Chapter 2: Forces

1 – 3, Due **Tuesday, January 21st**

4 – 5, Due **Tuesday, January 28th**

Learning objectives: Upon completion of the following topic (from in class lectures and completion of the external brain assignments), you will be able to:

1. Describe the differences between vector and scalar quantities and provide examples of each.
2. Use trigonometric functions to combine and resolve two-dimensional vectors, and apply this information to solving force equilibrium problems.
3. Define and provide examples of the significant forces encountered in biomechanical analyses.
4. Define static verse kinetic friction, explain how to calculate each type of friction, and evaluate the design of products based frictional demand.
5. Understand and identify the important characteristics of internal and external forces, how to draw free body diagrams showing which of these forces are acting on an object, and use the free body diagram to solve force equilibrium problems.

Assignments:

1. **Definitions and Vocabulary**
   a) Create a table which highlights differences between the following pairs of terms:
      - Vector verse scalar
      - Coefficient of static friction verse coefficient of dynamic friction
      - Internal force verse external force
      - Tensile force verse compressive force
      - Resultant force verse net force
      - Weight verse mass

   b) Use pictures or words to define the following concepts:
      - Force
      - Gravitational force
      - Normal force:
      - Frictional force:

2. **Friction**
   a) Use words or images to explain the differences between static and dynamic friction.

   b) Explain the formulas used to calculate the force of static friction and the force of kinetic friction. What do the symbols in the formula stand for?

c) Find a picture of some type of athletic footwear which shows the sole of the shoe. How does the design of the sole influence the frictional characteristics of the shoe? How would this affect the function of the shoe? Be sure to include a picture of the shoe with proper citation.

3. **Analyzing Forces Acting on Bodies**
   a) What is a free body diagram? What information is should be included when drawing a free body diagram?

4. **Draw free body diagrams for the following scenarios. Be sure to label the forces**.
   a) A college student is carrying a backpack by only one strap. Draw a free body diagram of the forces acting on the backpack. Consider the following forces: weight of the backpack, force through the strap.

   b) A person is out for a run on the Galligator trail. Draw a free body diagram of the runner and the forces acting on the runner. In this case the object of interest it their entire body. Consider the following forces: ground reaction force, weight of the runner, air resistance.

   c) Zooming in, now just analyze the foot. Draw a free body diagram of the forces acting on the foot at push-off. The heel has just lifted off but the forefoot is still on the ground. Consider the following forces: ground reaction force, weight of the foot, ankle joint reaction force.

   d) A person is doing a bicep curl. Assume the humerus is vertical and the elbow is flexed 30° (i.e. 30° from anatomical position). They hold a weight in their hand. Draw a free body diagram which includes the following forces: the weight of the dumbbell, the weight of their forearm, and the force being generated by their biceps brachii muscle.

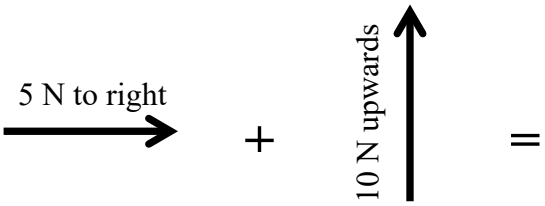
5. **Resolution of Forces.**
   a. What is meant by the "tip to tail" method for resolution of forces? Draw an example of using the tip to tail method to find the resultant force from three different forces.

   b. For each of the following scenarios determine the resultant force. Draw the correct vector for each answer. Use the tip-to-tail method you described above. Remember that forces are a vector so each answer needs both a magnitude <u>and</u> a direction

A. 5 N to right 5 N to right

B. 5 N to right 25 N to left

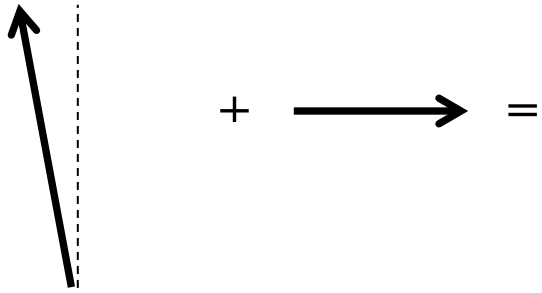
C. Remember your trigonometry!



D. Remember your trigonometry and that we can break it into left/right and up/down components.

50 N at 10° from vertical

10 N to the right



E. Hint: break into left/right and up/down components.

50 N at 10° from vertical

30 N at 25° from horizontal