Engineering Statics HW 3 Notes

In most of these problems it is extremely useful to write out the sum of forces and moments where each is equal to zero. Example:

$\Sigma Fx = 0 = Ax$
$\Sigma Fy = 0 = Ay - 200 - 600 + B$
$\Sigma M_A = 0 = -200*3 - 600*15 + B*21$ (moments about point A)

This way you may be able to see easy-to-solve equations quickly. They may be thought of as "relationship" equations or expressions because they describe the relationships between the various forces, distances and angles.

1. The pin connection at A has two unknowns, leaving the force at B. Sum the moments about point A, solving for the vertical reaction force at B. Now solve for the sum of forces in the y direction, solving for the vertical component of reaction A. Summing the forces in the x direction should give you Ax equal to zero.

2. If you wrote the relationship equations as previously directed (above) you should notice that taking the sum of moments through point A eliminates the forces at A, allowing you to focus on the force BC. (The force BC can be written in a fractional notation, where BCx= 4/5 BC, and BCy=3/5 BC .) Notice that the horizontal component of force BC can be ignored because it passes through point A. Once you have the magnitude of the force BC, the forces at A are straight forward.

3. Use the free body diagram to write your relationship equations. If you take the sum of moments about point C then you are able to ignore forces B and CD. This leaves just force A. And remember that cos45 = sin45. Don't forget to include the applied moment in your moment equation.

4. Use the free body diagram to write your relationship equations. You may want to take the sum of moments about point A because the reaction force at A can be ignored and you get the force at B immediately. Solving for the reaction forces at A should be pretty straight-forward.

5. In this problem the force at A shares the same geometry as the crane arm, thus ***A***=A cos(60) ***I*** + A sin(60)***j***. Knowing this you can sum the forces in the x direction to get BC in terms of A. Summing force in the y direction and substituting for BC you can get the magnitude of A, and substitute back into the first equation to get BC. It all becomes much more obvious if you write out the equations for the sum of forces in both the x and y direction.

6. Write out the sum of forces in the x and y direction (equal to zero), and the sum your moment about point B (also equal to zero) because there are two unknowns that pass through B. Solve the force at A. Substitute to get Bx. Solve for By.

7. Write out the sum of forces in the x and y direction (equal to zero), and the sum your moment about point A (also equal to zero) because there are two unknowns that pass through A. Sum the forces in the y direction giving you Ay. Solve for the moment about A giving you the force at B. Solve for the force Ax.

8. Write out the sum your moment about point A (equal to zero). We are not interested in point A, so why calculate the force at A.

9. The magnitude of the force on the wench is the applied force, 4 lbs. The moment Mz will be F*cos(30) at a distance of 14 inches.

10. Because of geometry we can see that the force at point B, the line in tension from B to E (BE) is in the yz plane intersecting along the z axis 5 ft above A. The length of this distance can be determined using the Pythagorean theorem Sqrt($10^2 + 5^2$) or 11.18. Summing the forces at A in the x , y and z direction, we can see that Ax is zero.
    Ay will be the fraction of BE, or BE*11.18/10, or $\Sigma Fy = 0 = Ay - BE*11.18/10$.
    Summing the forces in the z direction we see that $\Sigma Fz = 0 = BE*11.18/5 + Az$.
    The tension in the cable, CED, can be calculated once you know the tension in cable segment BE. Using the free body diagram provided, use geometry or trig to calculate the angle formed by the cable at C. You can then use regular vector methods for determining the tension in the cable.

11. The reaction forces are can be calculated using the sum of forces. The moments can be determined using cross products or equivalent methods. When in doubt, use cross products.