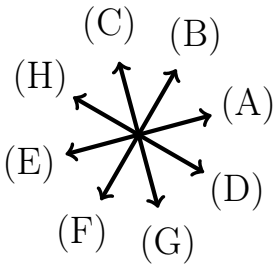
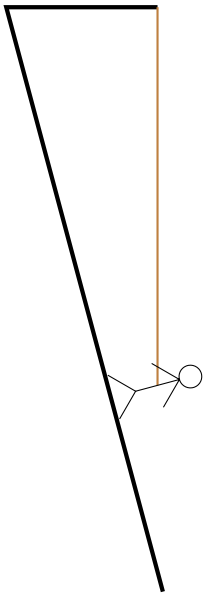
# Lecture 8: Free-Body Diagrams

Warm-Up Activity

What direction is the force of friction in the Mountain Climbing activity from Get-Ready #5?



## Free-Body Diagrams and Systems

- Choose a system.
  - Make sure you know what is internal to your system and what is external to your system.
- Identify and describe each external force: $\vec{F}_{\text{on,by}}^{\text{type}}$
  - Say what kind of force it is.
  - Determine the object the force is being acted on.
  - Determine the object that is exerting the force.
  - Write a symbolic version of the force that includes the information above.
  - Represent all the forces acting on a single object or system using a **free-body diagram**.
    - All forces on the same free body diagram should act on the same thing (same first subscript).

**(Newton's) Laws of Motion**

(1) An object in motion (or at rest) stays in motion (or at rest) unless a net external force acts on it.

(2) The net force on an object is equal to the object's mass times its acceleration.

$$\vec{F}^{net} = m\vec{a}$$

## L8-1: Moving a Box


Mike and Lucas are attempting to move a box, which does not move.

- Identify all forces acting on the box.
- Draw a free-body diagram for the box.
- Indicate the acceleration.

## L8-2: Moving a Box II


El pushes the box with her mind, and it begins to speed up.

- Modify your free-body diagram.
- Indicate the acceleration.
- Write a symbolic expression for the acceleration.

## Main Ideas

- Forces arise from interactions between objects.
- There are many different kinds of forces that we can analyze differently.
- Objects can only change their motion when acted upon by an external force.
- The net force on an object is equal to its mass times its acceleration.