The Open Learning Initiative

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What is the Open Learning Initiative?

Open online learning environments based on the science of learning and designed to improve both quality & productivity in higher education.
Determine the sum of three concurrent forces:

- Force $F_1$ has a magnitude of 9N; its line of action passes through points A (1, 1) and B (4, 3).
- Force $F_2$ has a magnitude of 5N; its line of action is parallel to a 3-4-5 triangle.
- Force $F_3$ has a magnitude of 5N; its line of action is at 60 degrees to the horizontal.

![Graph showing the forces and points](image)

What is the magnitude of the sum?

$$ R = \boxed{5.6} \ \text{N} $$

What is the direction and the sense of the vector sum? Enter the positive angle $\alpha$ and then choose the correct quadrant:

$$ \alpha = \boxed{\text{degrees}} $$

[Diagram showing the direction of the vector sum with options for $\alpha$]

**Hint:** Since the purpose of this activity is self-assessment, you should try to work through this one on your own. However, if you're still unsure of the procedure, you can [click here](#) to expand the problem.
Determine the sum of three concurrent forces:

Force $F_1$ has a magnitude of 9N; its line of action of passes through points $A \ (1,\ 1)$ and $B \ (4,\ 3)$

Force $F_2$ has a magnitude of 5N; its line of action is parallel to a 3-4-5 triangle

Force $F_3$ has a magnitude of 5N; its line of action is at 60 degrees to the horizontal

What is the magnitude of the sum?

$R = \boxed{5.6} \ N$

What is the direction and the sense of the vector sum? Enter the positive angle $\alpha$ and then choose the correct quadrant:

$\alpha = \boxed{\text{degrees}}$

Recall:

Step 1: Resolve each force into components:

$F_{1x} = \boxed{\text{N}} \quad F_{2x} = \boxed{\text{N}} \quad F_{3x} = \boxed{\text{N}}$

$F_{1y} = \boxed{\text{N}} \quad F_{2y} = \boxed{\text{N}} \quad F_{3y} = \boxed{\text{N}}$

Hint: The force has a known magnitude and sense, and its direction can be found because the force acts along the line passing through two known points.
Determine the sum of three concurrent forces:

- Force $F_1$ has a magnitude of 9N; its line of action passes through points A (1, 1) and B (4, 3).
- Force $F_2$ has a magnitude of 5N; its line of action is parallel to a 3-4-5 triangle.
- Force $F_3$ has a magnitude of 5N; its line of action is at 60 degrees to the horizontal.

What is the magnitude of the sum?

$$ R = \boxed{5.6} \text{ N} $$

What is the direction and the sense of the vector sum? Enter the positive angle $\alpha$ and then choose the correct quadrant:

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Recall:

Step 1: Resolve each force into components:

- $F_{1x} = \boxed{\text{N}}$
- $F_{2x} = \boxed{\text{N}}$
- $F_{3x} = \boxed{\text{N}}$
- $F_{1y} = \boxed{\text{N}}$
- $F_{2y} = \boxed{\text{N}}$
- $F_{3y} = \boxed{\text{N}}$

**Hint:** A triangle that describes the direction of the force has horizontal leg of $4 - 1 = 3$, vertical leg of $3 - 1 = 2$, and hypotenuse of $(3^2 + 2^2)^{0.5} = \sqrt{13} = 3.61$. The force has magnitude 9 and a
Determine the sum of three concurrent forces:

Force $F_1$ has a magnitude of 9N; its line of action of passes through points A (1, 1) and B (4, 3)
Force $F_2$ has a magnitude of 5N; its line of action is parallel to a 3-4-5 triangle
Force $F_3$ has a magnitude of 5N; its line of action is at 60 degrees to the horizontal

What is the magnitude of the sum?

$R = 5.6 \text{ N}$

What is the direction and the sense of the vector sum? Enter the positive angle $\alpha$ and then choose the correct quadrant:

$\alpha = \underline{\text{degrees}}$

Recall:

Step 1: Resolve each force into components:

$F_{1x} = \underline{\text{N}}$  
$F_{1y} = \underline{\text{N}}$

$F_{2x} = \underline{\text{N}}$  
$F_{2y} = \underline{\text{N}}$

$F_{3x} = \underline{\text{N}}$  
$F_{3y} = \underline{\text{N}}$

Hint: $F_{1x}$ is $9(3)/\sqrt{13} = 7.49$
Determine the sum of three concurrent forces:

Force $F_1$ has a magnitude of 9N; its line of action of passes through points A (1, 1) and B (4, 3)
Force $F_2$ has a magnitude of 5N; its line of action is parallel to a 3-4-5 triangle
Force $F_3$ has a magnitude of 5N; its line of action is at 60 degrees to the horizontal

What is the magnitude of the sum?

$R = 5.6 \text{ N}$

What is the direction and the sense of the vector sum? Enter the positive angle $\alpha$ and then choose the correct quadrant:

$\alpha = \text{degrees}$

Recall:

Step 1: Resolve each force into components:

\[
\begin{align*}
F_{1x} &= 7.49 \text{ N} \\
F_{1y} &= 4.99 \text{ N} \\
F_{2x} &= -4.00 \text{ N} \\
F_{2y} &= 3.00 \text{ N} \\
F_{3x} &= 2.5 \text{ N} \\
F_{3y} &= -4.33 \text{ N}
\end{align*}
\]

Good job! Can you finish the problem on your own now? If not, click here to see another step along with hints.
What is the magnitude of the sum?

\[ R = 5.91 \text{ N} \]

What is the direction and the sense of the vector sum? Enter the positive angle \( \alpha \) and then choose the correct quadrant:

\[ \alpha = 39.1 \text{ degrees} \]

Recall:

Step 1: Resolve each force into components:

- \( F_{1x} = 7.49 \text{ N} \)
- \( F_{2x} = -6.40 \text{ N} \)
- \( F_{3x} = 3.5 \text{ N} \)
- \( F_{1y} = 4.99 \text{ N} \)
- \( F_{2y} = 4.80 \text{ N} \)
- \( F_{3y} = -6.06 \text{ N} \)

Step 2: Find the components of the sum by summing components of the forces:

- \( R_x = \sum F_x = 4.59 \text{ N} \)
- \( R_y = \sum F_y = 3.73 \text{ N} \)

Step 3: Find the magnitude of the sum

(enter your answer at the top)

\[ R = \sqrt{R_x^2 + R_y^2} \]

Step 4: Find the direction and sense of the vector sum.

(enter your answer at the top)

\[ \alpha = \tan^{-1} \left| \frac{R_y}{R_x} \right| \]

Good job! Now click here to try one on your own, without us walking you through the individual steps.
What is a Cognitive Tutor?

A computerized learning environment whose design is based on cognitive principles and whose interaction with students is based on that of a (human) tutor—i.e., making comments when the student errs, answering questions about what to do next, and maintaining a low profile when the student is performing well.
Module 3 / Arsenic in Bangladesh

To show how stoichiometry is used in practice, much of this course is set in the context of arsenic contamination in the ground water of Bangladesh. The following video introduces this context and why stoichiometry plays an important role in this environmental problem.
According to the WHO, the recommended limit for arsenic in drinking water is 10 micrograms per liter. While it is not easy to answer if a well is toxic or not, a simpler question that can be answered is: Is the concentration of arsenic larger than the WHO recommendation?

If so, we may consider this water source toxic. If not, we may say that it is arsenic-wise safe to drink this water.

Activity 1: How many micrograms per liter of As is in the sample? (Please give your answer to 3 significant figures)

56.4 micrograms/L

The virtual lab shows solution information in moles, grams or molarity. Remember to pay attention to what quantity is currently being shown. Please try again.
Feedback: Changing the Productivity of Learners and Teachers
The Student

In OLI, I work through the module that includes “Learning Objective A.” In the module, I am asked to complete inline assessments. I apply the concepts and skills for “Learning Objective A” to solve problems. I receive immediate feedback on my performance.

The OLI system:
Records interaction-level detail as the student works through the module and provides immediate and targeted feedback to the student.
Learning Objectives

Summarize and describe the distribution of a categorical variable in context.

Generate and interpret several different graphical displays of the distribution of a quantitative variable (histogram, stemplot, boxplot).

Summarize and describe the distribution of a quantitative variable in context: a) describe the overall pattern, b) describe striking deviations from the pattern.

Relate measures of center and spread to the shape of the distribution, and choose the appropriate measures in different contexts.

Compare and contrast distributions (of quantitative data) from two or more groups, and produce a brief summary, interpreting your findings in context.

Apply the standard deviation rule to the special case of distributions having the "normal" shape.
Learning Objectives

1. Summarize and describe the distribution of a categorical variable in context.
2. Generate and interpret several different graphical displays of the distribution of a quantitative variable (histogram, stemplot, boxplot).
3. Summarize and describe the distribution of a quantitative variable in context: a) describe the overall pattern, b) describe striking deviations from the pattern.
4. Relate measures of center and spread to the shape of the distribution, and choose the appropriate measures in different contexts.

Estimated Learning by Student

Class Accuracy by Sub-Objective

- Predicting...
- Mean vs median
- Compute median
- Identify outlier
- Select appropriate...

@cmuoli    oli.cmu.edu
Relate measures of center and spread to the shape of the distribution, and choose the appropriate measures in different contexts.

**Estimated Learning by Student**

40 students
1 dot = 1 student

**Class Accuracy by Sub-Objective**

- Predicting...
- Mean vs median
- Compute median
- Identify outlier
- Select appropriate...

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<td>Select appropriate</td>
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**Students with Moderate Estimated Learning**

Student names removed

**Checkpoints and Quizzes**

- Checkpoint: Examining Distributions Checkpoint 1
- Checkpoint: Examining Distributions Checkpoint 2
- Checkpoint: Examining Distributions Checkpoint 3
Single Student View

Module 1: Examining Distributions

Learning Objectives

- Summarize and describe the distribution of a categorical variable in context.
- Generate and interpret several different graphical displays of the distribution of a quantitative variable (histogram, stemplot, boxplot).
- Summarize and describe the distribution of a quantitative variable in context: a) describe the overall pattern, b) describe striking deviations from the pattern.
- Relate measures of center and spread to the shape of the distribution, and choose the appropriate measures in different contexts.

ACTIVITIES AVAILABLE FOR THIS LEARNING OBJECTIVE

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<td>View</td>
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Measures of Center

Readability of Cancer Pamphlets

Background

A study was done in order to find out whether pamphlets containing information for cancer patients are written at a level that the cancer patients can understand. Tests were administered to measure the reading levels of 63 cancer patients, and the readability levels of 30 cancer pamphlets were evaluated based on such factors as the lengths of the sentences and the number of polysyllabic words. Both the reading and readability levels correspond to grade levels, but patients' reading levels of less than grade 3 and above grade 12 cannot be determined exactly. (Source: Short, Moriarty, and Cooly. (1995). "Readability of Educational Materials for Cancer Patients." Journal of Statistics Education, v.3, n.2)

The following tables indicate the number of patients at each reading level and the number of pamphlets at each readability level.

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What Are the Affordances of the Technology?
The “Killer App” Data Collection & Feedback Loops for Continuous Improvement
LearnLab: Transforming Education Research

Ed tech + wide use = “Basic research at scale”

NSF Science of Learning Center
• 10 years, ~$50 million
• Tech enhanced courses, assessment, & research
• School cooperation for data collection
Learning Curve Analysis

DataShop: Pittsburgh Science of Learning Center
The “Killer App” Data Collection & Feedback Loops for Continuous Improvement
OLI Development Process

Planning
Learning data is used to drive continuous improvement of the courses.
Research contributes new knowledge to learning sciences.

Adaptation
Core Development Team
- Domain Expert
- Domain Expert
- Instructional Designer
- Project Manager
- Universal Design for Learning Expert
- User Experience Designer

Synergy of Collaboration of multi-disciplinary team members.
Work does not factorize into domain part and instructional part.

Use & Evaluation
Real-time data is collected, reflecting how and what students are learning.

Review & Contribute
Domain experts outside of the core development team provide vital feedback.

Open Learning Initiative
Carnegie Mellon University

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Better insight ➔ better courses

Past research
• Careful “cognitive task analysis” produces much better courses

OLI Chemistry, equilibrium topic:
Previously: 20% correct on exam
After Redesign: 60%

New opportunity
• Ed tech provides data for automated analysis

Flat learning curve
Discovery opportunity!
Proven Results

This study, conducted at Carnegie Mellon University, shows that students using the OLI statistics course at Carnegie Mellon achieved the same or better learning outcomes as students in the traditional course in half the time.

Proven Results

“The results of this study are remarkable; they show comparable learning outcomes for this basic course, with a promise of cost savings and productivity gains over time.”

Deanna Marcum
Managing Director, Thaka S+R

Strategy for Educational Improvement

EdTech → Data → Theory → EdTech
Better Science & Technology ...

Improves Assessment

Increases Outcomes

Accelerates Learning

> 100 hours

~3% gain

< 50 hours

~18% gain

Produces A Virtuous Cycle

EdTech

Data

Theory
LearnLab is funded by The National Science Foundation award number SBE-0836012.
“Improvement in Post Secondary Education will require converting teaching from a ‘solo sport’ to a community based research activity.”

The late Herbert Simon, Nobel Laureate & CMU Professor

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