FRAMES ANALYSIS STEPS

1. Read the question and identify any 2-Force members in the frame.
2. Identify the external reactions – identify any pin supports where two members are connected by a common pin (when you substructure, include a FBD of this pin)
3. Identify any pins connecting 3 members of the frame. (This can include a pulley) (when you substructure, include a FBD of this pin)
4. Draw a separate FBD of the entire frame*. (DO NOT USE THE FIGURE GIVEN IN THE PROBLEM STATEMENT AS THE FBD) Write the equilibrium equations for the frame.
   Solve for **any** of the external reactions that you can.
   - Note – if pulleys are attached to the frame, before drawing the FBD of the entire frame, you may first draw separate FBDs of the pulleys and determine the pin horizontal and vertical reactions on the pulley. These are applied opposite (Newton's 3rd Law) on the FBD of the entire frame.
5. Draw each of the frame (in one location on your paper). Include any pins from Steps 2 &3. These will be the FBDs for each member of the frame. They are separate rigid bodies to which we will apply the equilibrium equations
6. Place all external loads any external reactions calculated from Step 4 on the FBDs drawn in Step 5.
   - If an external load (force) is applied at a pin connecting two frame members, apply that load to either of the members (BUT NOT BOTH). If the load is applied at a pin where three members are attached, you have drawn a FBD of that pin so apply the load to the pin.
7. Now apply Newton's 3rd Law placing "ACTION" and "REACTION" forces on the member FBD'
   - Note where two members are connected by a common pin. Apply Newton's Third Law "Member-to-Member". Where three members are connected by a common pin, you have drawn a FBD of that pin so Apply Newton's Third Law "Member-to-Pin"
   - IMPORTANT – If you have 2-force members in the frame, DO NOT SHOW FOUR UNKNOWN FORCES (2 at the pins at either end of the two force member). For a 2-force member label the force at one end and call the force at the other end the same with opposite sense. The line of action will be the line connecting the pins at either end of the two force member. For a two force member there is only one unknown NOT four!!!
8. Before starting the analysis, in your mind put the frame back together, ALL ACTION REACTION pairs must cancel or Newton's Third Law has been applied incorrectly. You should match the FBD of the entire frame from Step 4. Once you are satisfied NEVER TOUCH THESE AGAIN (DO NOT PLACE RESULTS ON THESE FBDs)!!!!!!!!!!
9. Pick one of the FBDs where you can determine at least one of the unknown Action-Reaction Forces by applying the equilibrium equations.
   - If your FBDs include a pulley do the pulley first – you will always be able to determine the pin reactions on the pulley
   - Next look for a FBD where there are no more than 3 unknown reaction forces. With 3 equilibrium equations you will be able to solve for all unknowns

- If you cannot find a member where there are only 3 unknown reaction forces, see if there is a member where you can apply the equilibrium equations to determine at least one of the unknowns. (Often the moment equation may be applied to a horizontal or vertical member to isolate one of the unknowns)
- If you are still unsuccessful, look for two members where you can apply the moment equation to each so that you get two equations in two unknowns.

10. Using results from Step 9 go to another FBD. REDRAW THE FBD placing results from Step 9 on the new FBD with the correct sense. Apply the equilibrium equations.
11. Repeat Steps 9 & 10 until all unknowns are determined
    - NOTE when working with a member or pin FBD and you determine the magnitude and direction of a force, you must also say what member or pin that force is acting on since it will be opposite on another member
12. CHECK YOUR WORK. – Draw new FBDs with all force indicated. Each FBD MUST be in equilibrium. Apply the moment equation about a different point