = 3.61$

$DA - DE = 23.11$ but from (C) $= DA - DE = 3.61$

Problem 2 Trusses 1:



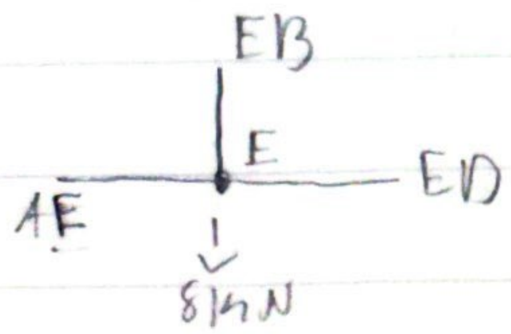
Joint A:



$\uparrow \Sigma F_y = 0 \quad \frac{4}{5} AB - 6 = 0 \quad \boxed{7.5\,kN(T) = AB}$

$\rightarrow \Sigma F_x = 0 \quad \frac{3}{5} AB + AE = \boxed{-4.5\,kN(C) = AE}$

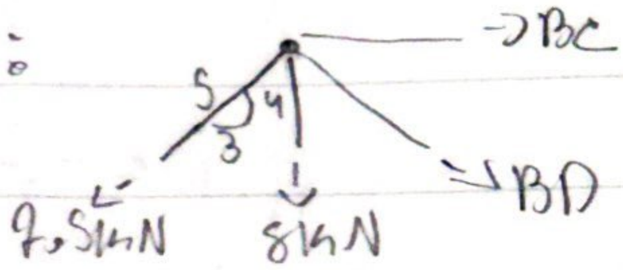
Joint E:



$\uparrow \Sigma F_y = 0 \quad EB - 8 = 0 \quad \boxed{EB = 8\,kN(T)}$

$\rightarrow \Sigma F_x = 0 \quad ED + 4.5 = 0 \quad \boxed{ED = 4.5\,kN(C)}$

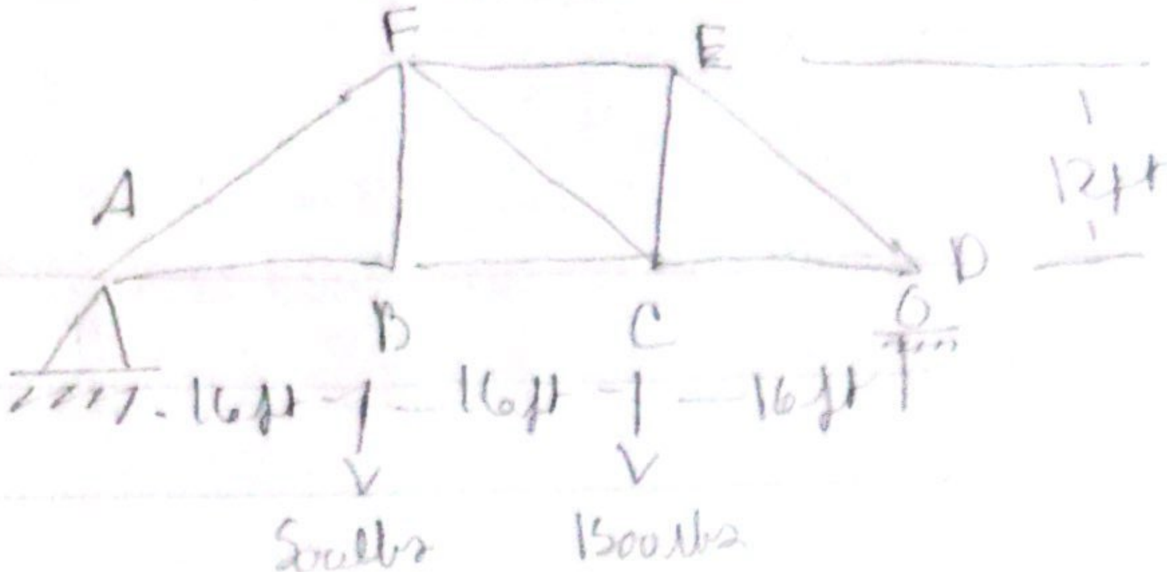
Joint B:



$\uparrow \Sigma F_y = 0 \quad -\frac{4}{5}(7.5) - 8 - \frac{1}{\sqrt{2}} BD = 0 \quad \boxed{BD = -19}$

$\rightarrow \Sigma F_x = 0 \quad BC + \frac{1}{\sqrt{2}} BD - 7.5\left(\frac{3}{5}\right) = 0 \quad \boxed{BC = 18.5}$

Problem 1 - Frames 1:



Announcement
3 EQNs
3 Unknowns

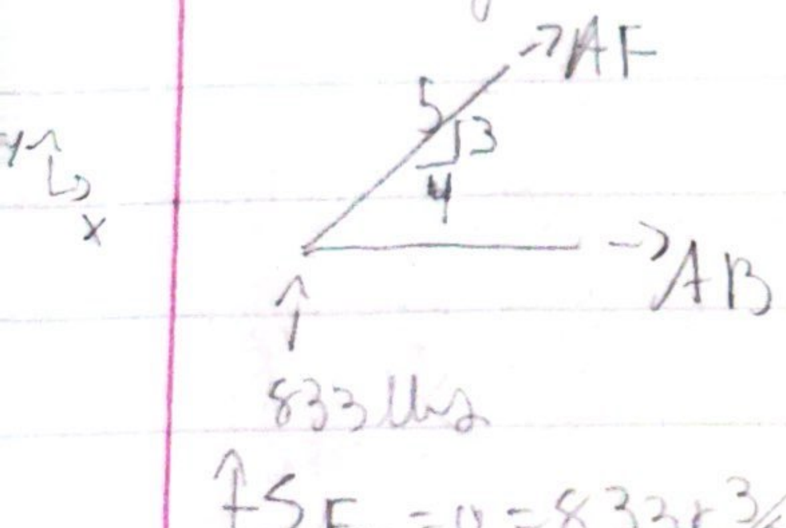
$\Sigma M_D = 0$

$48A_y - 32(500) - 16(1500) = 0$

$A_y = 833 lbs \uparrow$

$\rightarrow \Sigma F_x = 0 \quad A_x = 0$

FBD joint A:



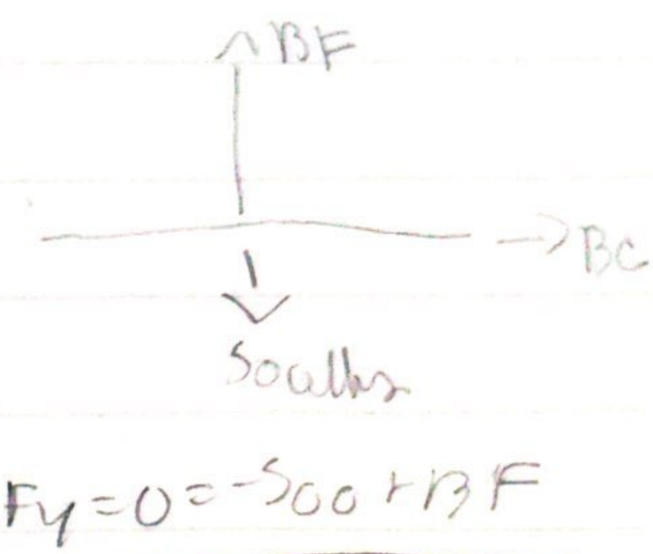
$\uparrow \Sigma F_y = 0 = 833 + \frac{3}{5} AF$

$\boxed{AF = -1388 = 1388 lbs (C)}$ //

$\rightarrow \Sigma F_x = 0 = AB + \frac{4}{5} AF$

$\boxed{AB = 1110 lbs (T)}$ //

FBD joint B:



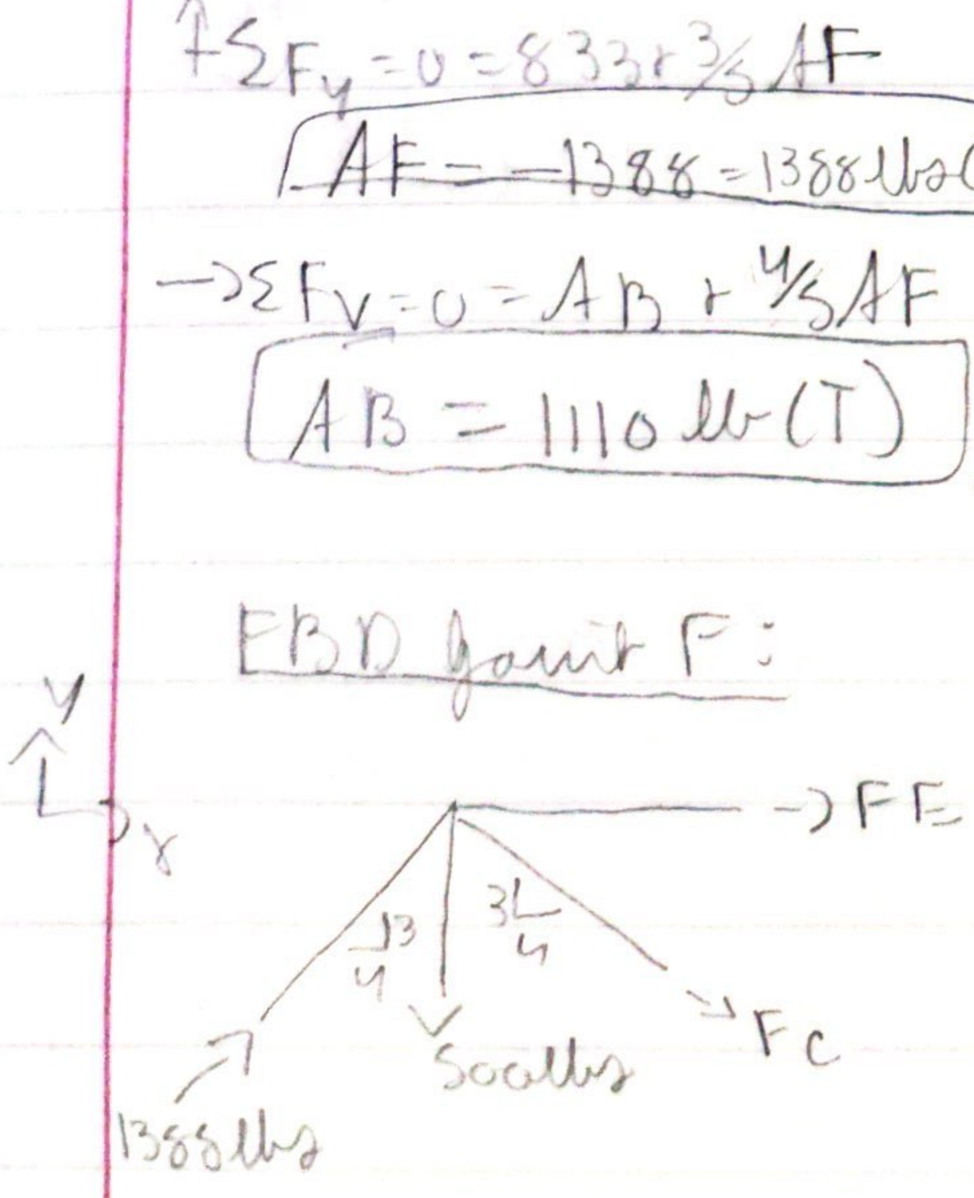
$\uparrow \Sigma F_y = 0 = -500 + BF$

$\boxed{BF = 500 lbs (T)}$ //

$\rightarrow \Sigma F_x = 0 = -1110 + BC$

$\boxed{BC = 1110 lbs (T)}$ //

FBD joint F:



$\uparrow \Sigma F_y = 0 = \frac{3}{5}(1388 lbs) - 500 lbs - \frac{3}{5} FC$

$\boxed{FC = 555 lbs (T)}$

$\rightarrow \Sigma F_x = 0 = \frac{4}{5}(1388) - \frac{4}{5} FC + FE$

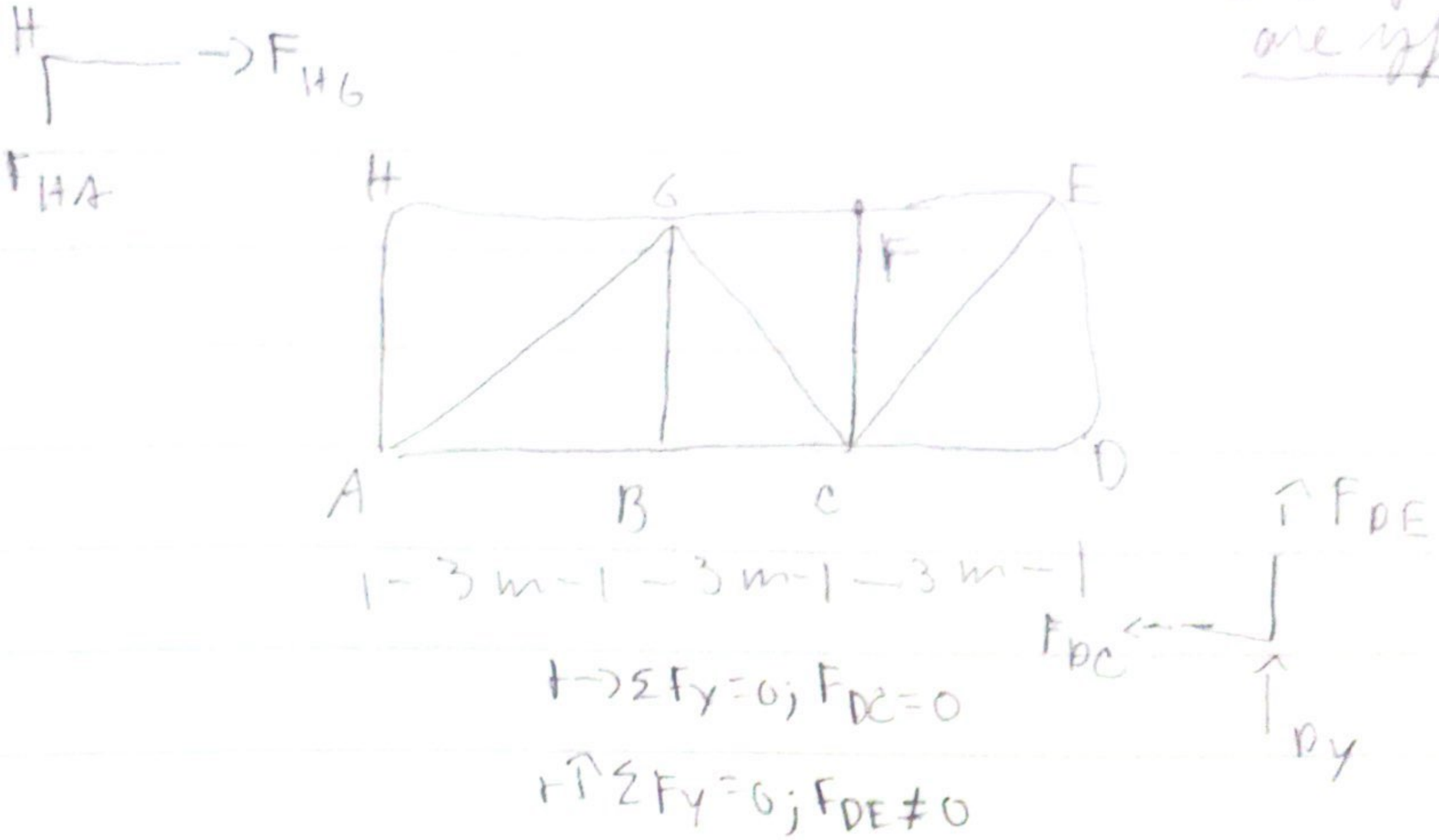
$\boxed{FE = -1554 = 1554 lbs (C)}$ //

Zero force members:

Inspect joint w/ 2 members if no external load or support reaction is applied to the joint then both are zero.

$\rightarrow \Sigma F_x = 0;\ F_{HG} = 0$

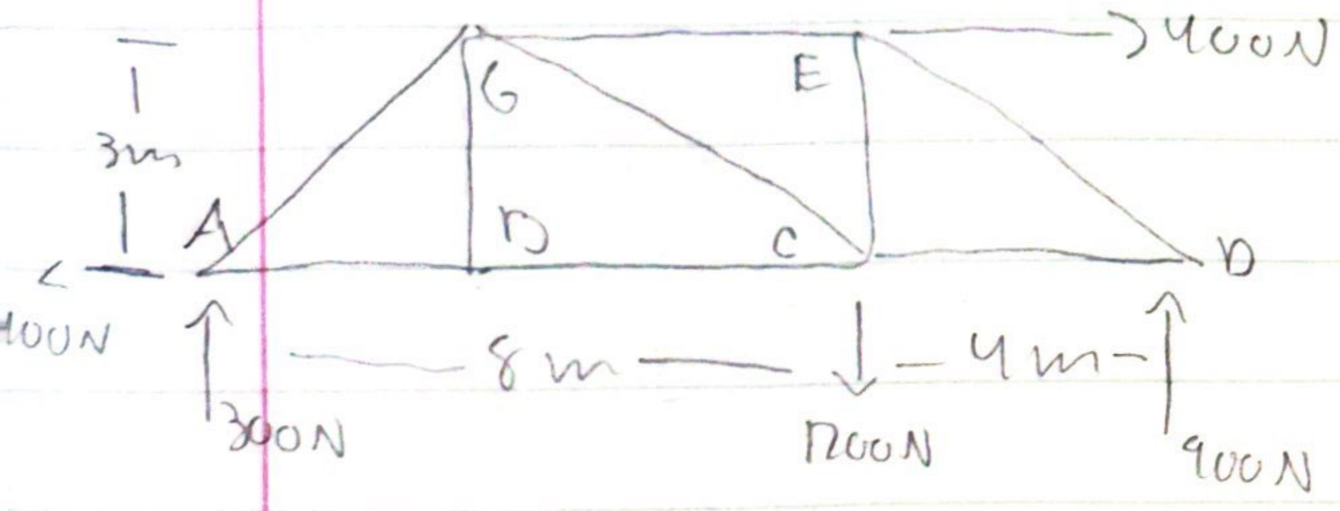
$+\uparrow \Sigma F_y = 0;\ F_{HA} = 0$

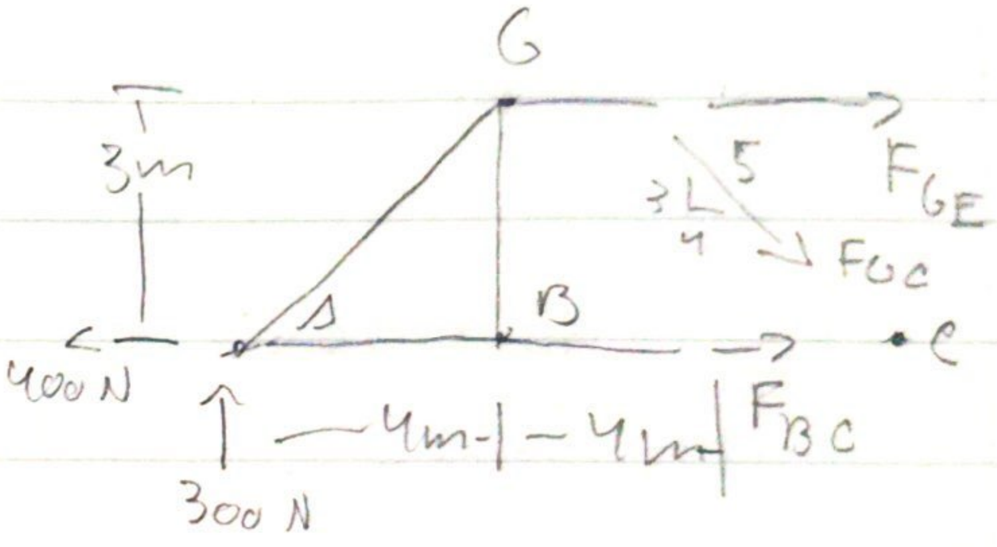


$\rightarrow \Sigma F_x = 0;\ F_{DC} = 0$

$+\uparrow \Sigma F_y = 0;\ F_{DE} \neq 0$

Method of Sections:





Sum of forces in the Y direction to solve for F_{GC}

$+\uparrow \Sigma F_y = 0;\ 300N - \frac{3}{5} F_{GC} = 0 \quad F_{GC} = 500N\ (T)$

Sum of moments about G to solve for directly for F_{BC}

$+CCW\ \Sigma M_G = 0;\ -300N(4m) - 400N(3m) + F_{BC}(3m) = \quad F_{BC} = 800\ N(T)$

Sum of moment about C to solve for F_{GE}

$+CCW\ \Sigma M_C = 0;\ -300N(8m) - F_{GE}(3m) = 0 \quad F_{GE} = -800\ N(C)$

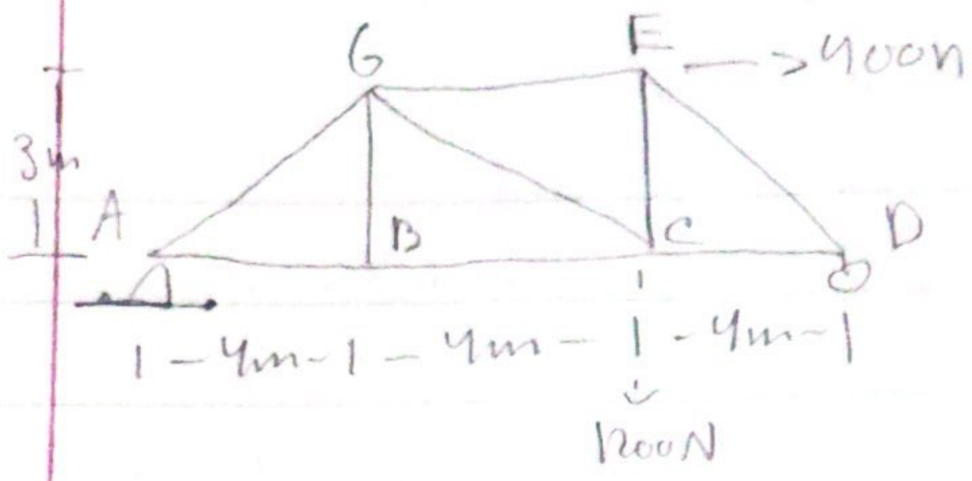
* joint = 2 unknowns
* section = 3 unknowns

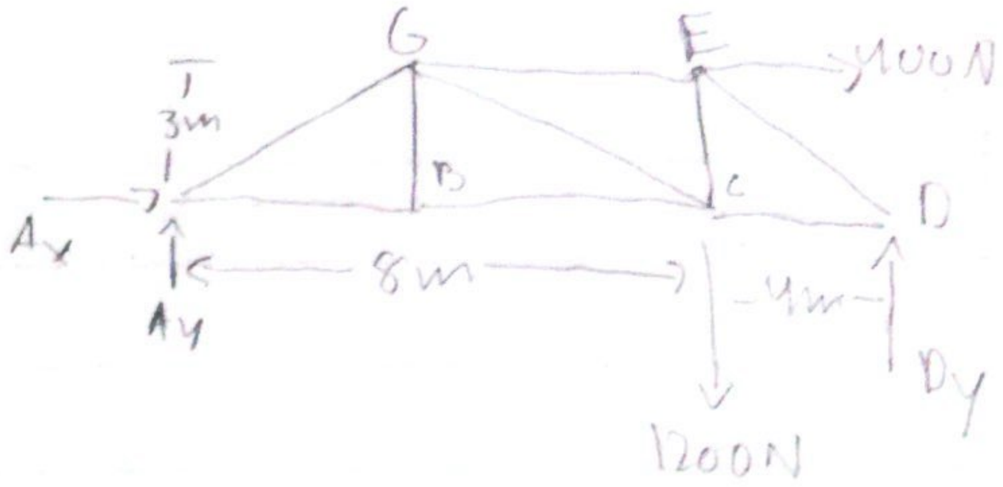
07/18/2025

Example: External Reactions:

FBD of whole truss:

non concurrent: $\Sigma F_x = 0, \Sigma F_y = 0, \Sigma M_z = 0$





Sum of forces in the x direction to solve for A_x

$+\rightarrow \Sigma F_x = 0; 400N + A_x = 0 \quad A_y = -400 = 400N \leftarrow$

Sum of moments about A to solve for D_y

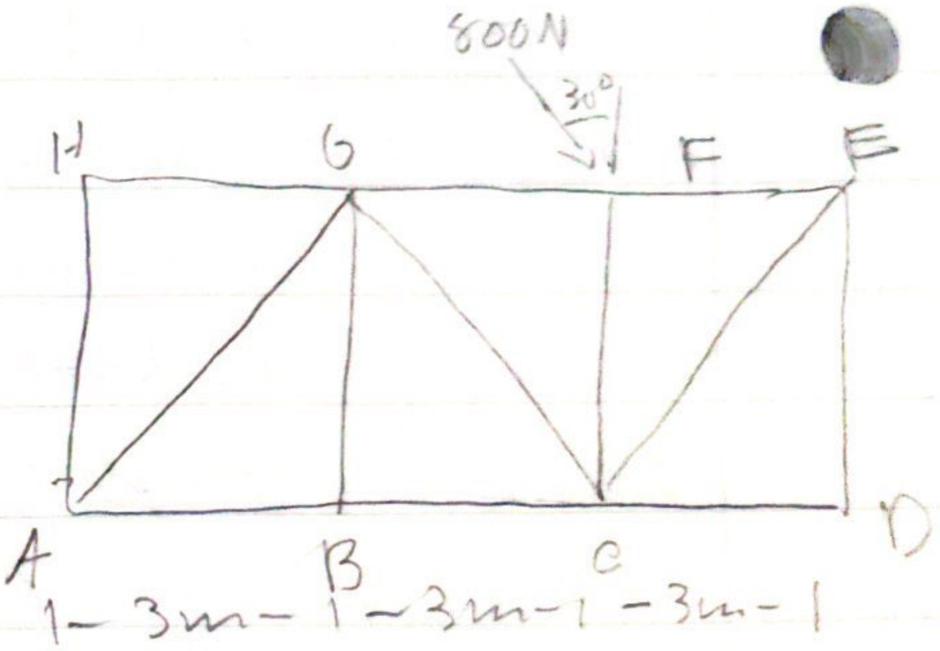
$+CCW \Sigma M_A = 0; -1200N(8m) - 400N(3m) + D_y(12m) = 0 \quad D_y = 900N \uparrow$

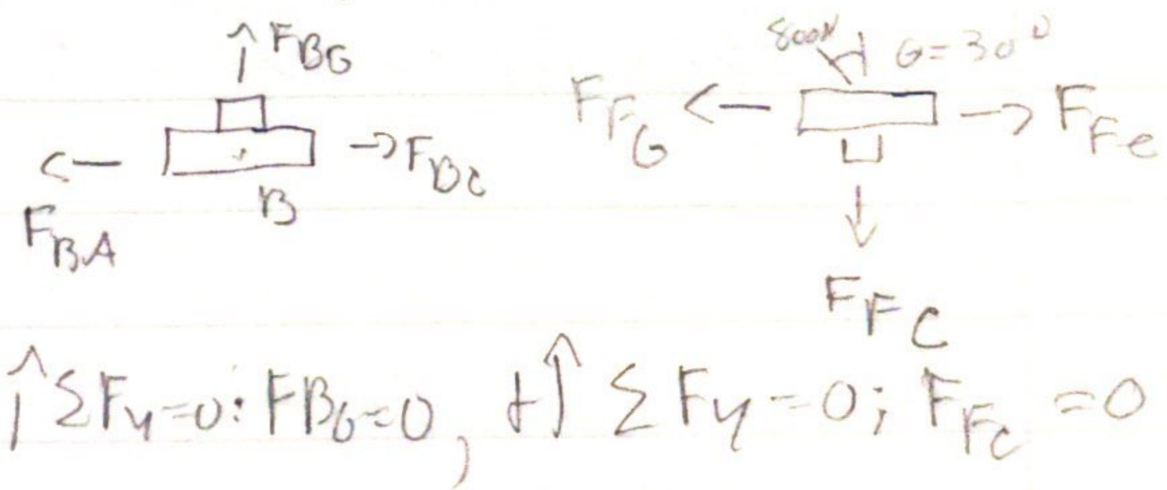
Sum of forces in the y direction and plug in D_y to solve for A_y

$+\uparrow \Sigma F_y = 0; A_y - 1200N + (D_y = 900N) = 0 \quad A_y = 300N \uparrow$

Zero-force members (ZFM):

- Inspect joint w/ 3 members
  if 2 are collinear and no external load or support reaction is applied to the joint then 3rd is a ZFM



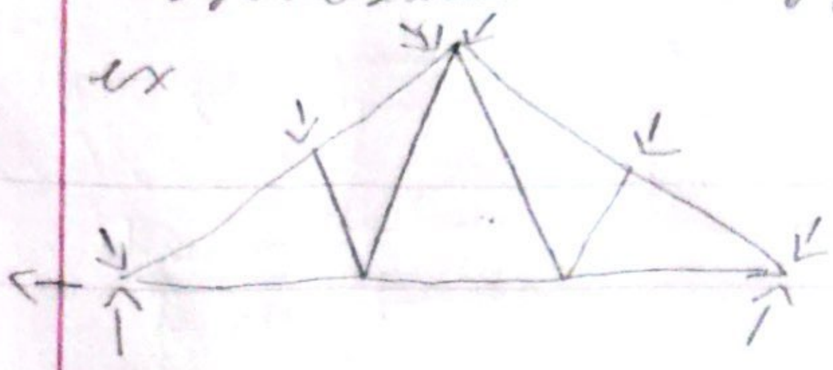


$+\uparrow \Sigma F_y = 0: F_{BG} = 0, \quad +\uparrow \Sigma F_y = 0; F_{FC} = 0$

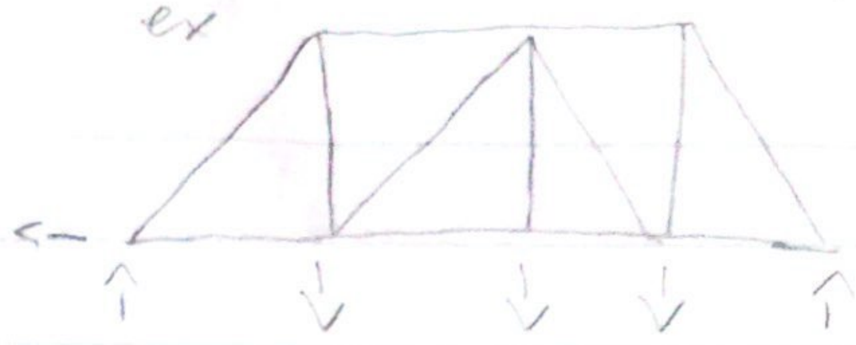
Trusses:

- supported by roller/pocket at one end
  → loads transmitted by joints of simple planar truss (coplanar)

ex

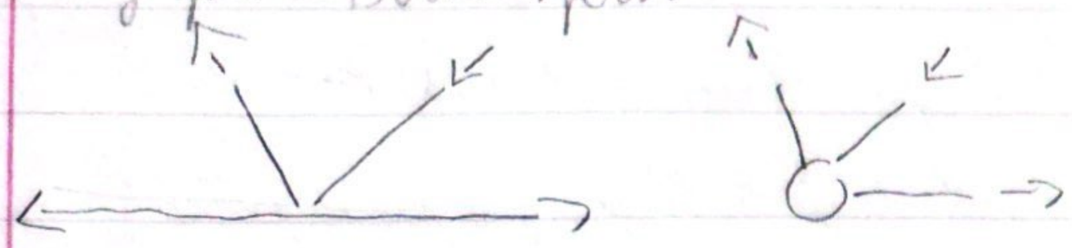


ex

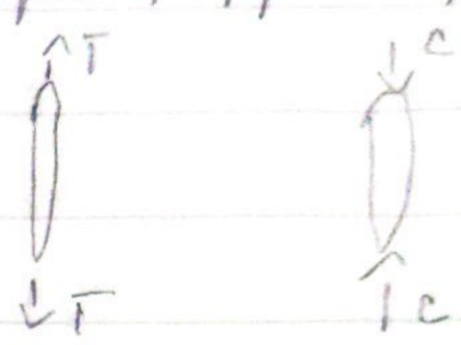


07/16/2025

- Members connected (concurrent)
  by plate/bolt/pin



- two-force members
  (equal, opposite, collinear)



Trusses:

two force members

assumption: to determine force in each member

- loads applied at the joints only
  neglect member weight or apply half at each end
- members connected by frictionless pins
  joining members have concurrent centerlines

free body diagrams:

- whole truss to solve for support reactions only if needed
- isolate joint or section to solve for member forces

Equations:

- Concurrent $\Sigma F_x = 0$ $\Sigma F_y = 0$
- Nonconcurrent $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma M_z = 0$