Lecture 12: Force Analysis and Special Cases

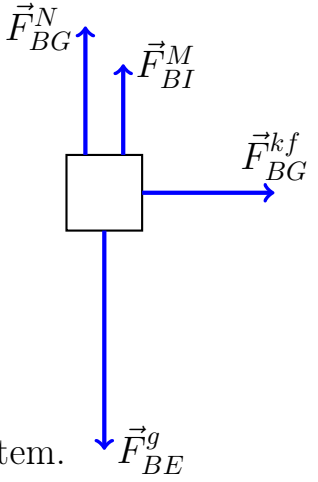
Announcements

- Mid-Term Ungrading due Saturday at 11:59 p.m.
  - Prompts for Ungrading are in the Syllabus, the Mid-Term Ungrading assignment, and in these lecture notes.
  - Review all of your work and feedback so far, discuss your work, your attendance, and your engagement, then propose a grade for yourself.
  - Citing and quoting your work and feedback as evidence is good.
  - Suggested minimum length of 2 pages.
- Homework 4 assessment completed
  - The Angled Block and the Calculate part of The Penny in the Elevator were not evaluated.
  - Compare your work against the solution. If you have questions or want more feedback, take your work into the Wormhole or office hours.

A Model for Interactions

- Quantities
  - Mass m
  - Force $\vec{F}$
- Laws
  - Net force is proportional to acceleration: $\vec{F}^{net} = m\vec{a}$
  - Forces come in pairs: $\vec{F}_{AB} = -\vec{F}_{BA}$
- Asssumptions
  - We can treat multiple objects as a system.
  - All forces act as if on the center of the system.

- Diagram



Solving Problems Using Forces

- Identify a system.
- Identify the (external) forces acting on the system.
  - Draw a free-body diagram.
- Identify the acceleration (**not a force**).
  - Static/dynamic equilibrium (acceleration = 0)
  - Dynamics (acceleration not 0)
- Use the laws of motion.
- Reflect on your answer (check units and evaluate special cases).

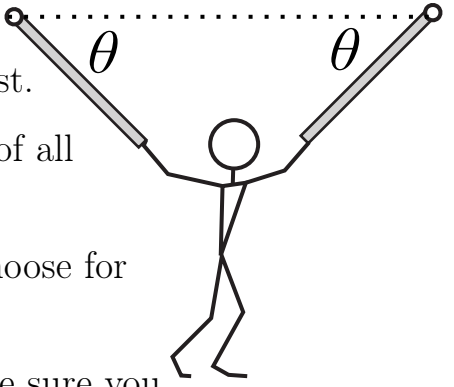
Special-Case Analysis

After you solve for a quantity:

- Choose a case that is **special**, not arbitrary.
- Figure out what your quantity **should** be in the case you chose.
- Identify the value of one or more other quantities that corresponds to your **case**.
- Evaluate your answer in the special case.
- Check whether or not your symbolic answer for the case matches what you expected the answer should be.

L12-1: The Gymnast

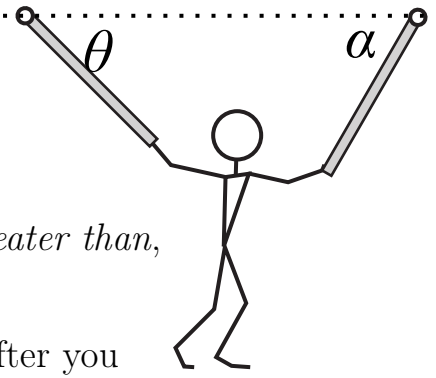
A gymnast of mass m is training using two ropes attached to the ceiling, as shown in the figure. The gymnast is suspended at rest.



- Identify and determine the magnitude of all forces acting on the gymnast.
- What special case(s) do you want to choose for this problem? Why?
- Try out at least one special case. (Make sure you know what the answer *should* be in your case!)

L12-2: The Gymnast *Reloaded*

What if the ropes were different angles?



- Don't solve the problem yet!
- You have a problem like this on your homework.
- Do you expect the left tension to be *greater than*, *less than*, or *equal to* the right tension?
- What special case could you evaluate after you solve this problem to check if your answer is right?

Main Ideas

- When an object is at rest or moving at constant speed, the forces balance and the object is in equilibrium.
- When an object is accelerating, there is a nonzero net force.