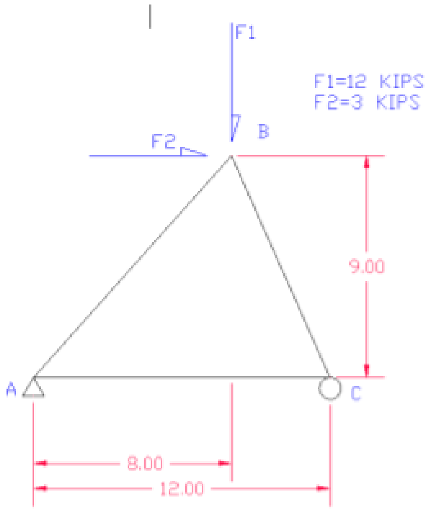
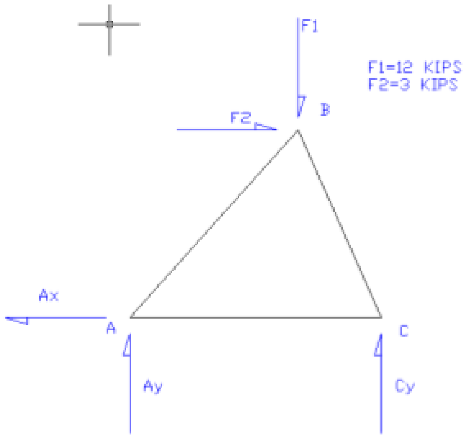
check it out - classic chapter 5-MOJ (that's method of joints) problem. basically - it's a concurrent force problem from chapter 4 (that's how we'll look at it).

first, let's define the problem. see the diagram of the original "truss" below.



note the original applied loads are at point "B" (12 kip and 5 kip, respectively)

refer to the figure at right for a free body diagram of the truss. note that the reactions (a pin and a roller at A and C, respectively, have been replaced by force vectors.



SOLUTION NOTES:
MOMENT SUM ABOUT "A"
YIELDS Cy=10.25 KIPS

MOMENT SUM ABOUT "B"
YIELDS Ay=1.75 KIPS

SUM Fy=0; SOLUTION
CHECKS

NOTE: SUM Fx=0 YIELDS
Ax=-3 KIPS

using techniques from chapter 4 of the text, a moment sum about A yields Cy=10.25 kips, and a moment sum about C yields Ay=1.75 kips.

as the only applied x-force is the 3 kip force at B, the pin joint must support this force. it's magnitude will be the same, its direction opposite to the applied x-force (the figure shows this).

method of joints solutions require that we start at a point on the truss (usually a reaction point) and work across the truss.

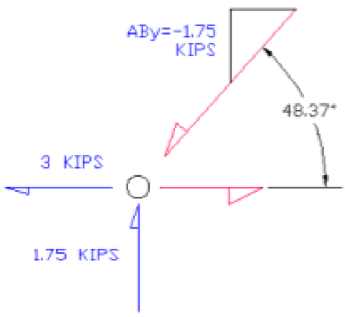
we can only have two unknowns (recall that we are working with concurrent force systems - moments (or torques) don't come into play.

we'll start at point A. the free body diagram is shown at right.

SOLUTION @ A:
FORCE SUM Fy=0
DETERMINES ABy & AB

FORCE SUM Fx=0
DETERMINES ACx & AC

NOTE: FORCES SUM TO ZERO. ALSO, ENSURE YOU INCLUDE ALL EXTERNAL FORCES AT THE JOINT.FOR POINT A, THIS INCLUDES THE 1.75 & 3 KIP REACTION FORCES.



next, we'll sum the vertical forces to determine AB. note that the vertical "component" of AB (ABy) must equal the vertical reaction (1.75 kips). we are saying that ABy must equal the reaction at A in magnitude. it's direction must be opposite, thus it must compress or push on the joint.

SOLUTION @ A:
FORCE SUM Fy=0
DETERMINES ABy & AB

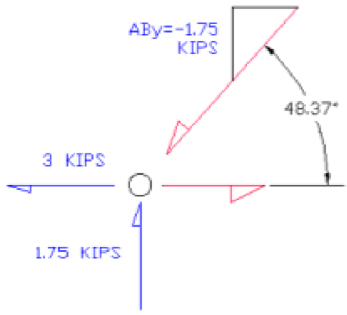
SUM Fy=0 (KIPS)
0=1.75-AB*SIN(48.37)
AB=2.34 KIPS (C)
(C) DENOTES COMPRESSIVE

as you might expect, the magnitude of AB must be a little larger than 1.75 so its vertical component equals 1.75.

note also that the sign of AB is positive. does this mean AB is positive? NO! what this means is that we have assumed the correct direction for AB. again, all it means is that we guessed correctly in assuming that AB was compressive, that it "pushed" on joint A.

next, we'll sum the horizontal forces to determine AC. note that the sum of the horizontal "components" of AB (ABx), AC, and the -3 kip reaction force must equal 0. since we know AB now, we can solve for AC (or ACx - they are the same as AC aligns with the positive x-axis).

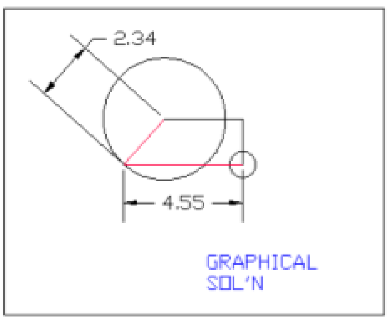
as AB is compressing on the joint, the magnitude of AC must equal the sum of the 3 kip reaction and the horizontal component of AB. it's direction must be opposite to these, thus it must be tensile, or pull on t joint. the diagram at right assumes this.



SOLUTION @ A:
FORCE SUM Fx=0
DETERMINES ACx (OR
AC-THEY ARE THE SAME
BECAUSE AC ALIGNS WITH
THE POSITIVE X-AXIS)

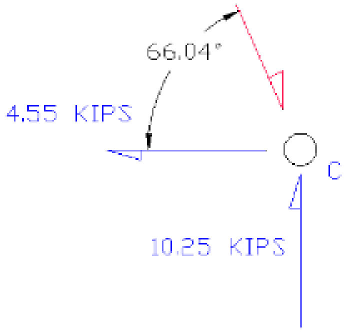
SUM Fx=0 (KIPS)
0=-3-AB*COS(48.37)+AC
0=-3-1.55+AC
AC=4.55 KIPS (T)
(T) DENOTES TENSILE

as the above shows, AC=4.55 kips (T). the assumptions for both AB and AC are correct. now we are ready to go to the next joint. we'll select C, since it's a little easier to handle. once we've completed analysis at C, we'll check our solutions with a force sum at B.



the diagram at left summarizes results for joint A. the small circle is the origin. the reactions are added in, followed by AB (2.34 kips) and AC (4.55 kips). as you can see by the diagram, I "finish" where I started. that is the essence of statics.

at joint C there is only one unknown - that is CB. CA is known (see figure) from the analysis at joint A. note how CA is drawn in the figure. as it is tensile (see joint A solution) it remains tensile here. since it "pulls" on the joint, its direction must be in the negative x-direction. we'll use this information to help us determine CB.



the diagram for joint C is at left.
note that there is only one unknown.

SOLUTION @ C:
FORCE SUM Fy=0
DETERMINES CBy & CB

FORCE SUM Fx=0
UNNECESSARY - ALREADY
KNOW DETERMINES CA

NOTE: FORCES SUM TO
ZERO. ALSO, ENSURE YOU
INCLUDE ALL EXTERNAL
FORCES AT THE JOINT. IN
THIS CASE THE 10.25 KIP
REACTION FORCE SHOWS.

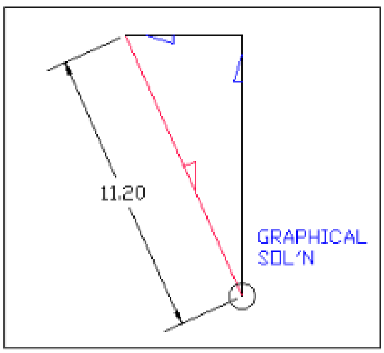
the note at left summarizes the solution for joint C - note again that only external forces (e.g. the 10.25 kip reaction at C) are included in this joint analysis.

SOLUTION @ C:
FORCE SUM Fy=0
DETERMINES CBy & CB

SUM Fy=0 (KIPS)
0=10.25-CB*SIN(66.04)
CB=11.22 KIPS (C)
(C) DENOTES COMPRESSIVE

note the solution at left. the angle reference comes from the figure above. and the positive answer indicates that we selected the proper direction for CB. note that if we had gotten a negative answer, it would have meant that our actual direction for CB should have been 180 degrees from our assumption.

see the graphical solution for joint C at right. as there is only one unknown, the graphic is straightforward.



now, we'll check our solution at joint B.

we'll sum forces in the vertical and horizontal directions. if they both sum to zero, then we're good to go.

CHECK SOLUTION @ B:
CHECK FORCE SUM Fy=0

NOTE: FORCES SUM TO ZERO. ALSO, ENSURE YOU INCLUDE ALL EXTERNAL FORCES AT THE JOINT. IN THIS CASE THE 12 KIP & 3 KIP EXTERNAL FORCES SHOW IN FORCE SUMS.

CHECK SOLUTION @ B:
FORCE SUM Fy=0

SUM Fy=0 (KIPS)
0=-12+ABy+CBy
0=-12+2.34*SIN(48.37)+11.22*SIN(66.04)
0=0 CHECKS OE

CHECK SOLUTION @ B:
FORCE SUM Fx=0

SUM Fx=0 (KIPS)
0=3+AB*COS(48.37)-CB*COS(66.04)
0=3+2.343*COS(48.37)-11.22*COS(66.04)
0=0 CHECKS OE

examine the graphical solution at right. again, the small circle is the origin. the applied forces (-12 kip vertical, 3 kip horizontal) are shown in the figure. the 11.22 (C) and the 2.34 kip (C) are added. as you can see from the figure, they sum to zero. thus, the solution checks.