

# Announcements

- Quiz 2 re-try this week (Thu-Sat)
  - Same material, different problems
  - Come to my office hours for Quiz 2 questions
- No lecture Friday (2/15) 😊
  - Friday office hours will still meet

## ☐ Upcoming deadlines:

- Friday (2/15)
  - Written Assignment
- Tuesday (2/12)
  - PL HW

# Objective

- Free body diagram for 2D rigid body
- Types of constraints
- Equations of equilibrium for 2D rigid body

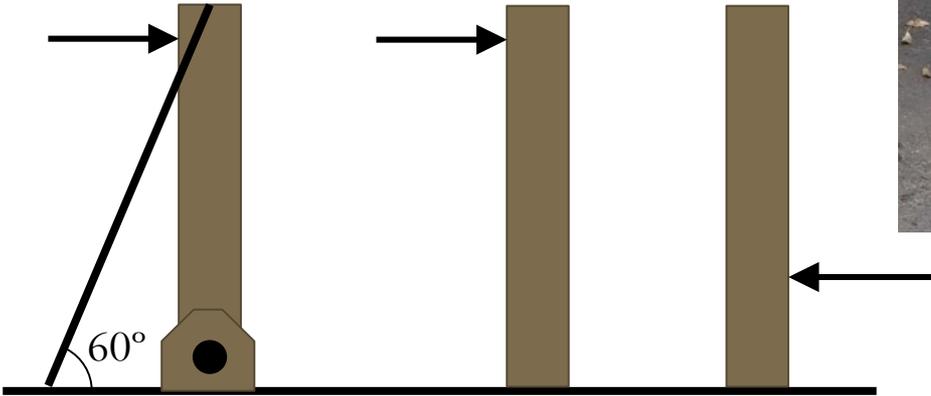
# Equilibrium in two-dimensional bodies

## Why different support?

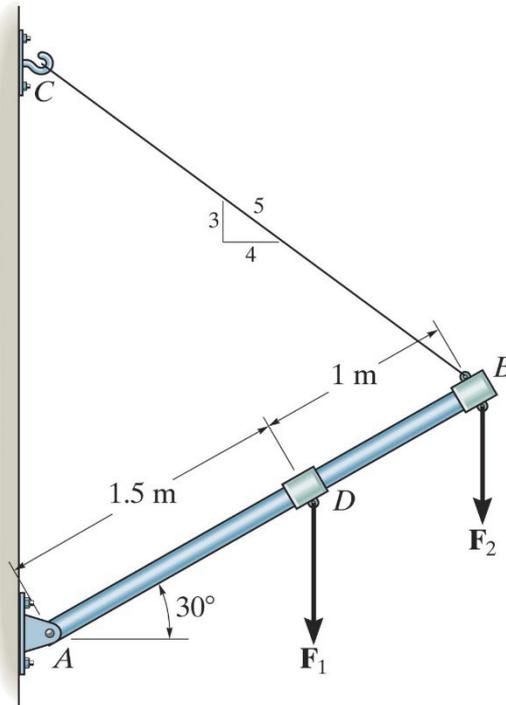
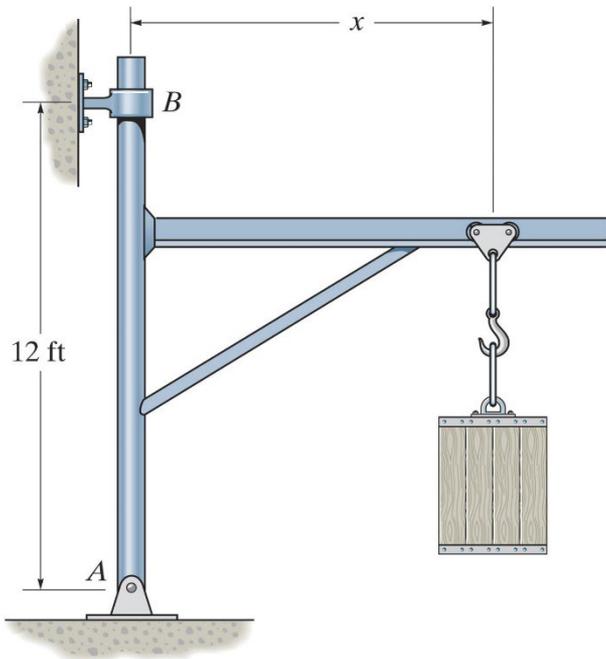
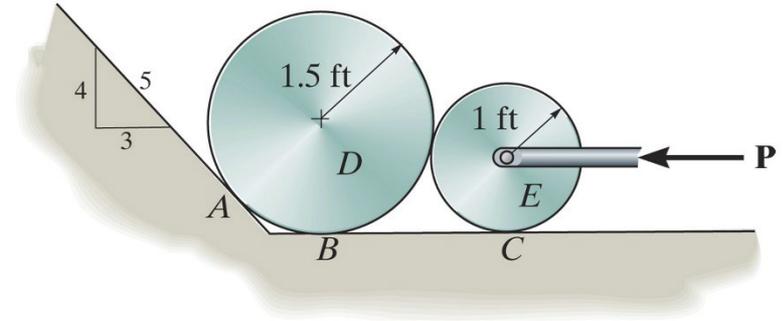


# Equilibrium in two-dimensional bodies

## Active Forces vs. Support reaction components



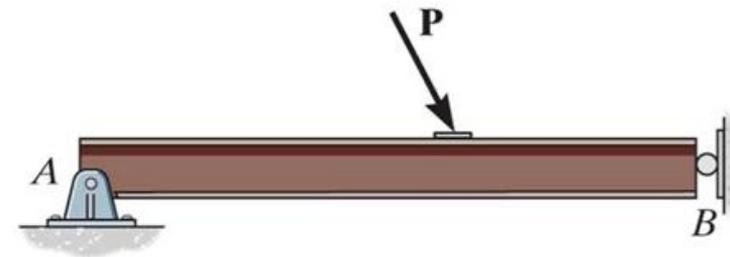
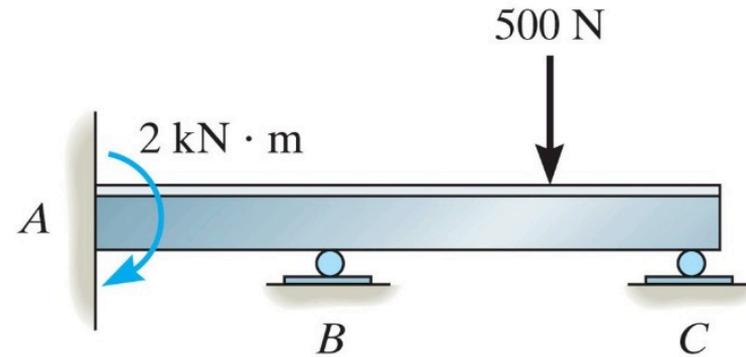
# Free Body Diagrams



# Constraints

To ensure equilibrium of a rigid body, it is not only necessary to satisfy equations of equilibrium, but the body must also be properly constrained by its supports

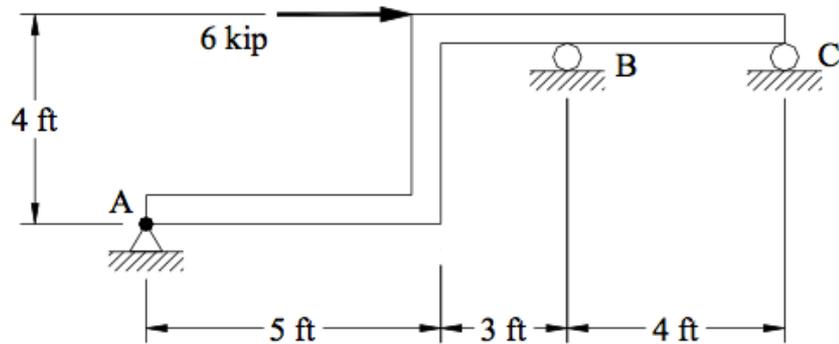
- **Redundant constraints:** the body has more supports than necessary to hold it in equilibrium; the problem is **STATICALLY INDETERMINATE** and cannot be solved with statics alone
- **Improper constraints:** In some cases, there may be as many unknown reactions as there are equations of equilibrium. However, if the supports are not properly constrained, the body may become unstable for some loading cases.



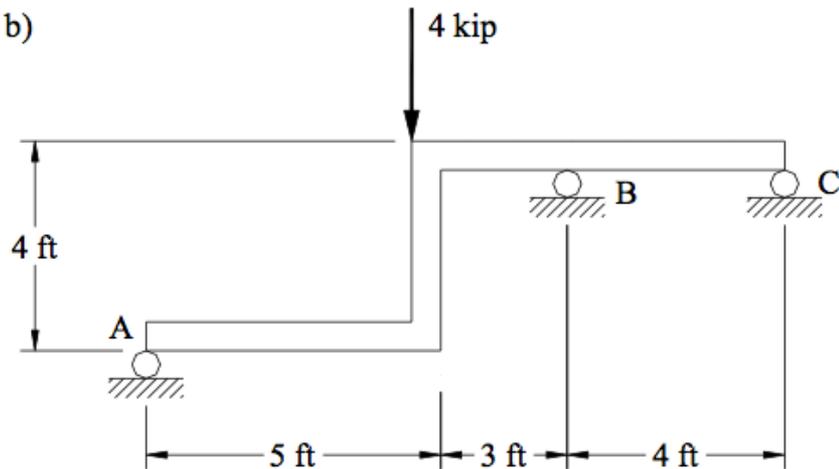
# Constraints

## Proper, redundant, or improper constraints

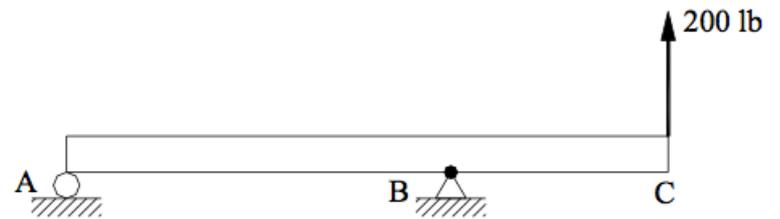
a)



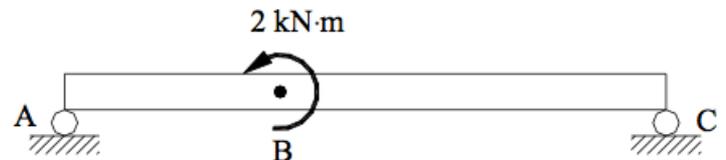
b)



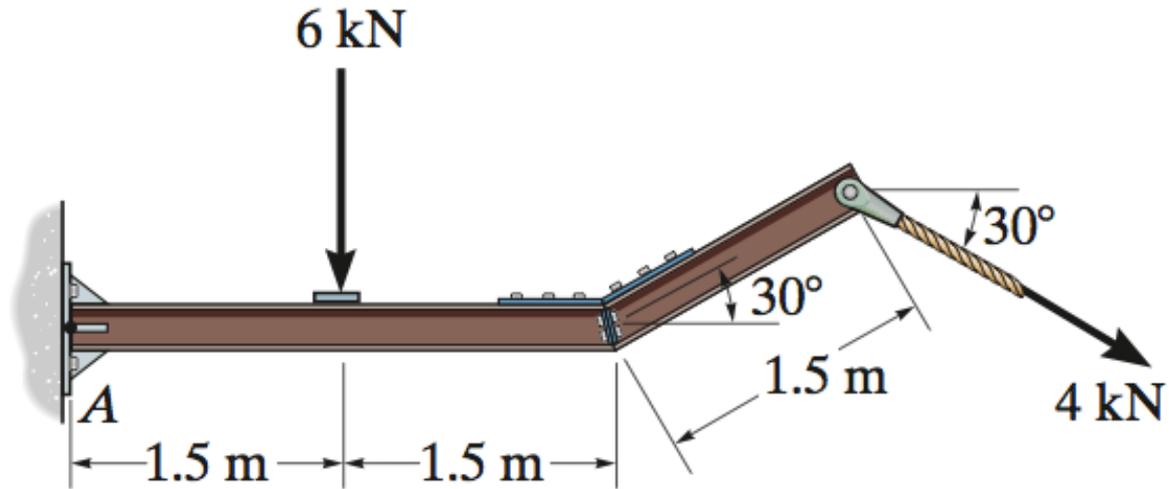
c)



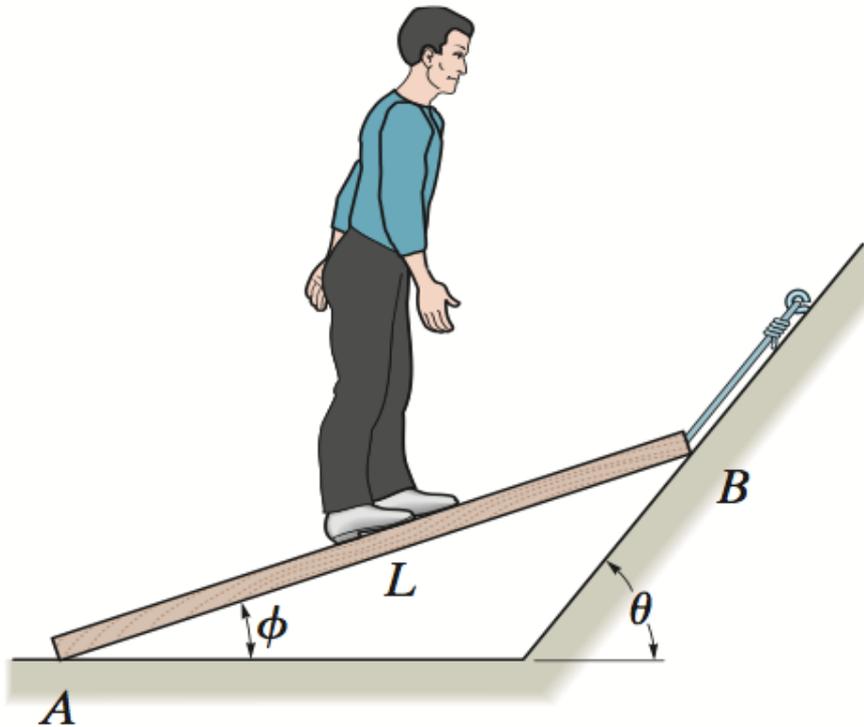
d)



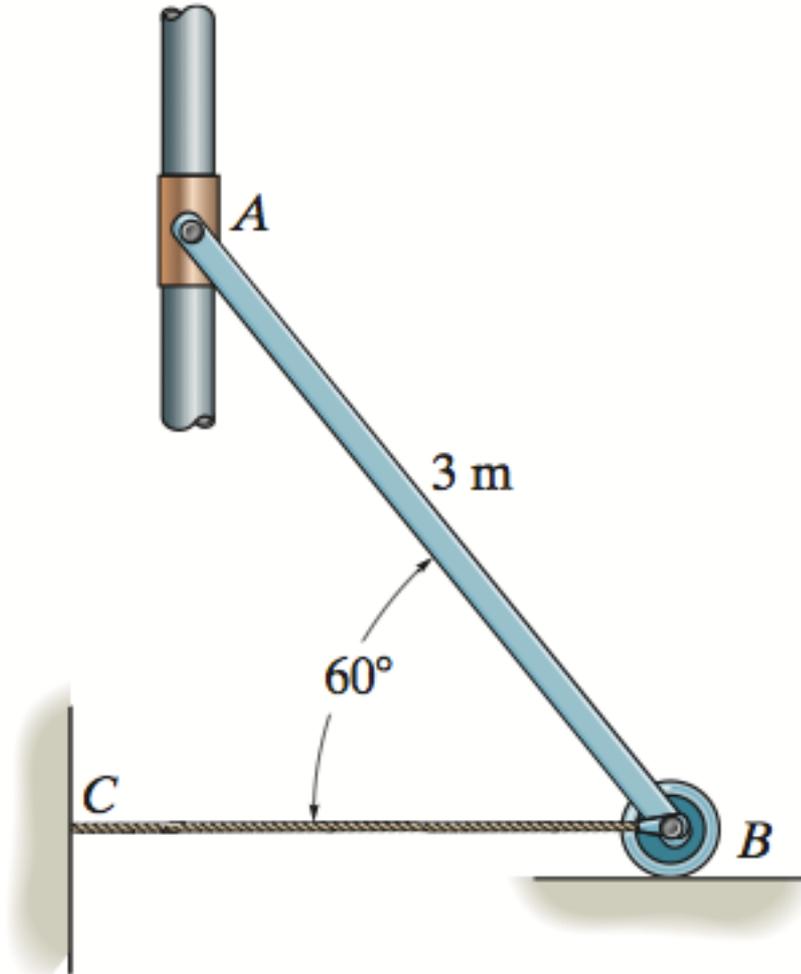
Determine the components of the support reactions at the fixed support  $A$  on the cantilevered beam.



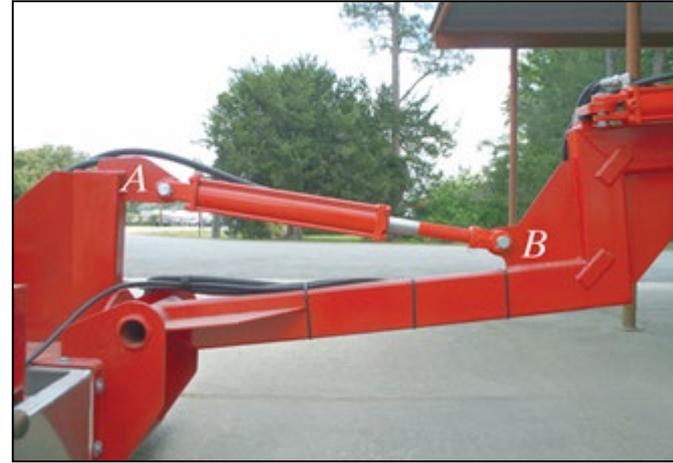
The man has a weight  $W$  and stands at the center of a plank with negligible weight. If the planes at  $A$  and  $B$  are smooth, determine the tension in the cord in terms of  $W$  and  $\theta$ .



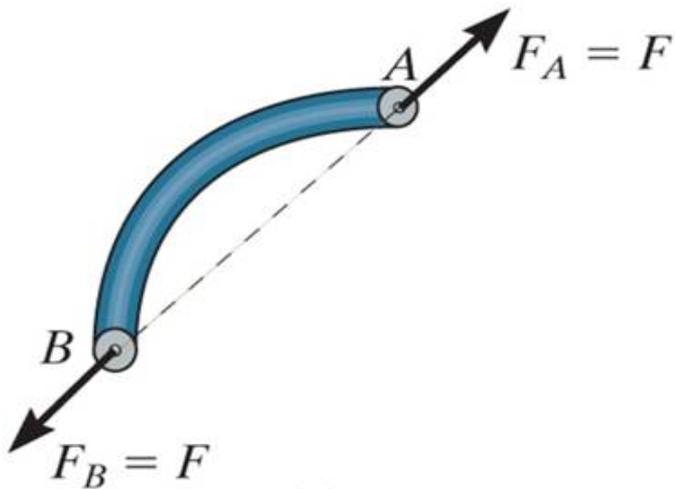
The uniform rod  $AB$  has a mass of 40 kg. Determine the force in the cable when the rod is in the position shown. There is a smooth collar at  $A$ .



# Two-force members



In the cases above, members AB can be considered as two-force members, provided that their weight is neglected.



Find the maximum weight that can be support by cage if the maximum loads that can be applied on arm A and hydraulic BC are given.

