LESSON OBJECTIVES

1. **Determine** the magnitude and direction of a resultant force (or other vector quantity) using the Parallelogram Law and direct graphical measurement (using a protractor and a ruler), given its component vectors.

2. **Determine** the magnitude and direction of a resultant force (or other vector quantity) using the Parallelogram Law and trigonometry (the Sine Law or the Cosine Law), given its component vectors.

3. **Solve** for any two unknown quantities (magnitude and/or direction) in a force vector addition problem using the Parallelogram Law; e.g., given the resultant magnitude and direction and the component directions, find the component magnitudes; e.g., given the magnitudes of the component vectors and the resultant magnitude and direction, find the directions of the component vectors; etc.

TODAY WE USE THREE (3) LAWS:

- Parallelogram Law
- Sine Law
- Cosine Law

REQUIRED READING/SUGGESTED PROBLEMS

Hibbeler 2.1, 2.2, 2.3. Study all examples in section 2.3, particularly 2.4.

IN CLASS WORK:

Fill-in-the-blank:

A _______________ is a graphical way to represent physical quantities that have magnitude and direction.

A _______________ is a physical quantity that obeys the parallelogram law.

Simon Stevinus (1548-1620) invented ____________ representation of forces because it enables the solution of force resultants using the parallelogram law.

Problem 1: Find the resultant force vector

Problem 2: Resolve F into components in the x’ and y directions

Problem 3: Find θ and F₁ such that the resultant is 1000N, directed vertically. Given: F₂=446 N

HOMEWORK (Due Friday)

All problems must be completed using the Parallelogram Law; you may not solve the problems by using Cartesian components. You may either use a graphical measurement (protractor and a ruler) or your knowledge of trigonometry for the following problems, unless stated otherwise.

1. Determine the resultant of the two forces by **graphical measurement**; i.e., draw the parallelogram neatly to scale and obtain the answer by directly measuring the angle and magnitude. For your drawing, use a scale of 2 kN = 1”. For your
final answer, report the magnitude of the resultant and the angle with respect to the x-axis (counterclockwise, considered to be a positive angle).

2. If the magnitude of the resultant force is 500 N directed along the positive \( y \) axis, determine the magnitude of force \( F \) and its direction \( \theta \).

3. Determine the angle \( \theta \) (\( \theta \) is between 0 and 90 degrees) and the magnitude \( F \) so that the resultant force acting on the post is directed vertically with a magnitude of 750 N.

4. Forces are transmitted by two members to pin A. If the sum of these forces is 700 lbs directed vertically, what are the angles \( \alpha \) and \( \beta \)?