

## GUIDED PRACTICE

### CE 95: Theory & Application of Statics

Department of Civil & Environmental Engineering, SJSU

Time estimate to complete this assignment: 60 minutes.

#### Overview

This class is flipped -- we'll spend most of our time in the workshop actually *working*, and your job before coming to the workshop is to prepare through some reading and video-watching. The lesson to be covered includes: Applying the *Triangle Rule* to add two 2D vectors acting on a particle, and determining their Resultant **R**.

#### Learning Objectives

##### Basic objectives (pre-class)

1. State the *Triangle Rule* mathematically and describe its various components
2. State the *Law of Sines* mathematically and describe its components
3. State the *Law of Cosines* mathematically and describe its components

##### Advanced objectives (in class)

1. Construct a force triangle by arranging the given vectors in a tip-to-tail (or head-to-tail) manner
2. Determine the internal angles of the force triangle using basic principles of Trigonometry
3. Calculate the magnitude of the Resultant **R** using the *Law of Cosines*
4. Calculate the direction of the Resultant **R** using the *Law of Sines*

#### Pre-Class Individual Activities:

1. **Read:** **Either** Chapter 2, Section 2.1 C in the *LearnSmart* module on the Connect portal, OR review the PowerPoint presentation entitled "Lecture 02.pdf." As you read, think about what's important, what surprises you, what links up with things you already do, and what questions you are left with. (Linked to Basic LOs: 1-3)
2. **Watch:** Please watch the below videos (Linked to Basic LOs: 1-3)  
<https://www.youtube.com/watch?v=aLKW1YNYvOU>
3. **Submit:** Write and submit one "Muddiest Point" question by Canvas, worth 5 points (Linked to Basic LOs: 1-3)

#### In-Class Group Activities:

The tasks (linked to Advanced LOs 1–4) include:

1. Instructor answers a selection of the "Muddiest Point" questions submitted

2. Students will take a short quiz on Canvas based on the reading and videos
3. Instructor will illustrate an example problem on the whiteboard, and then write up two problems on the whiteboard for students to solve
4. Students will form groups of 4 each; and then group tackle the problems on the board
5. After completing task, class will discuss results and ask any questions

### Post-Class Individual Activities:

The tasks (linked to Advanced LOs 1–4) include:

1. Students will apply their knowledge of the *Triangle Rule* in a homework assignment on the Connect portal

# CE 95: Theory & Application of Statics

## Lesson Plan

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**Lesson:** Apply the *Triangle Rule* to add two 2D vectors acting on a particle, and determine their Resultant **R**

**Timeframe:** 60 minutes

**Materials needed:** Copies of worksheet, Canvas portal for uploading PowerPoint slides, in-class projector for presenting PowerPoint slides, Canvas portal for taking quiz, McGraw Hill Connect portal for completing HW

### Objectives:

#### *Basic:*

1. State the *Triangle Rule* mathematically and describe its various components
2. State the *Law of Sines* mathematically and describe its components
3. State the *Law of Cosines* mathematically and describe its components

#### *Advanced:*

1. Construct a force triangle by arranging the given vectors in a tip-to-tail (or head-to-tail) manner
2. Determine the internal angles of the force triangle using basic principles of Trigonometry
3. Calculate the magnitude of the Resultant **R** using the *Law of Cosines*
4. Calculate the direction of the Resultant **R** using the *Law of Sines*

### Background to the Lesson:

Class Description: CE 95 is a service-level, pre-requisite course offered to students majoring in civil, mechanical, chemical and biomedical engineering.

Lesson Plan: Based on Chapter 2, Section 2.1 (Beer & Johnston), the proposed lesson plan illustrates how to determine the Resultant  $\mathbf{R}$  of a given set of two force vectors using the *Triangle Rule*, and thereafter the magnitude and direction of  $\mathbf{R}$  using the *Law of Cosines* and *Sines* respectively.

Lesson pre-requisite: Students must have knowledge of basic rules of analyzing triangles, such as the *Law of Cosines* and the *Law of Sines*.

Learning Challenge: A generally observed challenge is arranging the given forces in a tip-to-tail (or head-to-tail) manner to properly construct the force triangle.

### **Introduction to Lesson:**

During the day before the class, students will either read Chapter 2, Section 2.1 C in the *LearnSmart* module on the McGraw Hill Connect portal or review the PowerPoint presentation on Chp 2, Section 2.1 C in Canvas. Students will follow it up by watching a short YouTube video that visually illustrates the *Triangle Rule* and then submit one “Muddiest Point” question by Canvas.

### **Pre-Class Individual Space Activities and Resources:**

<b>Steps</b>	<b>Purpose</b>	<b>Estimated Time</b>	<b>Learning Objective</b>
Step 1/2:  Read Chp 2, Section 2.1 C in the <i>LearnSmart</i> module on the McGraw Hill Connect portal  Download and review PowerPoint presentation on Chp 2, Section 2.1 C: <i>Addition of Vectors</i>	Introduce students to the <i>Triangle Rule</i> for adding vectors; Refresh definitions of the <i>Law of Cosine</i> and the <i>Law of Sine</i>	10 min	Basic LO #1, #2, #3
Step 3:  Watch YouTube video <a href="https://www.youtube.com/watch?v=aLKW1YNYvOU">https://www.youtube.com/watch?v=aLKW1YNYvOU</a>	Visually illustrate the <i>Triangle Rule</i>	2 min	Basic LO #1, #2, #3

<p>Step 4:</p> <p>Submit one “Muddiest Point” question by Canvas, worth 5 points</p>	<p>Pre-requisite for starting the discussion in the group space</p>	<p>10 min</p>	<p>Basic LO #1, #2, #3</p>
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### *In-Class Group Space Activities and Resources*

<b>Steps</b>	<b>Purpose</b>	<b>Estimated Time</b>	<b>Learning Objective</b>
Step 1:  Answer a selection of the “Muddiest Point” questions submitted before class	Clear up any confusion or misconceptions	5 min	Basic LO #1, #2, #3
Step 2:  Take a short quiz on Canvas worth 5 points	Review and reinforce the material introduced in individual space	10 min	Basic LO #1, #2, #3
Step 3:  Instructor illustrates an example problem on the whiteboard.	Show students how to apply the concepts they learned in the individual space using a practical example	15 min	Advanced LO #1, #2, #3, #4
Step 4:  Form groups of 4 students. Each group receives a worksheet with at least 2 word problems to solve.	Have students apply the concepts they learned in the individual space to practical problems	20 min	Advanced LO #1, #2, #3, #4
Step 5:  Discuss results and ask questions.	Reinforce concepts learned through practice.	10 min	Advanced LO #1, #2, #3, #4

### ***Post-Class Individual Space Activities and Resources***

Students will apply their knowledge of the *Triangle Rule* in a homework assignment on McGraw Hill's Connect portal.

### **Evaluation:**

#### ***Analysis***

The biggest challenge I see is managing teams in the classroom. With 60+ students at a time, chaos will surely influence implementation.

#### ***Connections to Future Lessons***

The topic that follows is: Resolving a given force into components. The individual space and the group space activities would be similar.

## Appendix

Canvas quiz (worth 5 points)

1. True or False: The Parallelogram Law provides a graphical solution for adding two 2D vectors.
2. The addition of two vectors is
  - Distributive
  - Commutative
  - Associative
3. “Arranging P and Q in tip-to-tail fashion and then connecting the tail of P with the tip of Q” is the definition of
  - The Parallelogram Law
  - The Triangle Rule
  - The Polygon Rule
4. If the given vectors are coplanar, it means that:
  - the two vectors are collinear
  - the two vectors must be subtracted
  - the two vectors are coplanar
5. The product of a vector and a negative scalar
  - changes the magnitude only
  - changes the direction only
  - changes both the magnitude and direction