

Midterm Examination I

Solutions

Name _____
Last, First

Problem 1 _____ /50

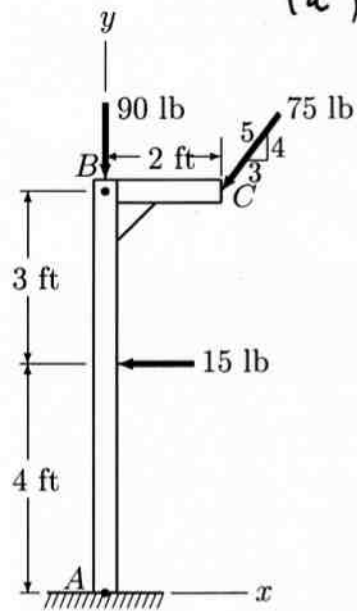
Problem 2 _____ /50

Total _____ /100

~~1~~

(a) Replace the load system by a statically equivalent force at (0,0) and a couple, and determine (i) the magnitude and direction of the force, (ii) the magnitude and orientation of the couple moment.

(b) Replace the load system by a single statically equivalent force, and determine the points where its line of action intersects members AB and BC.

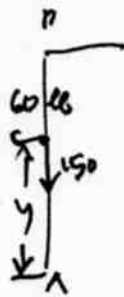
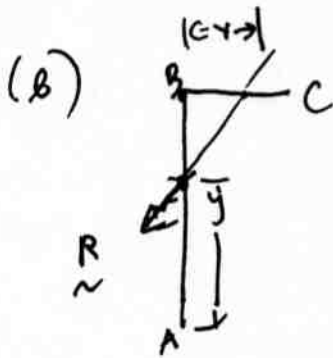


$$\begin{aligned} (a) \quad \vec{R} &= \sum \vec{F} = (-15 \text{ lb}) \hat{i} + (-90 \text{ lb}) \hat{j} \\ &\quad + \left(-\frac{3}{5} \times 75 \text{ lb}\right) \hat{i} + \left(-\frac{4}{5} \times 75 \text{ lb}\right) \hat{j} \\ &= -60 \text{ lb} \hat{i} - 150 \text{ lb} \hat{j} \end{aligned}$$

$$\theta = \tan^{-1} \frac{60}{150} = 21.8^\circ$$

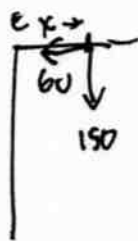
$$R = \sqrt{60^2 + 150^2} \text{ lb} = 161.6 \text{ lb}$$

$$\begin{aligned} M_A &= (15 \text{ lb}) 4 \text{ ft} + \frac{3}{5} (75 \text{ lb}) 7 \text{ ft} - \frac{4}{5} (75 \text{ lb}) 2 \text{ ft} \\ &= 255 \text{ lb-ft} \quad \curvearrowright \end{aligned}$$



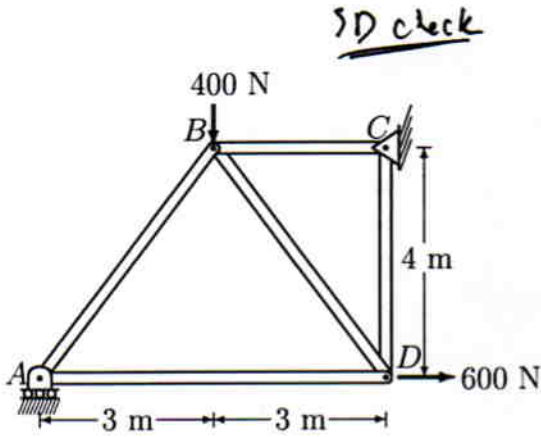
$$\begin{aligned} y \times 60 \text{ lb} &= 255 \text{ lb-ft} \\ \rightarrow y &= \underline{\underline{4.25 \text{ ft}}} \end{aligned}$$

$$60 \text{ lb} \times 7 \text{ ft} - (150 \text{ lb}) x = 255 \text{ lb-ft}$$



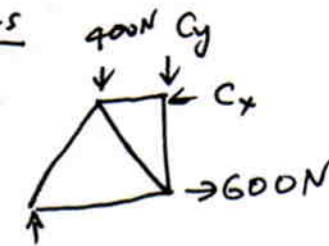
$$\underline{\underline{x = 1.10 \text{ ft}}}$$

2. Check the static determinacy of the planar truss shown, and if it is statically determinate find all the member forces. Show all pertinent free-body diagrams and whether member forces are in tension or compression.

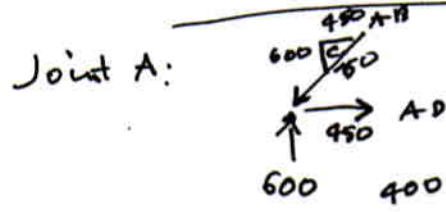


bars = 5
 joints = 4
 constraints = 3
 $b + c = 2j$ OK

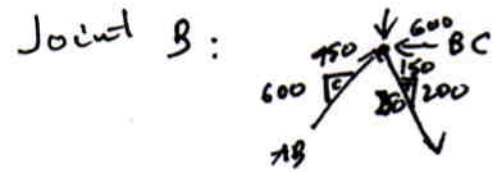
Reactions



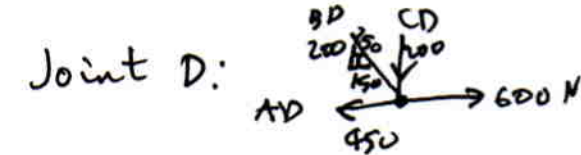
$\sum M_C = 0: 400 \text{ N} \cdot 3 \text{ m} + 600 \cdot 4 \text{ m} = A_y \cdot 6 \text{ m}$
 $\rightarrow A_y = 600 \text{ N}$
 $\sum F_x = 0 \rightarrow C_x = 600 \text{ N}; \sum F_y = 0 \rightarrow C_y = 200 \text{ N}$



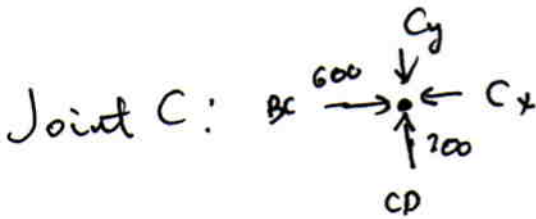
$AB = 750 \text{ N (C)}, AD = 450 \text{ N (T)}$



$BC = 600 \text{ N (C)}, BD = 250 \text{ N (T)}$



$CD = 200 \text{ N (C)}, BD = 250 \text{ N (T)}$ (check)



$C_x = 600 \text{ N}, C_y = 200 \text{ N}$
check