

Free-Body Diagram Construction

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General Procedure for the Construction of Free Body Diagrams

- Choose the free body to isolate;
- Isolate the body from all of its surroundings;
- Magnitudes and directions of all known and unknown forces acting on the body should be included and clearly indicated;
- Dimensions should be indicated on the FBD.

Most errors in mechanics problems result from a mistake in the FBD

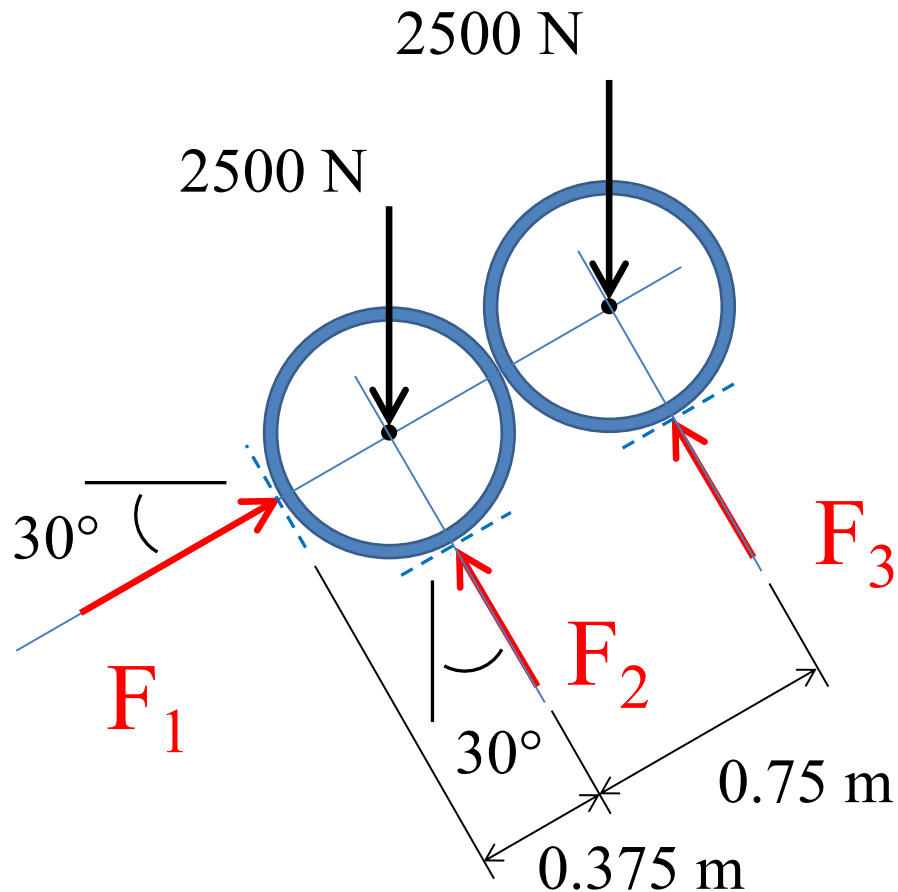
Free-Body Diagram Construction Example

Two smooth pipes of diameter 0.75 m, each having a weight of 2500 N, are supported by the forked tines of the tractor shown in the photo. The tines of the tractor are inclined 30 degrees with the horizontal.

Draw free-body diagrams of: 1) both pipes together; and 2) each pipe separately.



1) Free-Body Diagram of both pipes together



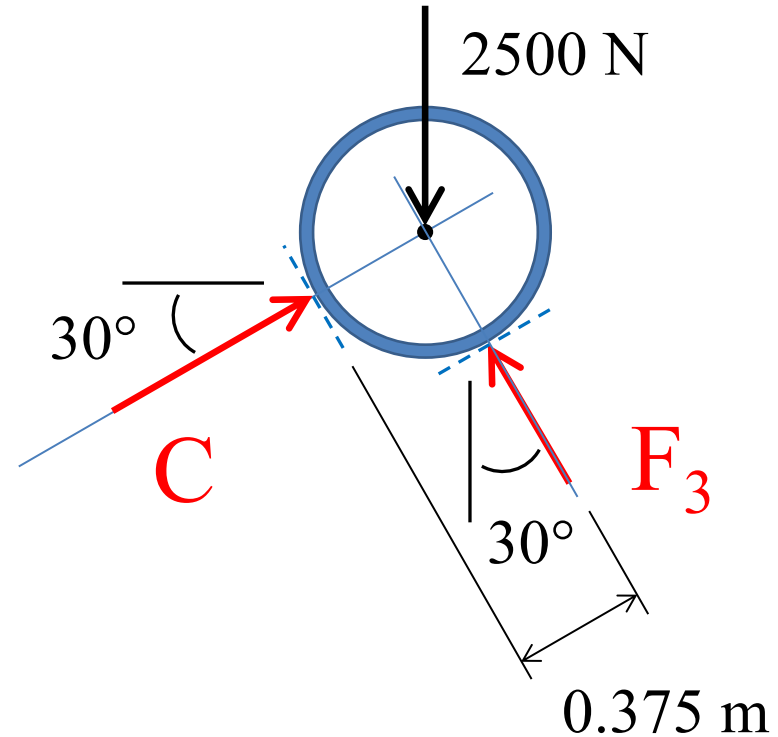
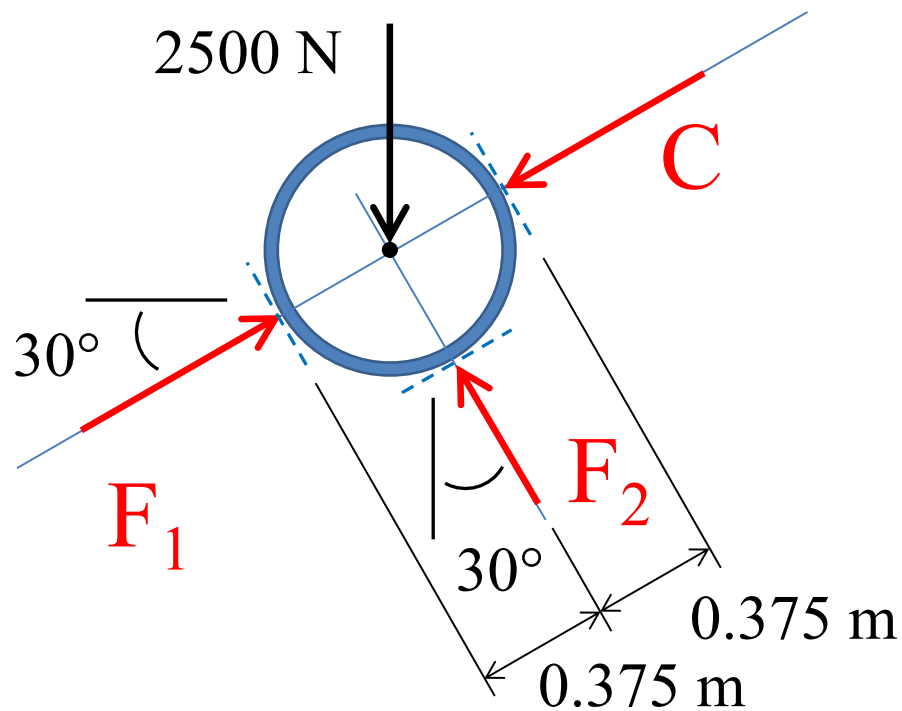
Notes

- The weight of the pipes can be expressed as an equivalent force applied at the center of gravity of each pipe;
- The dimensions, the line of action of the forces, and the pipe weight are known (shown in black text);
- The magnitude of the contact forces between the smooth pipes and the tines are unknown (shown in red text) and are perpendicular to the contact surface.

2) Free-Body Diagram of each pipe separately

Note

The magnitude of the contact force between the two smooth pipes is unknown and has an equal and opposite action on the upper and the lower pipe



Note

The forces on each pipe are concurrent at the center of gravity of the pipe. Only two equations of equilibrium are available to find unknown forces