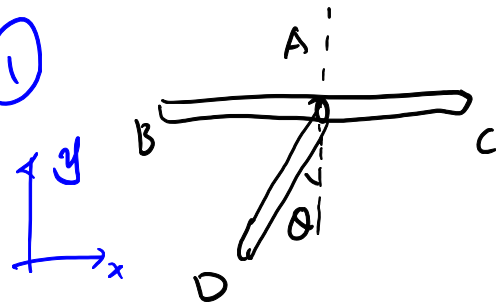
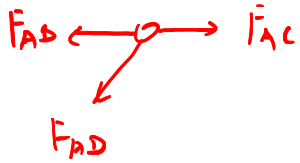
Identifying Zero-force Members

Typical Cases:

① 

- No external force at A
- Three members, two of which are in a straight line.



$\Sigma F_y = 0$: $-F_{AD}\cos\theta = 0 \Rightarrow \boxed{F_{AD} = 0}$

$\Sigma F_x = 0$: $F_{AB} = F_{AC}$

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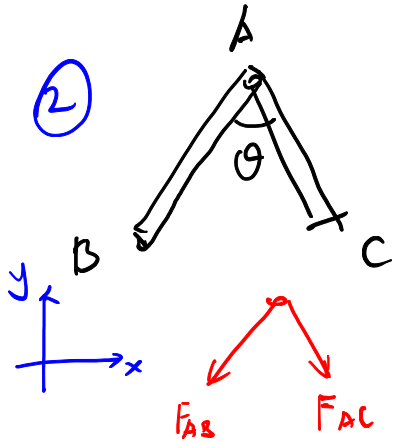
② 

- No external force at A
- Two members with a angle.

$\Sigma F_x = 0$: $\Rightarrow$ F_{AB}, F_{AC} have the same sign

$\Sigma F_y = 0$: $\Rightarrow$ F_{AB}, F_{AC} have opposite sign.

$\Rightarrow \boxed{F_{AB} = F_{AC} = 0}$

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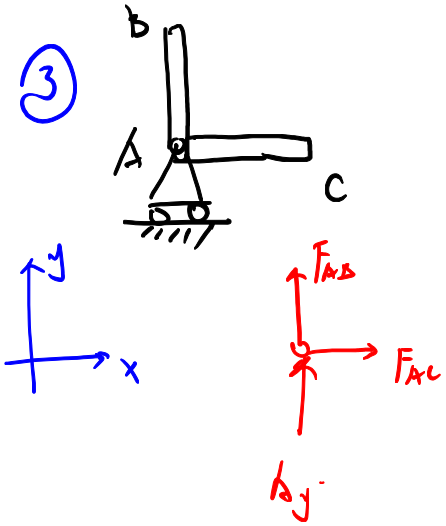
③ 

- AB ⊥ AC
- Roller support at A ($A_x = 0$)

$\Sigma F_x = 0$: $\boxed{F_{AC} = 0}$

$\Sigma F_y = 0$: $F_{AB} = A_y$

Zero-Force Members

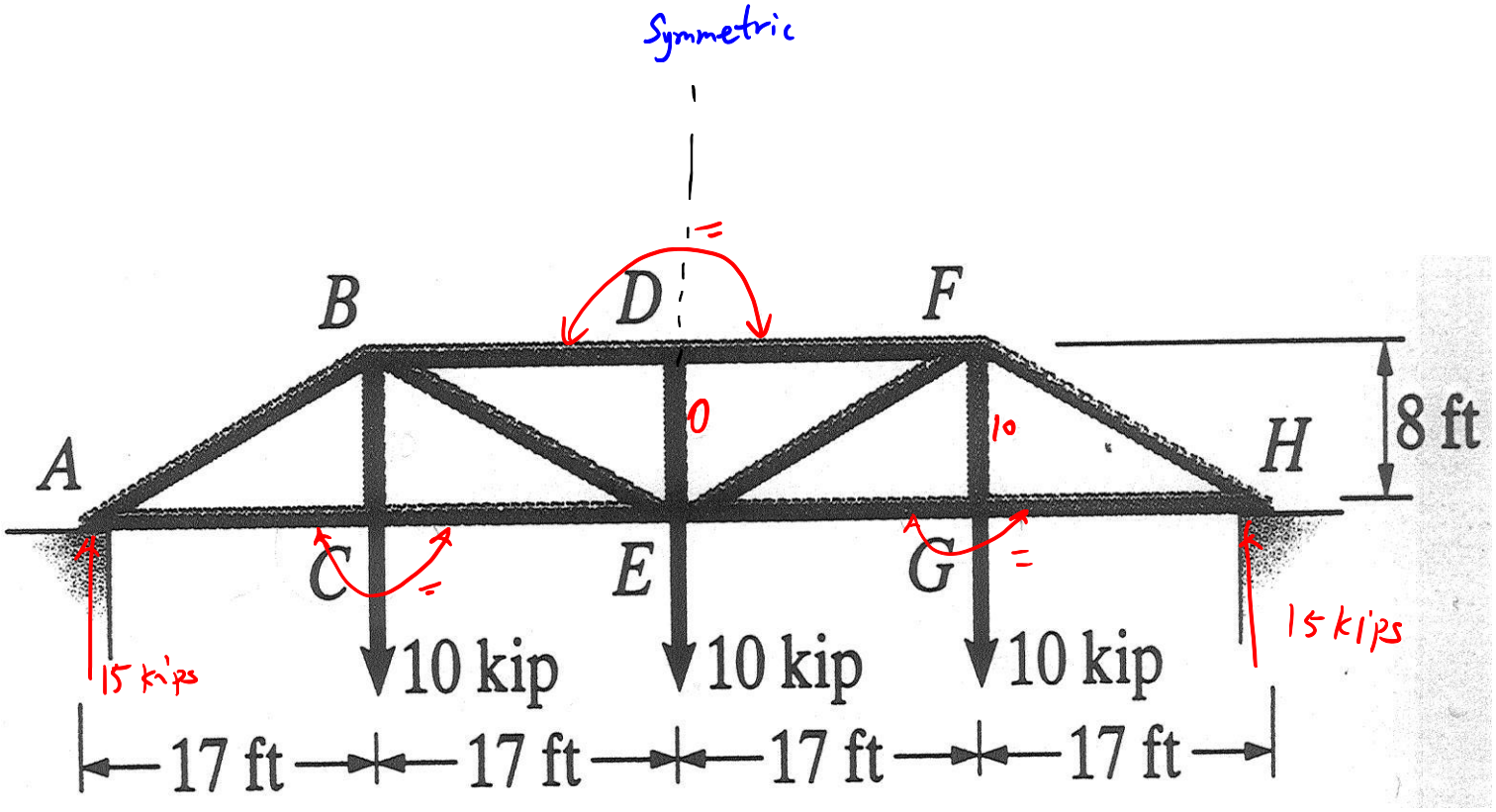
Example 1

Given: The truss shown is in static equilibrium.

Find: For the truss,

a) Identify all zero-force members by inspection.

b) State anything else you can determine about the truss by inspection.



Zero-Force Members

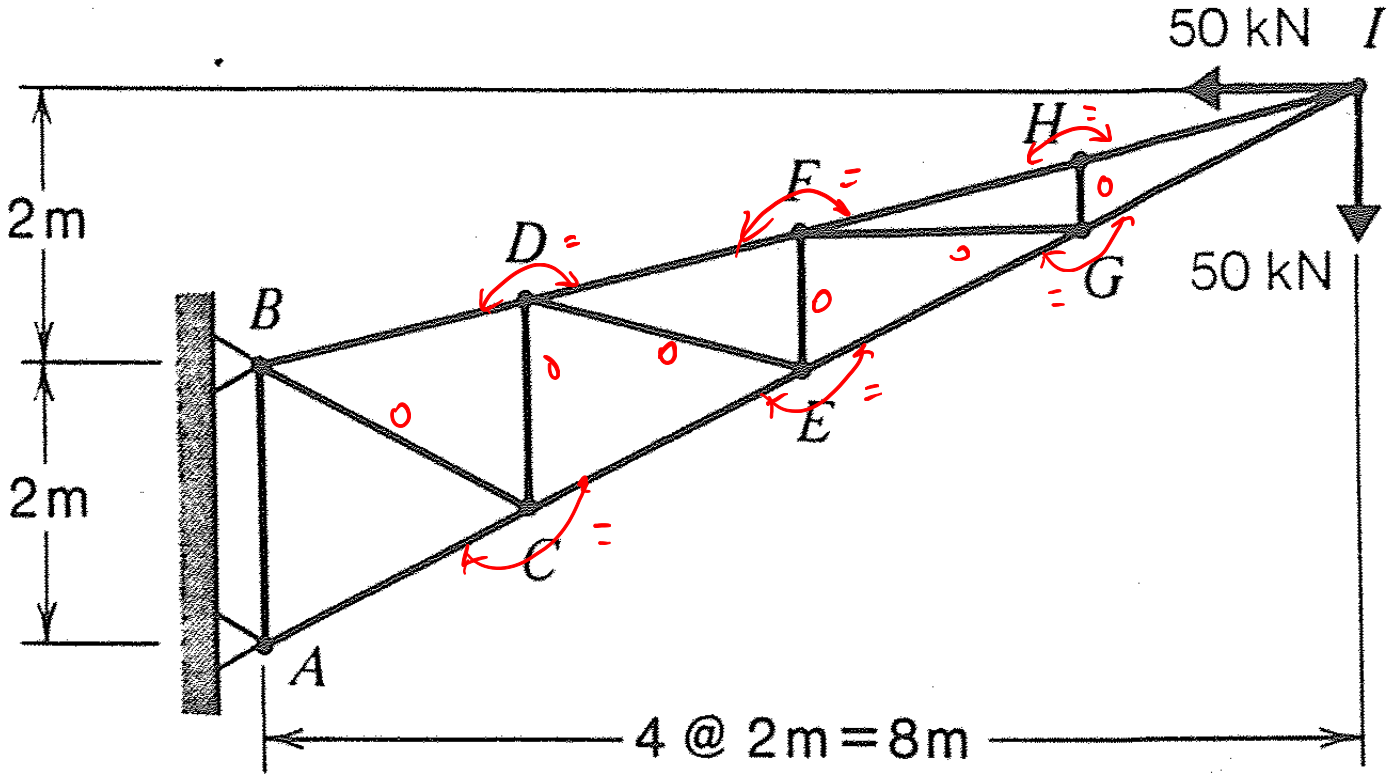
Example 2

Given: The truss shown is in static equilibrium.

Find: For the truss,

a) Identify all zero-force members by inspection.

b) State anything else you can determine about the truss by inspection.



Zero-Force Members

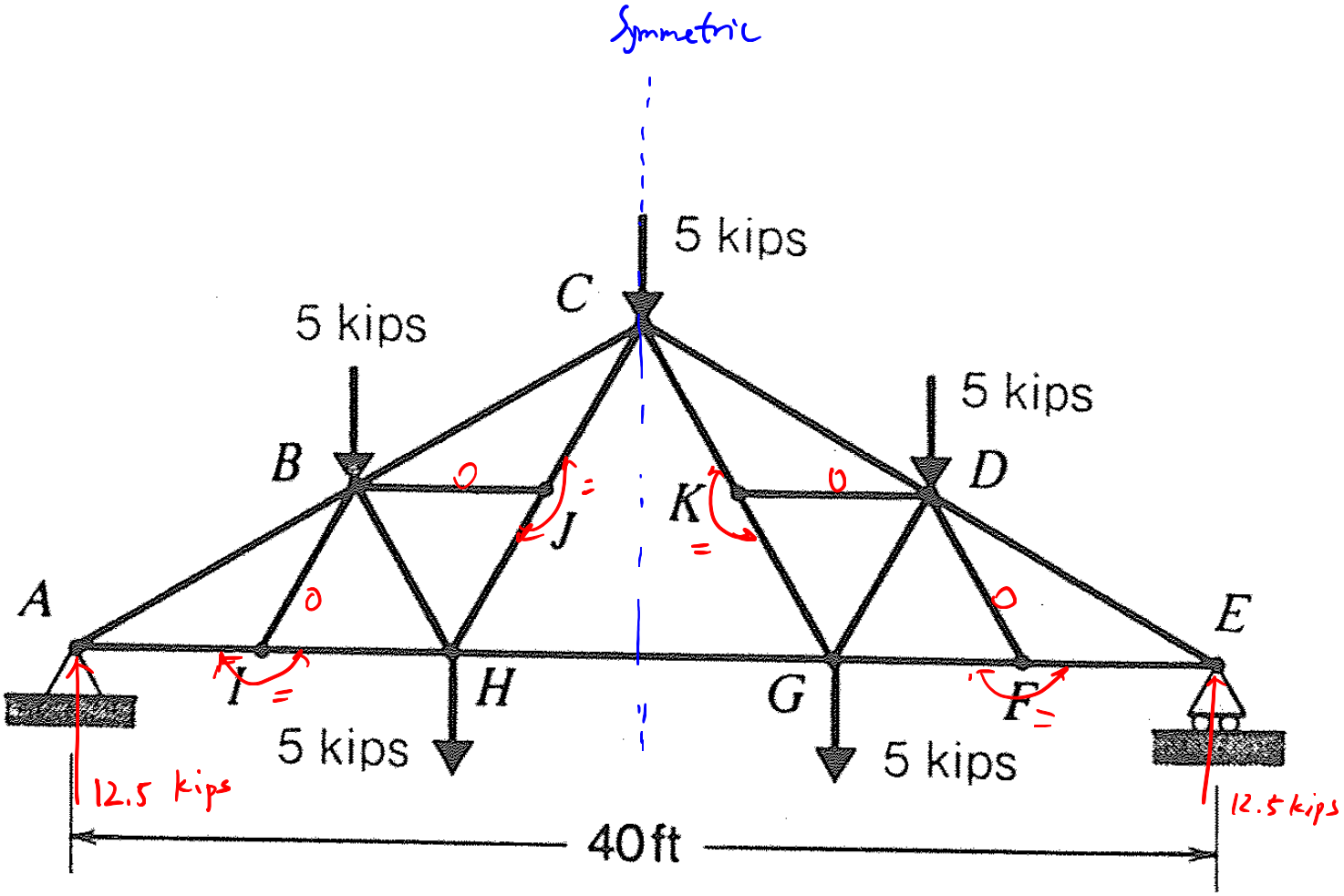
Example 3

Given: The truss shown is in static equilibrium.

Find: For the truss,

a) Identify all zero-force members by inspection.

b) State anything else you can determine about the truss by inspection.



Zero-Force Members

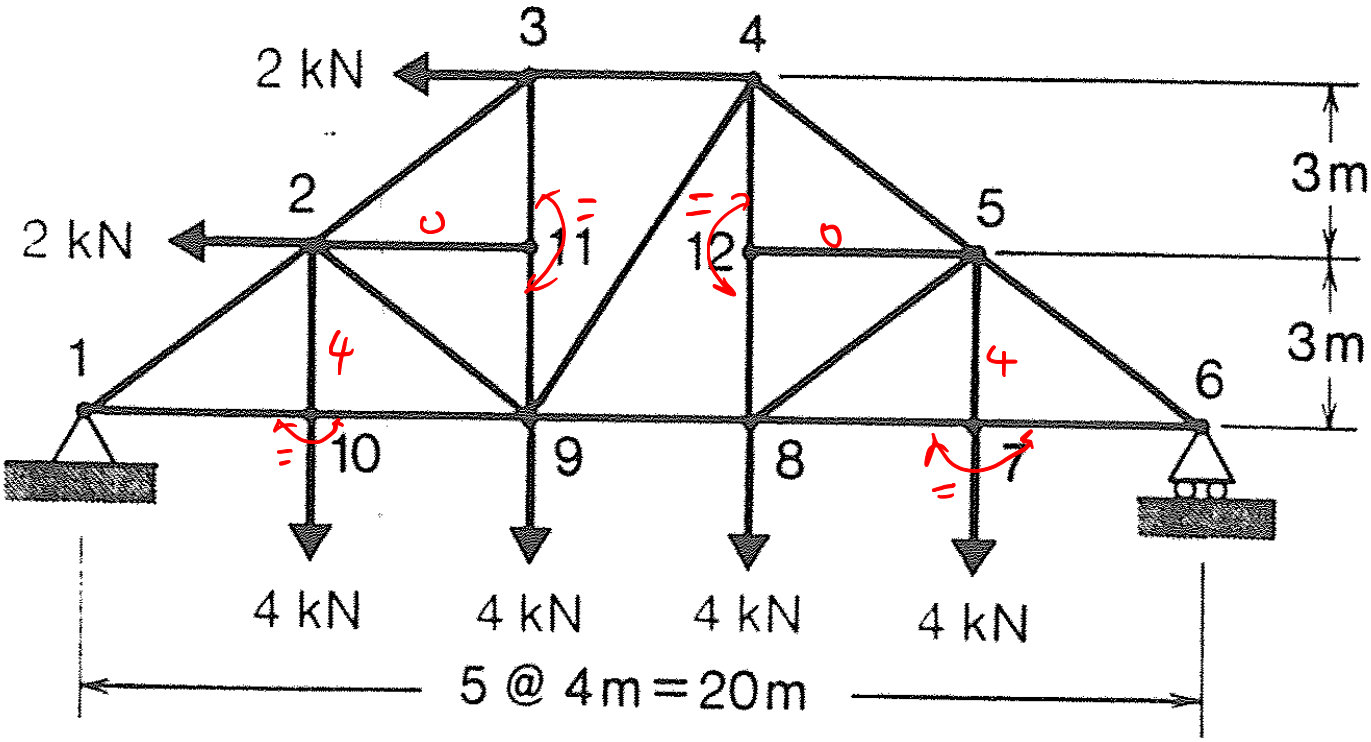
Example 4

Given: The truss shown is in static equilibrium.

Find: For the truss,

a) Identify all zero-force members by inspection.

b) State anything else you can determine about the truss by inspection.



Zero-Force Members

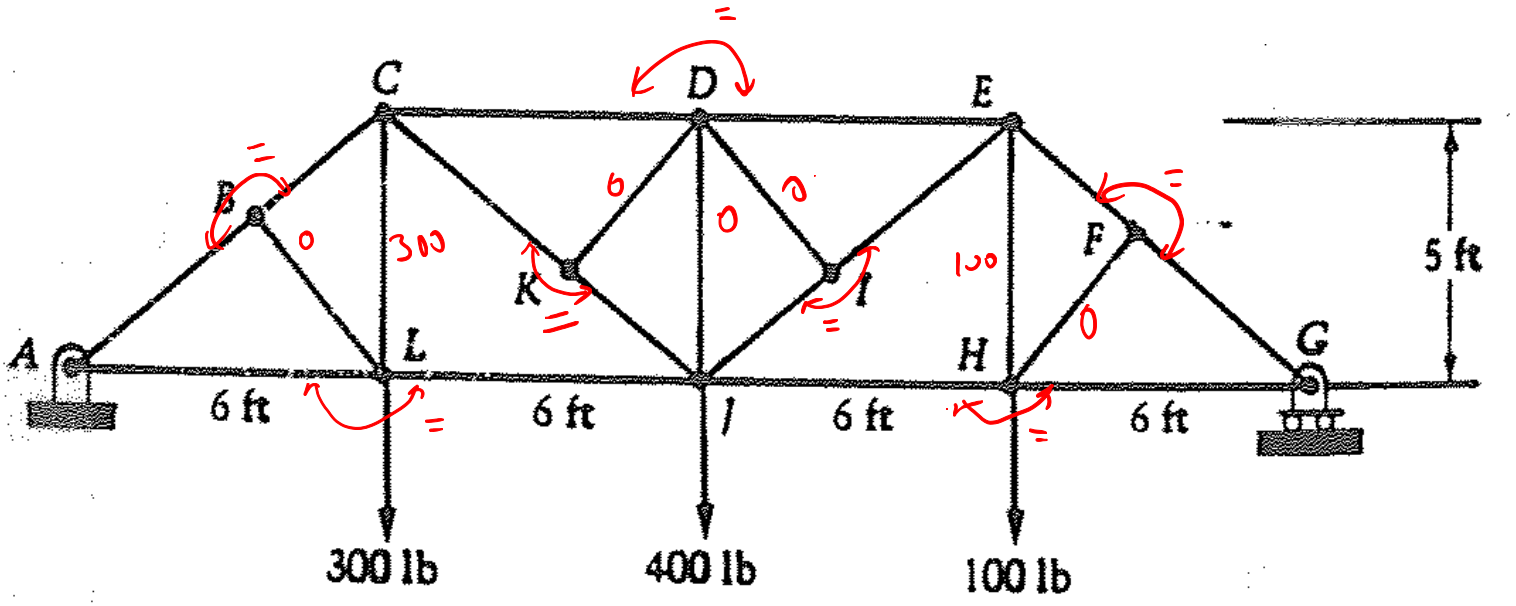
Example 5

Given: The truss shown is in static equilibrium.

Find: For the truss,

a) Identify all zero-force members by inspection.

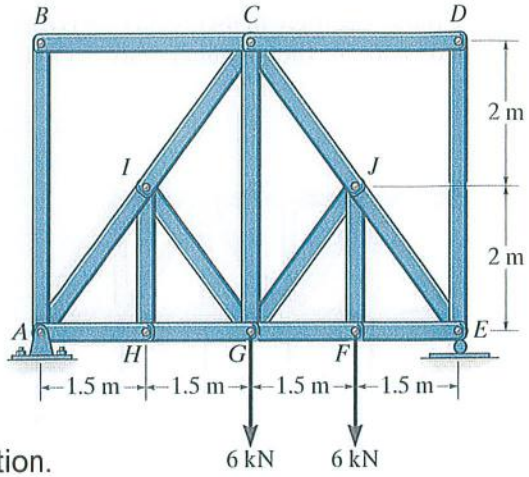
b) State anything else you can determine about the truss by inspection.



Zero-Force Members

Example 6

Given: The truss shown is loaded with two 6 kN forces and is held in static equilibrium by a pin support at A and a roller support at E.

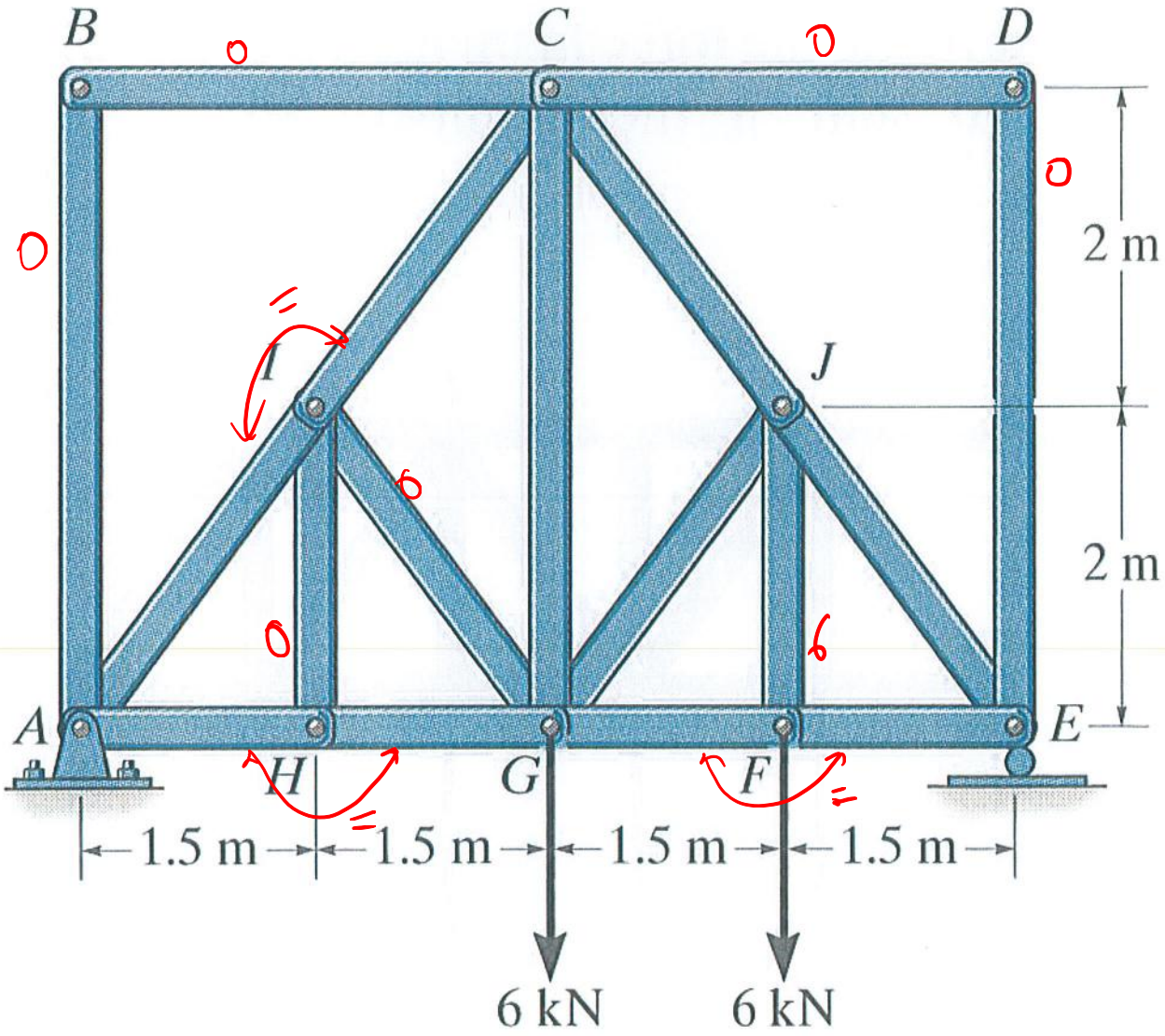


Find:

a) Identify all zero-force members in the truss by inspection.

b) Using your equations of static equilibrium, prove the members HI and IG are zero-force members.

c) Indicate any other members whose load can be identified or is equivalent to another member by inspection.


B
C
D
A
E
I
J
H
G
F
2 m
2 m
1.5 m
1.5 m
1.5 m
1.5 m
6 kN
6 kN

Zero-Force Members
Group Quiz 1

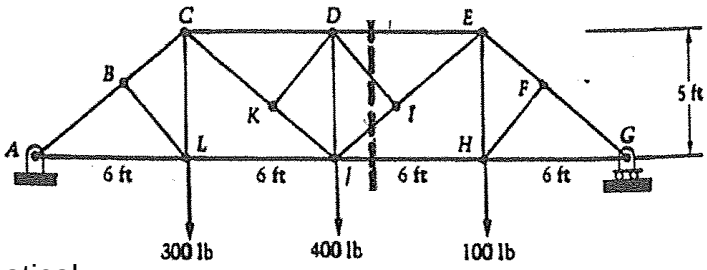
Group #: _____ Group Members: 1) _____
(Present Only)

Date: _____ Period: _____ 2) _____

3) _____

4) _____

Given: A truss is subjected to the loading shown.



Find:

a) Determine the reaction forces at support pin A and roller G.

b) Determine the load carried in members DE, DI, IJ, HJ. Be sure to show a mathematical justification for your answer. Indicate whether each member is in tension or compression.

c) Identify <u>all</u> zero-force members in the truss.

d) If an additional downward load were applied at joint D, would the force carried in
- member DI change or stay the same
- member DJ change or stay the same, and
- member DK change or stay the same.

Solution:

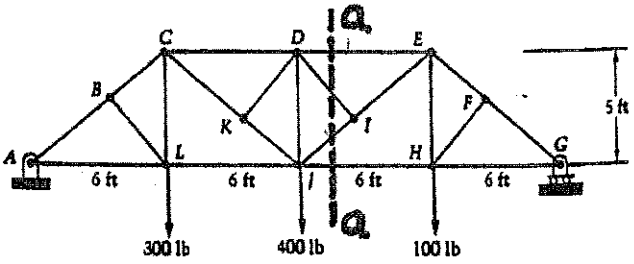
ME 270 - Basic Mechanics I - Group Quiz

Name/Group #: _____ Group Members: 1) _____ 2) _____

Date: _____ Period: _____ 3) _____ 4) _____

Given:

A truss is subjected to the loading shown.



Find:

(a) Determine the reaction forces at support pin A and roller G.

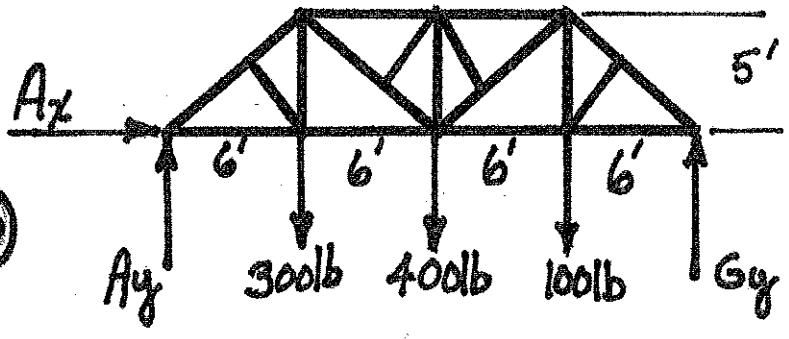
(b) Determine the load carried in members DE, DI, IJ, HJ. Be sure to show a mathematical justification for your answer. Indicate whether each member is in the tension or compression.

(c) Identify all zero-force members in the truss.

(d) If an additional downward load were applied at joint D, would the force carried in

- member DI change or stay the same, $F_{DI}=0$
- member DJ change or stay the same, and $F_{DJ}=$ Applied Load
- member DK change or stay the same. $F_{DK}=0$

Solution:



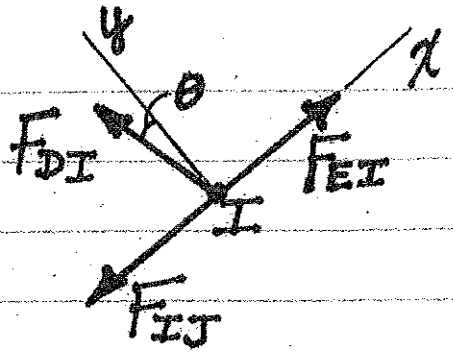
(a) $\Sigma M_A = 0 = -6(300) - 12(400) - 18(100) + 24(G_y)$

$\therefore \boxed{G_y = 350\,lb}$

$\Sigma F_x = 0 = A_x \Rightarrow \boxed{A_x = 0\,lb}$

$\Sigma F_y = 0 = A_y - 300 - 400 - 100 + G_y \Rightarrow \boxed{A_y = 450\,lb}$

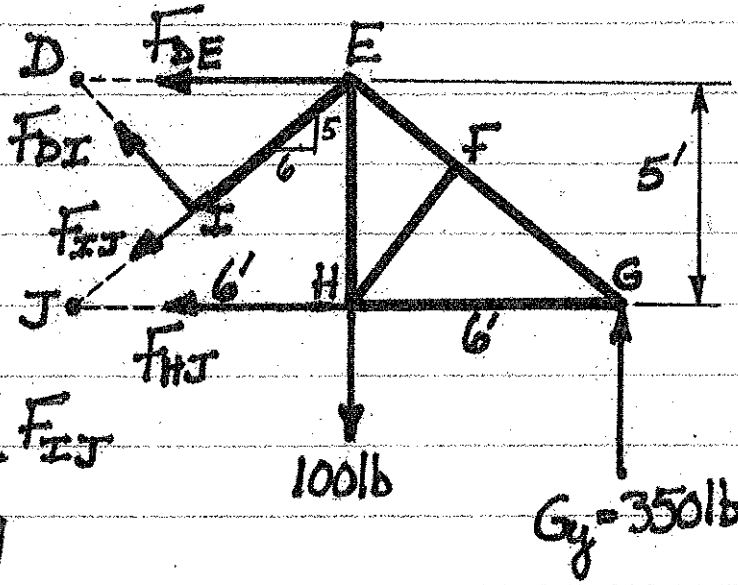
(b) Joint I



$\Sigma F_y = 0 = F_{DI} \cos\theta$

$\therefore F_{DI} = 0\,lb$

SECTION a-a



$\Sigma F_y = 0 = G_y - 100 - \frac{5}{\sqrt{61}} F_{IJ}$

$F_{IJ} = 391\,lb$ (T)

$\Sigma M_J = 0 = -6(100) + 12(350) + 5(F_{DE})$

$\therefore F_{DE} = -720\,lb = 720\,lb$ (C)

(c) ZERO-FORCE MEMBERS = $0 = F_{BL} = F_{DK} = F_{DI} = F_{FH} = F_{DJ}$

Also note: $F_{AB} = F_{BC}$; $F_{AL} = F_{JL}$; $F_{CK} = F_{JK}$;

$F_{CD} = F_{DE}$; $F_{EI} = F_{IJ}$; $F_{GH} = F_{HJ}$; $F_{EF} = F_{FG}$;
$F_{GL} = 300\,lb$; $F_{EH} = 100\,lb$.