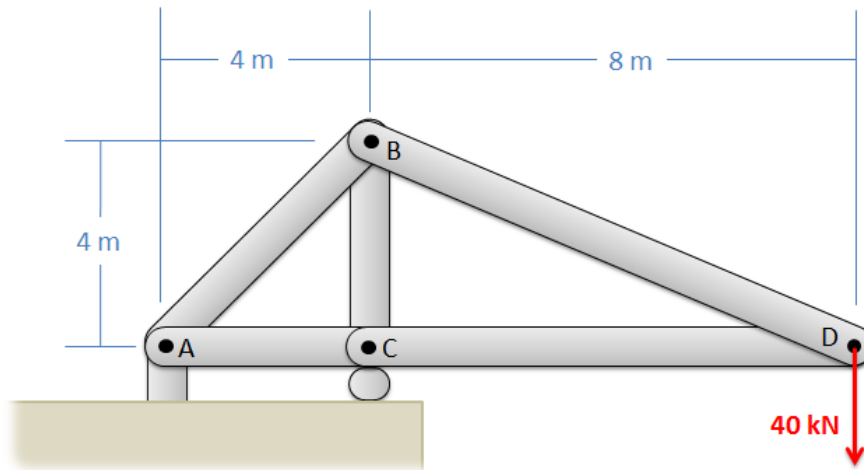Chapter 5 Homework Problems

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 kN T, F_{AC} = 80 kN C, F_{BC} = 120 kN C, F_{BD} = 89.44 kN T, F_{CD} = 80 kN C
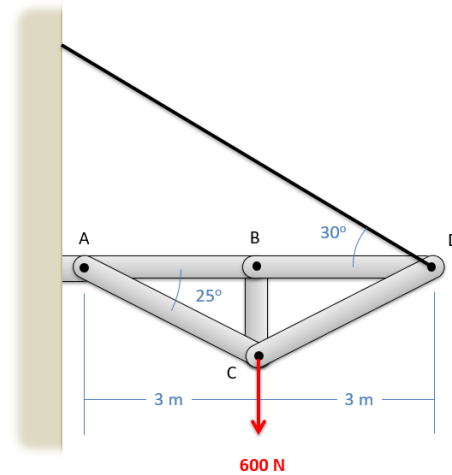
Problem 5.2

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.
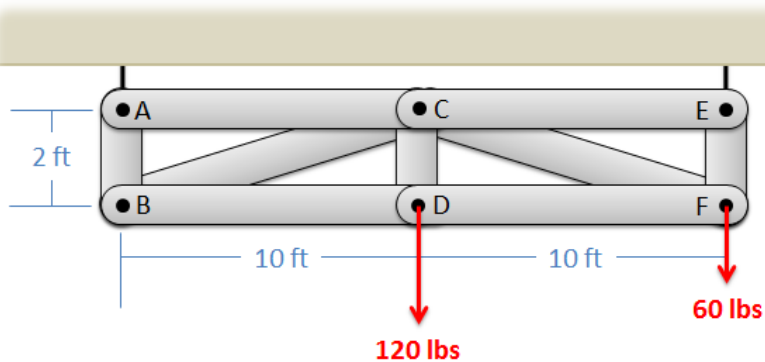
Solution: F_{AB} = 60 lbs T, F_{AC} = 0, F_{BC} = 305.94 lbs C, F_{BD} = 300 lbs T, F_{CD} = 120 lbs T, F_{CE} = 0, F_{CF} = 305.94lbs C, F_{DF} = 300 lbs T, F_{EF} = 120 lbs T
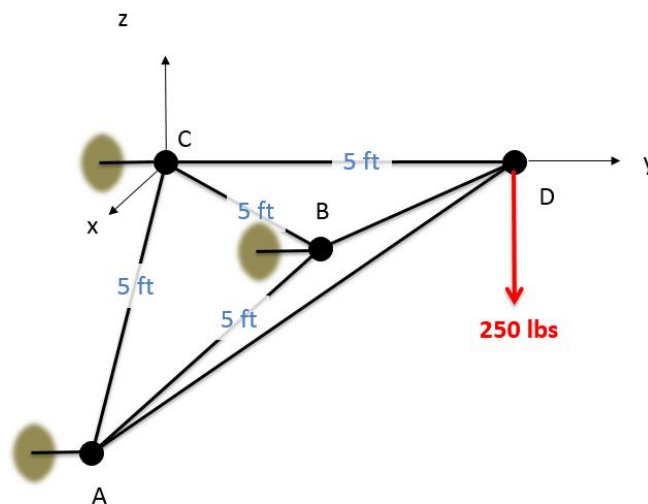
Problem 5.3

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 N C, F_{AC} = 709.86 N T, F_{BC} = 0 N, F_{BD} = 1162.97 N C, F_{CD} = 709.86 N T
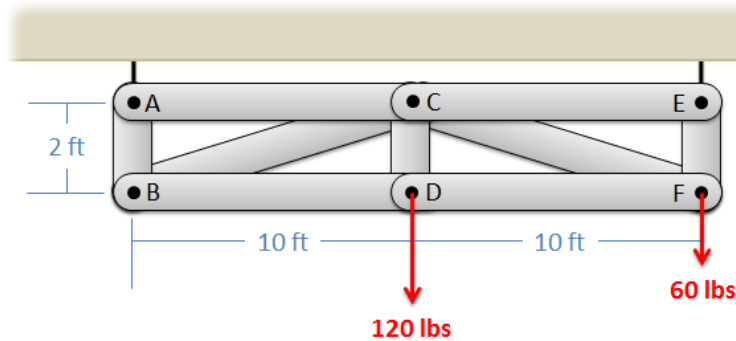
Problem 5.4

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 lbs T, F_{AD} = 204.09 lbs C, F_{BC} = 144.33 lbs T, F_{BD} = 204.09 lbs C, F_{CD} = 288.68 lbs T
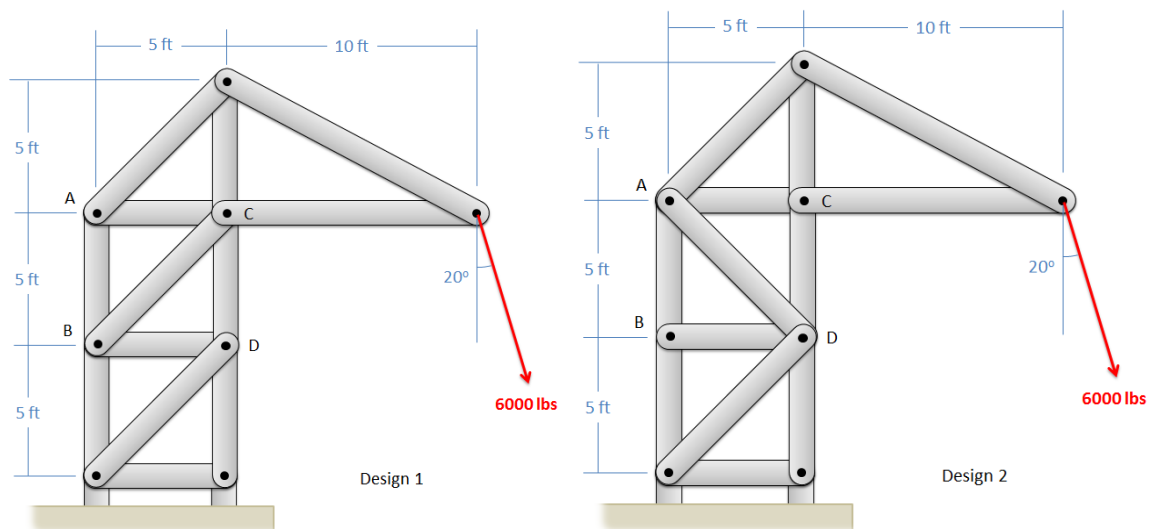
Problem 5.5

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.
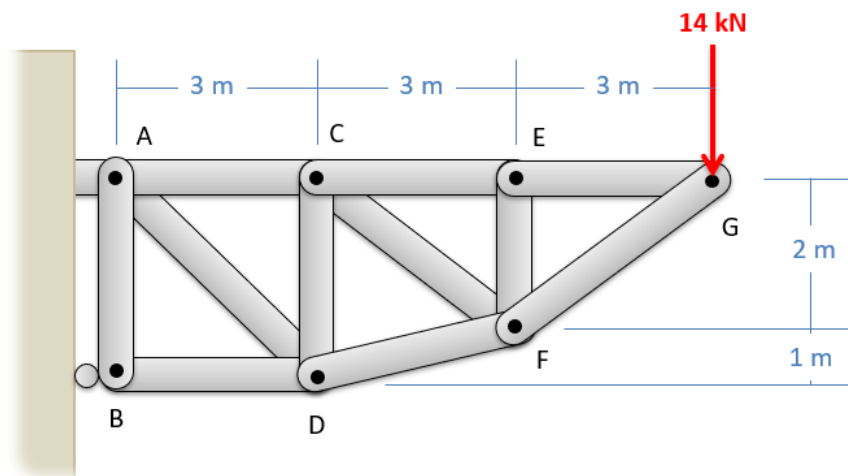
Problem 5.7

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).
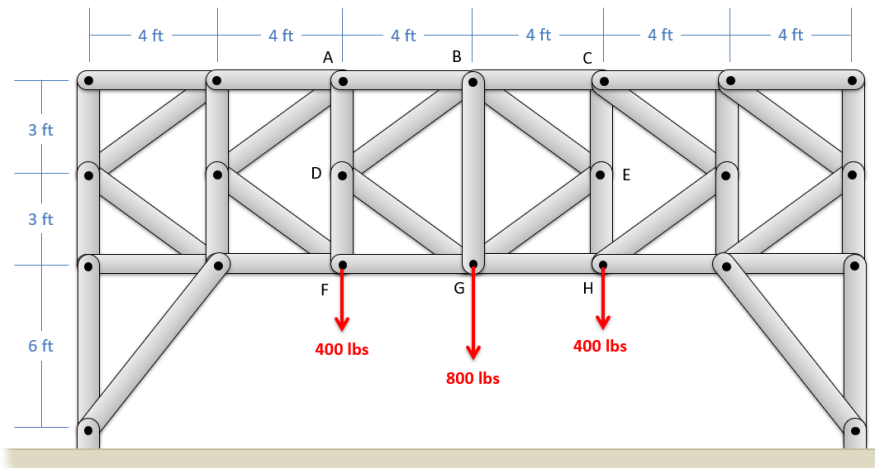
Solution: F_{AB} = 1066.67 lbs C, F_{FG} = 1066.67 lbs T
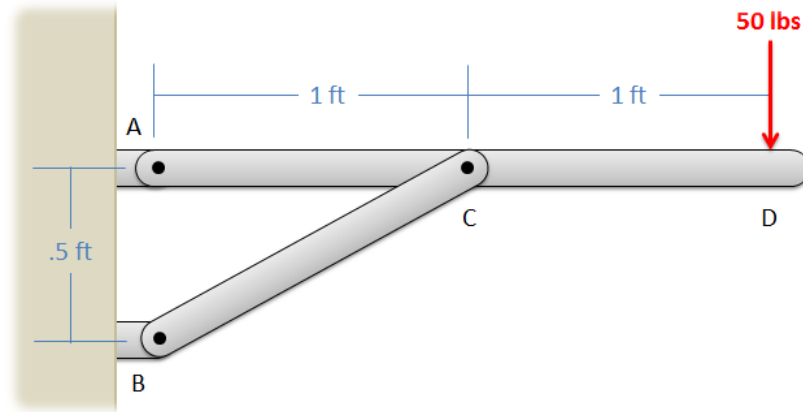
Problem 5.8

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 kN T, F_{CF} = 8.41 kN T, F_{CD} = 4.67 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
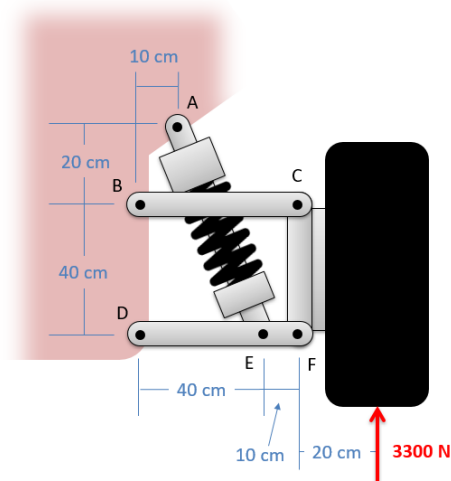
Problem 5.10

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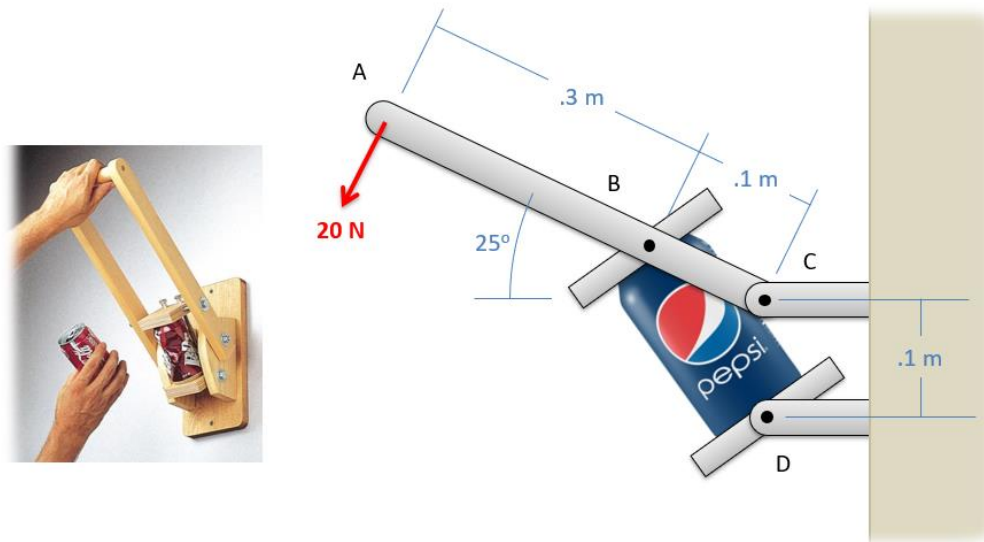
Solution: F_{can} = 148.9 N (Compression)

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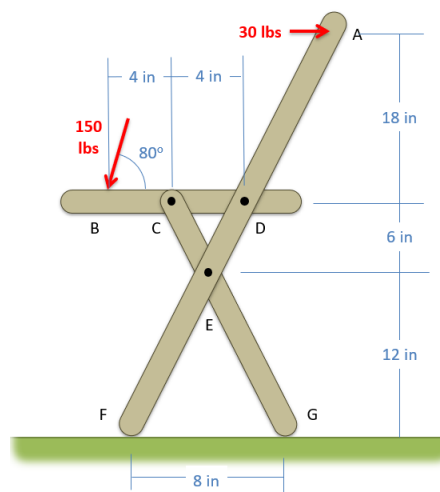
Solution: F_F = 108.3 lbs, F_{GX} = - 3.95 lbs, F_{GY} = 39.5 lbs, F_{CX} = ± 116.89 lbs, F_{CY} = ± 295.4 lbs, F_{DX} = ±142.9 lbs, F_{DY} = ±147.7 lbs, F_{EX} = ± 112.9 lbs, F_{EY} = ±256.0 lbs