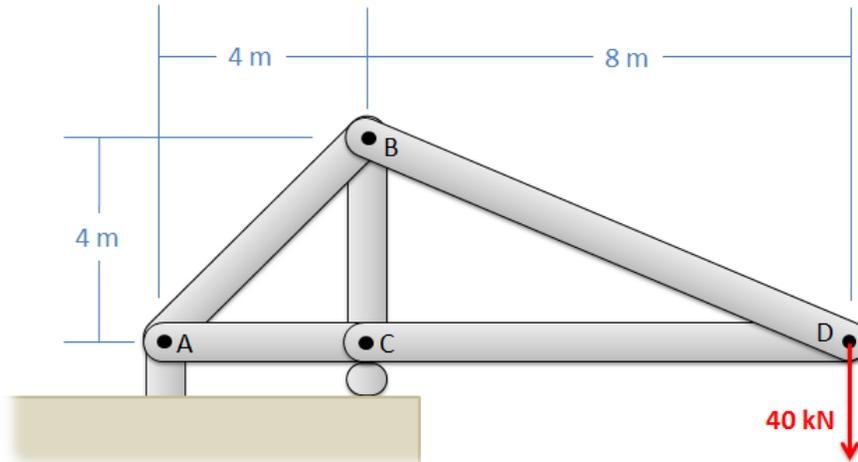


Chapter 5 Homework Problems

Problem 5.1

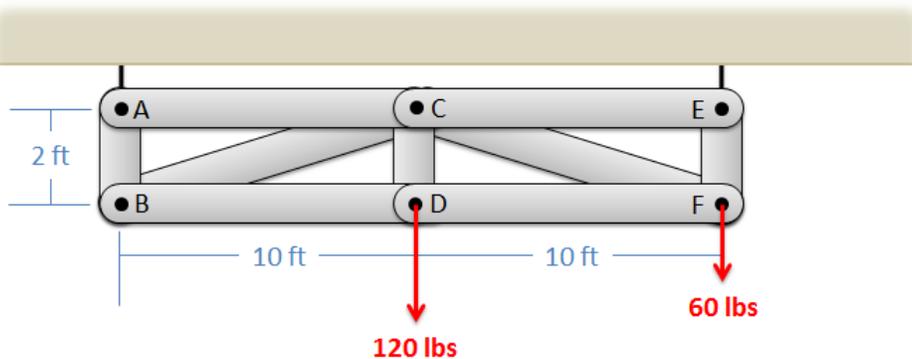
Use the method of joints to solve for the forces in each member of the lifting gantry truss shown below.



Solution: $F_{AB} = 113.14 \text{ kN T}$, $F_{AC} = 80 \text{ kN C}$, $F_{BC} = 120 \text{ kN C}$, $F_{BD} = 89.44 \text{ kN T}$, $F_{CD} = 80 \text{ kN C}$

Problem 5.2

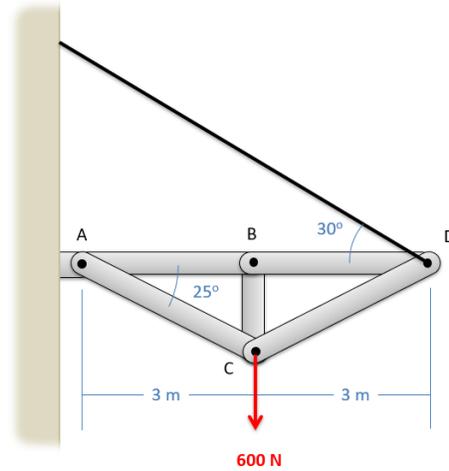
The truss shown below is supported by two cables at A and E, and supports two lighting rigs at D and F, as shown by the loads. Use the method of joints to determine the forces in each of the members.



Solution: $F_{AB} = 60 \text{ lbs T}$, $F_{AC} = 0$, $F_{BC} = 305.94 \text{ lbs C}$, $F_{BD} = 300 \text{ lbs T}$, $F_{CD} = 120 \text{ lbs T}$, $F_{CE} = 0$, $F_{CF} = 305.94 \text{ lbs C}$, $F_{DF} = 300 \text{ lbs T}$, $F_{EF} = 120 \text{ lbs T}$

Problem 5.3

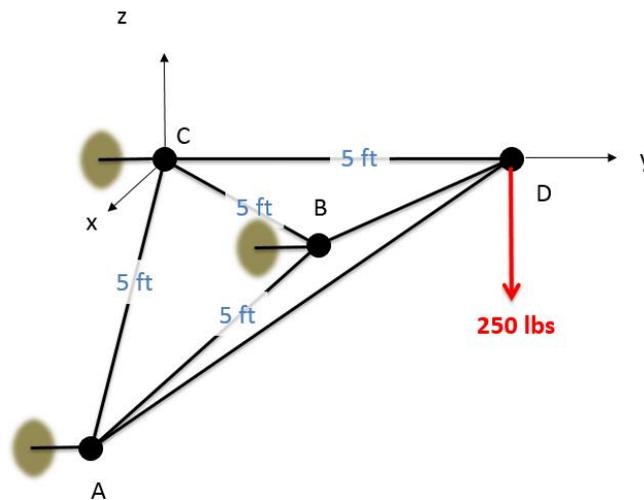
The truss shown below is supported by a pin joint at A, a cable at D, and is supporting a 600 N load at point C. Use the method of joints to determine the forces in each of the members. Assume the mass of the beams are negligible.



Solution: $F_{AB} = 1162.97 \text{ N C}$, $F_{AC} = 709.86 \text{ N T}$, $F_{BC} = 0 \text{ N}$, $F_{BD} = 1162.97 \text{ N C}$, $F_{CD} = 709.86 \text{ N T}$

Problem 5.4

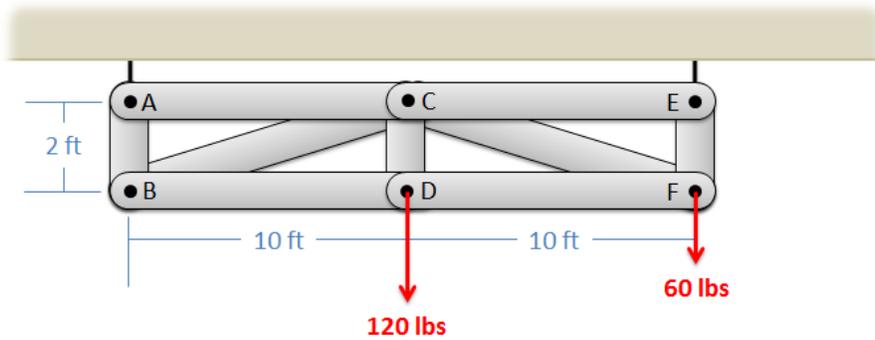
The space truss shown below is being used to lift a 250 lb box. The truss is anchored by a ball and socket joint at C (which can exert reaction forces in the x, y, and z directions) and supports at A and B that only exert reaction forces in the y direction. Use the method of joints to determine the forces acting all members of the truss.



Solution: $F_{AB} = 0$, $F_{AC} = 144.33 \text{ lbs T}$, $F_{AD} = 204.09 \text{ lbs C}$, $F_{BC} = 144.33 \text{ lbs T}$, $F_{BD} = 204.09 \text{ lbs C}$, $F_{CD} = 288.68 \text{ lbs T}$

Problem 5.5

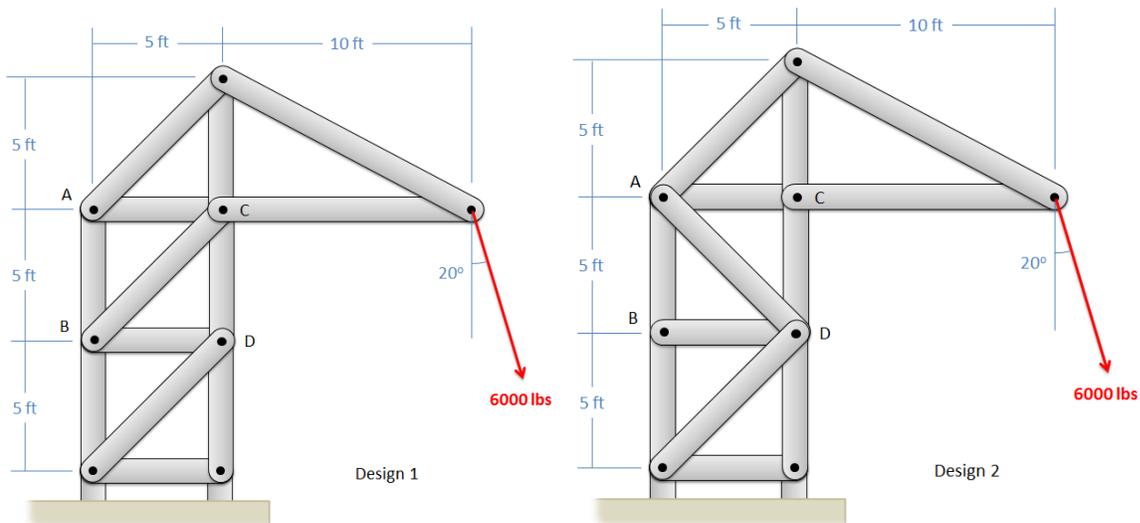
Use the method of sections to solve for the forces acting on members CE, CF, and DF of the gantry truss shown below.



Solution: $F_{CE} = 0$, $F_{CF} = 306.2$ lbs C, $F_{DF} = 300.2$ lbs T

Problem 5.6

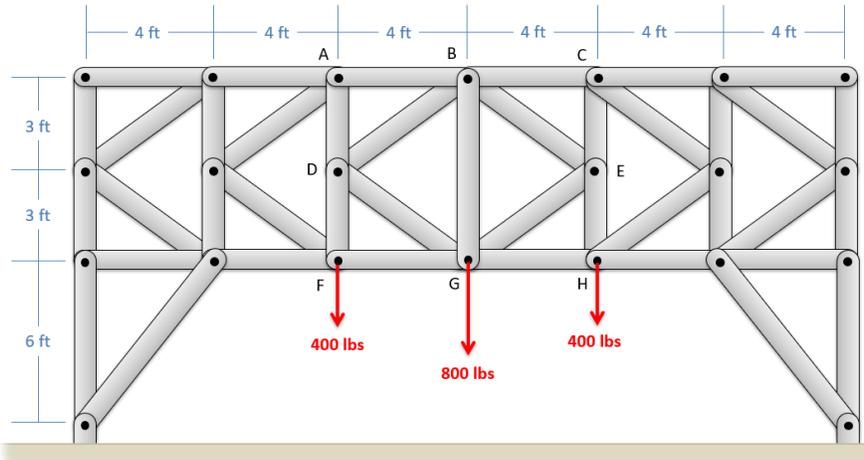
You are asked to compare two crane truss designs as shown below. Find the forces in members AB, BC, and CD for Design 1 and find forces AB, AD, and CD for Design 2. What member is subjected to the highest loads in either case?



Solution: Design 1: $F_{AB} = 11,276$ lbs T, $F_{BC} = 2,902$ lbs T, $F_{CD} = 18,967$ lbs C Design 2: $F_{AB} = 13,322$ lbs T, $F_{AD} = 2902$ lbs C, $F_{CD} = 16,914$ lbs C. The largest forces are in member CD for both designs.

Problem 5.7

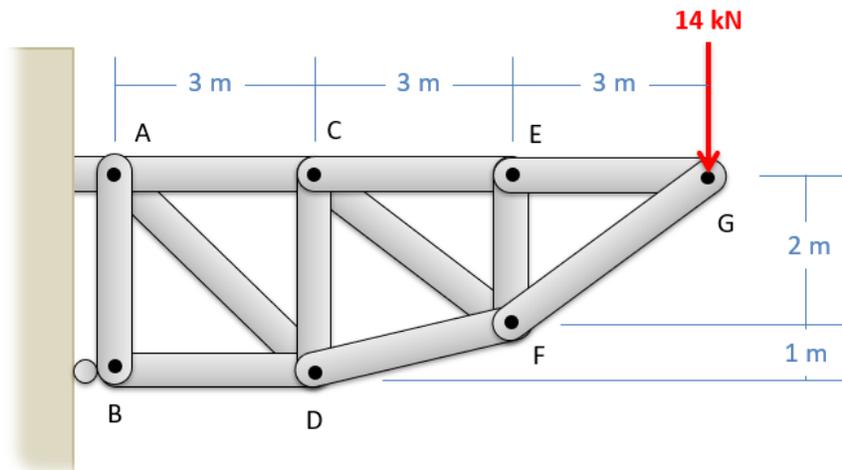
The K truss shown below supports three loads. Assume only vertical reaction forces at the supports. Use the method of sections to determine the forces in members AB and FG. (Hint: you will need to cut through more than three members, but you can use your moment equations strategically to solve for exactly what you need).



Solution: $F_{AB} = 1066.67 \text{ lbs C}$, $F_{FG} = 1066.67 \text{ lbs T}$

Problem 5.8

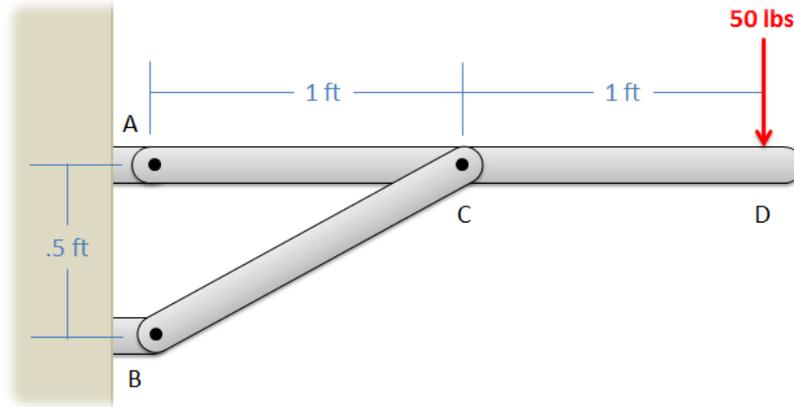
The truss shown below is supported by a pin support at A and a roller support at B. Use the hybrid method of sections and joints to determine the forces in members CE, CF, and CD.



Solution: $F_{CE} = 21 \text{ kN T}$, $F_{CF} = 8.41 \text{ kN T}$, $F_{CD} = 4.67 \text{ kN C}$

Problem 5.9

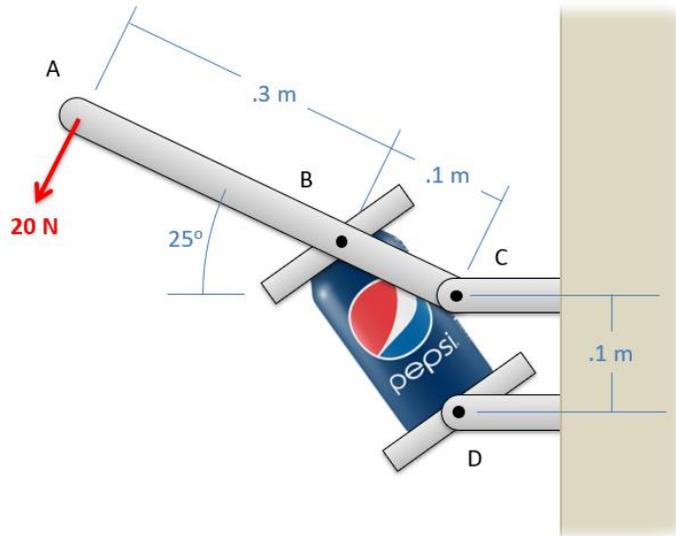
The shelf shown below is used to support a 50 lb weight. Determine the forces on members ACD and BC in the structure. Draw those forces on diagrams of each member.



Solution: $F_{BC} = 223.6$ lbs (Compression), $F_{AX} = -200$ lbs, $F_{AY} = -50$ lbs

Problem 5.10

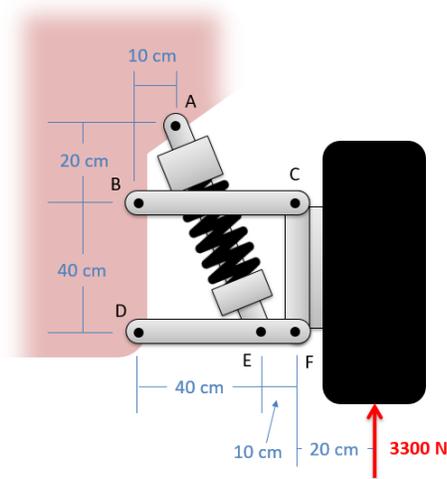
A 20 N force is applied to a can crushing mechanism as shown below. If the distance between points C and D is .1 meters, what are the forces being applied to the can at points B and D? (Hint: treat the can as a two-force member)



Solution: $F_{can} = 148.9$ N (Compression)

Problem 5.11

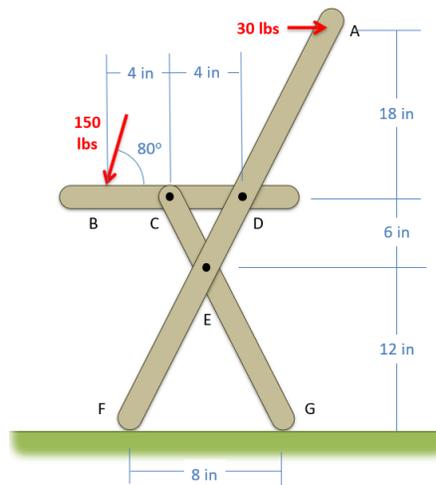
The suspension system on a car is shown below. Assuming the wheel is supporting a load of 3300 N and assuming the system is in equilibrium, what is the force we would expect in the shock absorber (member AE)? You can assume all connections are pin joints.



Solution: $F_{AE} = 4611.9 \text{ N}$ (Compression)

Problem 5.12

The chair shown below is subjected to forces at A and B by a person sitting in the chair. Assuming that normal forces exist at F and G, and that friction forces only act at point G (not at F), determine all the forces acting on each of the three members in the chair. Draw these forces acting on each part of the chair on a diagram



Solution: $F_F = 108.3 \text{ lbs}$, $F_{GX} = -3.95 \text{ lbs}$, $F_{GY} = 39.5 \text{ lbs}$, $F_{CX} = \pm 116.89 \text{ lbs}$, $F_{CY} = \pm 295.4 \text{ lbs}$,
 $F_{DX} = \pm 142.9 \text{ lbs}$, $F_{DY} = \pm 147.7 \text{ lbs}$, $F_{EX} = \pm 112.9 \text{ lbs}$, $F_{EY} = \pm 256.0 \text{ lbs}$