Frames are rigid structures designed to support loads, while **Machines** generally contain moving parts and are designed to alter force. Unlike trusses, the components of frames and machines are not necessarily two-force bodies, so we can not assume that the force acting on a member acts in a known direction.

Both are solved by first constructing Free Body Diagrams for the structure as a whole and for each part of the structure. The principle of action and reaction must be carefully applied when constructing the FBDs. Once the FBDs are correct, apply the principles of equilibrium to solve for the unknown forces. Each free body diagram will provide three equations, and permit you to solve for three unknowns

Typical Procedure:

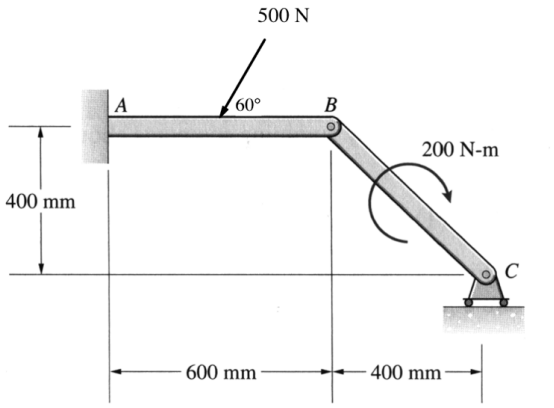
1. Draw and number free body diagrams of the structure and each of its parts.
2. Decide on a strategy to apply the equations of equilibrium to the FBDs. Plan your approach before you begin.
3. Solve. Indicate which FBD applies when writing equilibrium equations.

Hints:

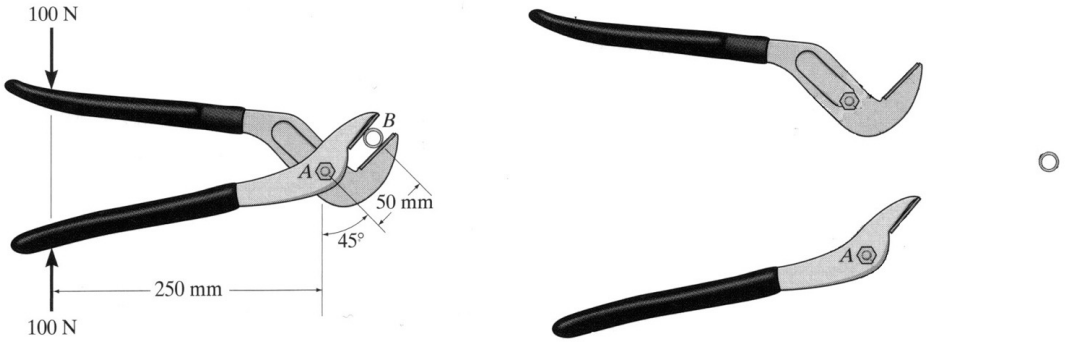
1. Look for two force bodies and show forces acting on those along the known line-of-action.
2. Ensure that all forces on the diagrams are consistent with the supports and are consistent with each other.
3. Look for free body diagrams with only three unknowns and solve them first.
4. If there is no FBD with only three unknowns you may still be able to solve for one unknown if the remaining unknowns on the diagram intersect at a common point.
5. If all else fails, you may have to solve two equations simultaneously to determine the forces.
6. After a force is determined, carry its value over to other diagrams to reduce the number of unknowns there.

Example 1 — Frame

Determine the reaction at fixed connection A for the frame shown. Assume that the loads are applied at the midpoints of the members.

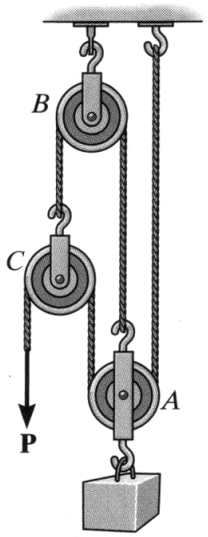


Example 2 — Machine



Example 3 — Machine

Determine the force *P* required to support the 200 lb. weight.



Example 4 — Frame

Determine all forces acting on member ABCD of the frame shown.