How to Draw a Free Body Diagram.

Before you begin, you should be familiar with the symbols and reactions associated with

- Frictionless surfaces, rockers and rollers;
- Ropes, cables and short links;
- Frictionless collars and slots;
- Frictionless pins and hinges;
- Rough (frictional) surfaces;
- Fixed or embedded connections, frictional hinges

Refer to Table 4-1 on page 142 of your book for this information.

Procedure

1. Select an appropriate object, and isolate it from all its supports. Imagine that you have cut the object out of the world, and it is floating in space.
2. Sketch the outline of your object. No great artistry is required! Just draw a neat outline. Make it big enough.
3. Traverse the perimeter of the object, and wherever you cut through a support in order to free the body, draw the appropriate reaction forces. Use a sharp pencil and a straight edge to draw force vectors.
4. Add force vectors representing any loads or body forces (weights) and indicate any concentrated moments with a circular arrow.
5. Make sure every force has a clear arrowhead indicating its known or assumed direction, and a symbolic label.
6. Indicate and label any other angles or distances that you will need on the FBD, but try to avoid cluttering it up with unnecessary information.

Notes

If the direction of a force is known, show the force vector acting in that direction. Use *x*- and *y*-components to represent forces whose line of action is unknown.

Short links don't have to be straight. A line through the two connection points of the link defines the line of action of the force.

Forces which hold parts of the object together are called "internal forces" and do not appear on a free body diagram.

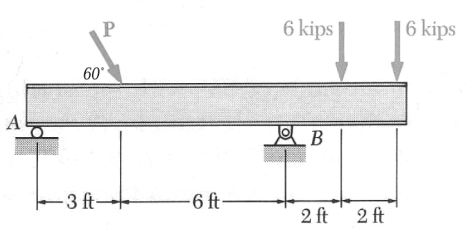
Sometimes, you can't decide on the sense of a force or moment. If so, simply guess (assume) one and move on. You will find out if your guess is correct later.

In this class a Free Body Diagram is not correct unless it shows ALL the forces acting on the object, the forces vectors have clear arrowheads indicating their assumed direction, and all forces have a symbolic name.

Draw a neat labeled Free Body Diagram for each situation.

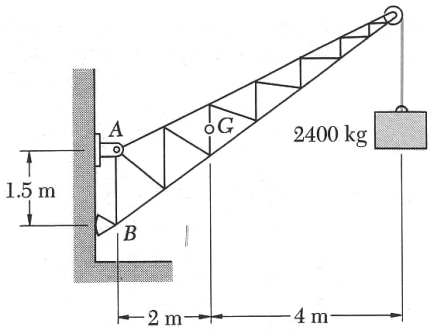
Draw FBD of Beam of weight *W*.

A

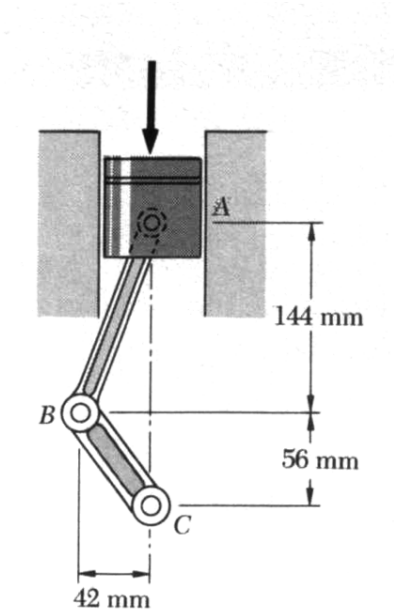


Draw FBD of Boom
Boom has non-negligible weight.

B



C

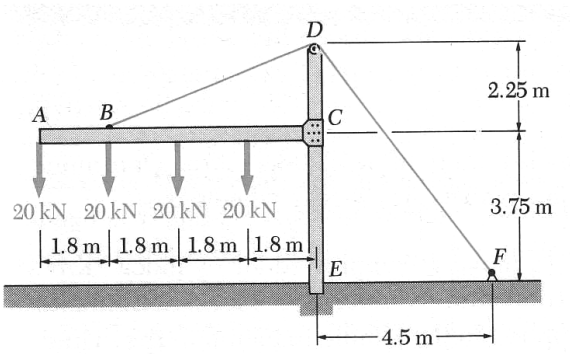


Draw FBD of Piston.

Draw FBD of crank *BC*.

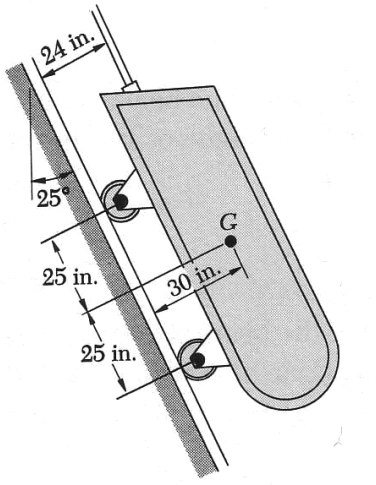
Draw FBD of Frame *ACDE*.

D



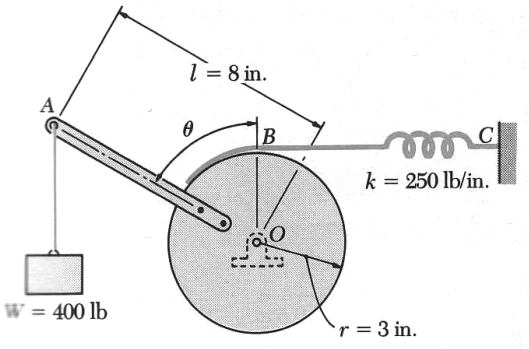
Draw FBD of Cart of weight *W*.

E



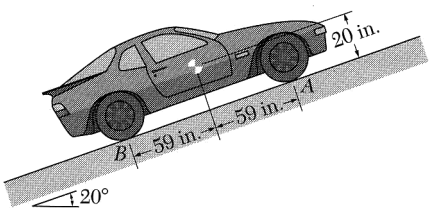
Draw FBD of cylinder plus arm *A*.

F



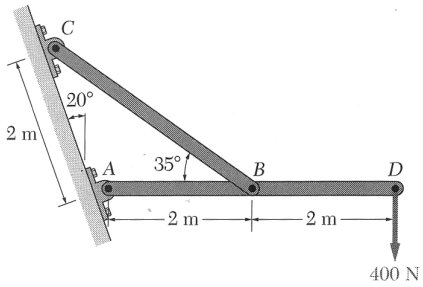
G

Draw FBD of 4000 lb car
rear brakes are engaged.



H

Draw FBD of member *ABD*.



I

Draw FBD of 250 lb cylinder on the verge
of rolling. Surface at *A* is rough.