

# **Physics 111 - Class 2A**

## **Displacement and Vectors**

September 12, 2022

# Logistics/Announcements

- Lab this week: Please go to your labs!
- HW2 due this week on Thursday at 6 PM
- HW1 is the Math Diagnostic and is not for marks but can be used as one of your 9 HW assignments that count
- Test 1 will be held on Friday during class, Bonus Test 1 next week
- Learning Log 1 was due on Saturday at 6 PM
- With the grace period, it's still available until 6 PM today.
- HW and LL deadlines have a 48 hour grace period

# Learning Log #1

A screenshot of a Learning Log entry. At the top, it says "Submitted answer 2" with a red box around "incorrect: 0%". A large red X is drawn over this box. Below it, it says "Submitted at 2022-09-11 09:41:08 (PDT)". There are two small buttons: "i" and "hide ^". In the main area, there's a note: "Note: Each week, I will ask you to explain a concept we covered in class. You will typically be expected to write 3-5 sentences about the concept or question. This week, I will ask you to explain a concept from the Unsyllabus - which you should have read by now." Below the note are two input fields: "In your own words..." and "Favourite parts:".

- Sorry about the "incorrect:0%" tag on your LL1 questions!
- I will be grading these questions manually so it will say 0% until I look at it
- I have changed this behaviour for future learning logs!

# Learning Log #1

Submitted answer 2 **incorrect: 0%**  
Submitted at 2022-09-11 09:41:08 (PDT)

Note: Each week, I will ask you to explain a concept we covered in class. You will typically be expected to write 3-5 sentences about the concept or question. This week, I will ask you to explain a concept from the Unsyllabus - which you should have read by now.

In your own words...

Favourite parts:

A large red 'X' is drawn over the 'incorrect: 0%' message.

Save This question will be manually graded.  
New variant

Submitted answer **saved, not graded**  
Submitted at 2022-09-12 11:16:24 (PDT)

Note: Each week, I will ask you to explain a concept we covered in class. You will typically be expected to write 3-5 sentences about the concept or question. This week, I will ask you to explain a concept from the Unsyllabus - which you should have read by now.

In your own words...

- Sorry about the “incorrect:0%” tag on your LL1 questions!
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# Class Outline

- Introduction to Chapters 1 and 2
- Clicker Questions
- Problem Solving Template
- Activity
- Debrief
- Growth Mindset

# Introduction

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Search this book



My highlights

Preface

## ▼ Mechanics

- ▶ 1 Units and Measurement
- ▶ 2 Vectors
- ▶ 3 Motion Along a Straight Line
- ▼ 4 Motion in Two and Three Dimensions

Introduction

- 4.1 Displacement and Velocity Vectors
- 4.2 Acceleration Vector
- 4.3 Projectile Motion
- 4.4 Uniform Circular Motion
- 4.5 Relative Motion in One and Two Dimensions

## ▶ Chapter Review

- ▶ 5 Newton's Laws of Motion
- ▶ 6 Applications of Newton's Laws
- ▶ 7 Work and Kinetic Energy
- ▶ 8 Potential Energy and Conservation of Energy
- ▶ 9 Linear Momentum and Collisions
- ▶ 10 Fixed-Axis Rotation
- ▶ 11 Angular Momentum
- ▶ 12 Static Equilibrium and Elasticity
- ▶ 13 Gravitation
- ▶ 14 Fluid Mechanics



**Figure 1.1** This image might be showing any number of things. It might be a whirlpool in a tank of water or perhaps a collage of paint and shiny beads done for art class. Without knowing the size of the object in units we all recognize, such as meters or inches, it is difficult to know what we're looking at. In fact, this image shows the Whirlpool Galaxy (and its companion galaxy), which is about 60,000 light-years in diameter (about  $6 \times 10^{17}$  km across). (credit: modification of work by S. Beckwith (STScI) Hubble Heritage Team, (STScI/AURA), ESA, NASA)

## Chapter Outline

- [1.1 The Scope and Scale of Physics](#)
- [1.2 Units and Standards](#)
- [1.3 Unit Conversion](#)
- [1.4 Dimensional Analysis](#)
- [1.5 Estimates and Fermi Calculations](#)
- [1.6 Significant Figures](#)
- [1.7 Solving Problems in Physics](#)



## Physics 111

Search this book...

Unsyllabus

### ABOUT THIS COURSE

- Course Syllabus (Official)
- Course Schedule
- Accommodations
- How to do well in this course

### GETTING STARTED

- Before the Term starts
- After the first class
- In the first week
- Week 1 - Introductions!

### PART 1 - KINEMATICS

#### Week 2 - Chapter 2

- Readings
- Videos
- Homework
- Lecture
- Test
- Lab
- Learning Logs

### COURSE FEEDBACK

Anonymous Feedback Form

# Videos

Below are the assigned videos for this week. The videos are collapsible so once you're done with one, you can move to the next one. In the sidebar on the right, you can use the checklists to keep track of what's done.

## Required Videos

### 1. Introduction to Significant Figures

Introduction to Significant Figures with Examples

Copy link

Watch on YouTube

- Notes
- Direct link to Mr. P's page

### 2. Working with Significant Figures

### 3. Introduction to Tip-to-Tail Vector Addition

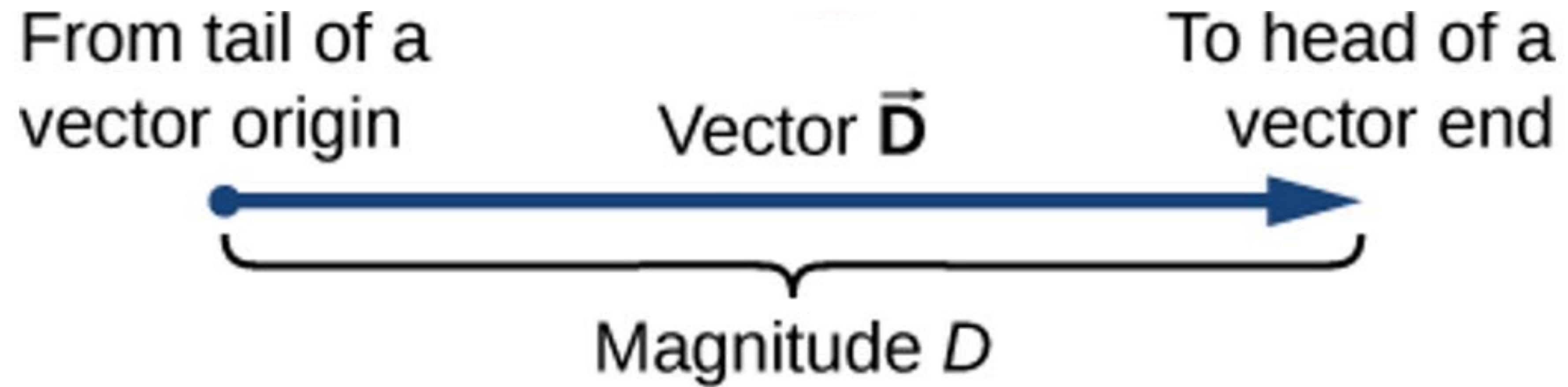
Introduction to Tip-to-Tail Vector Addition, Vectors and Scalars

Copy link

### Checklist of items

- Video 1
- Video 2
- Video 3
- Video 3
- Video 3

# What is a vector?



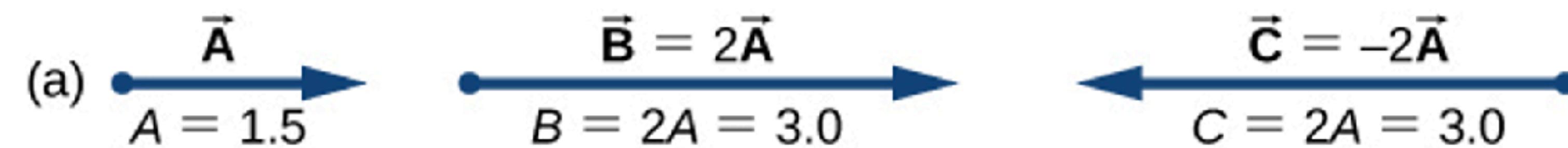
# Vectors

**Algebra of vectors in one dimension.**

# Vectors

**Algebra of vectors in one dimension.**

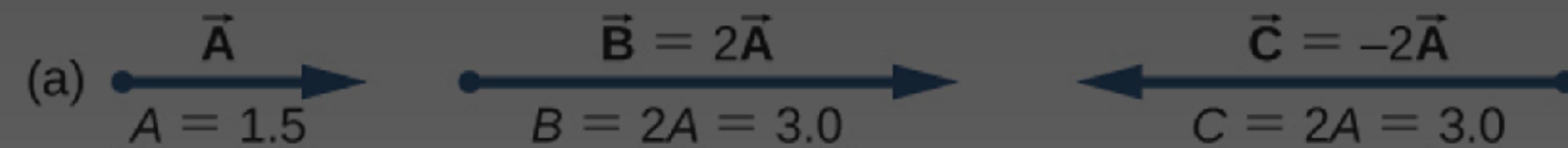
(a) Multiplication by a scalar.



# Vectors

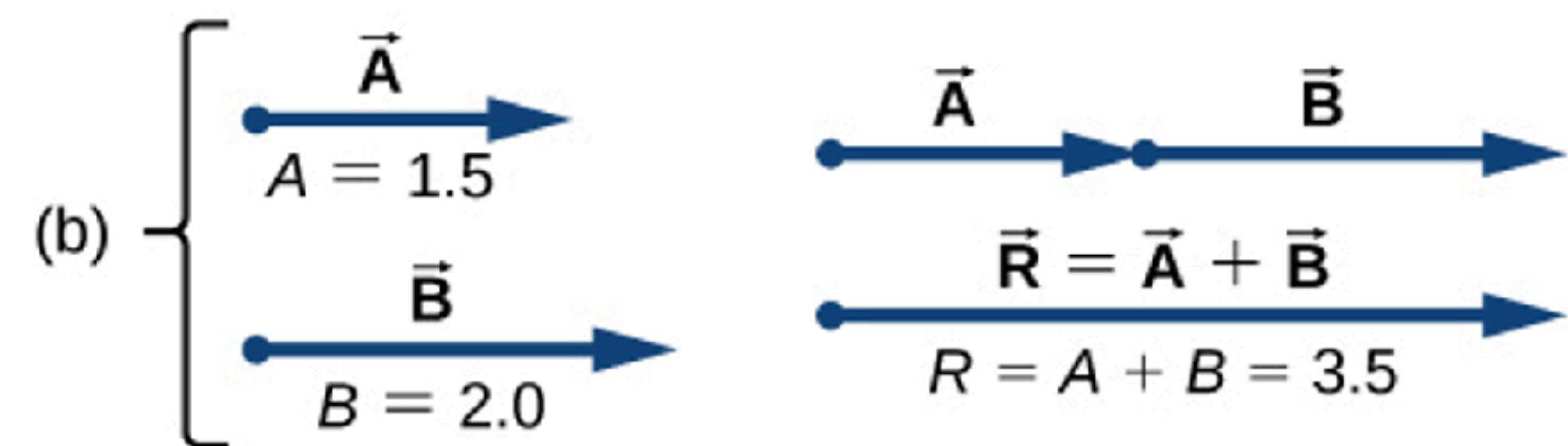
## Algebra of vectors in one dimension.

(a) Multiplication by a scalar.



(b) Addition of two vectors

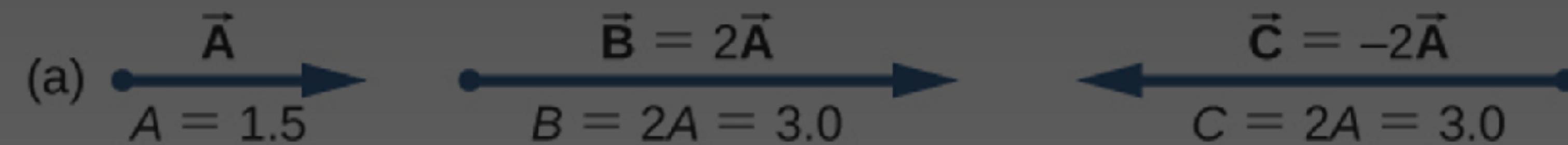
$\vec{R}$  is called the *resultant* of vectors  $\vec{A}$  and  $\vec{B}$ .



# Vectors

## Algebra of vectors in one dimension.

(a) Multiplication by a scalar.



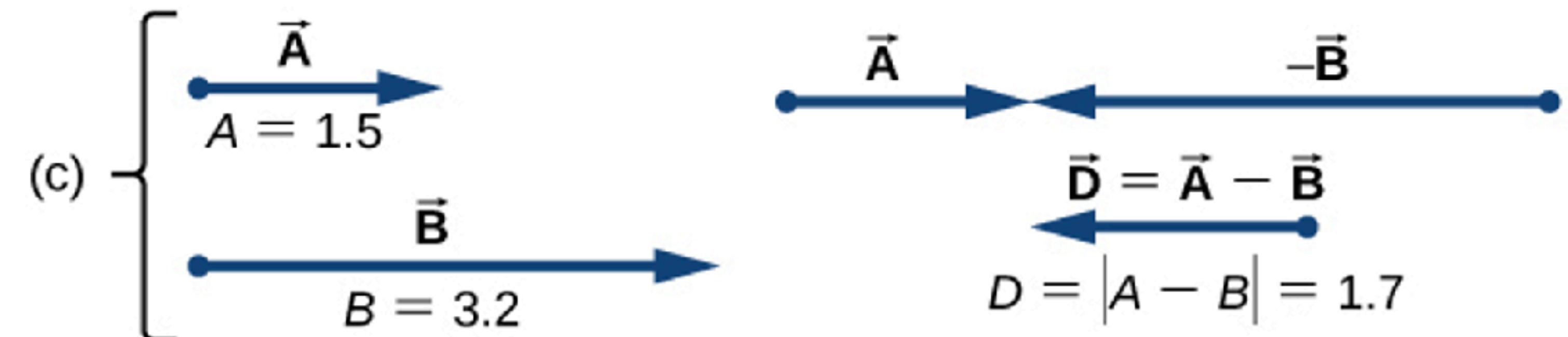
(b) Addition of two vectors

$\vec{R}$  is called the *resultant* of vectors  $\vec{A}$  and  $\vec{B}$ .

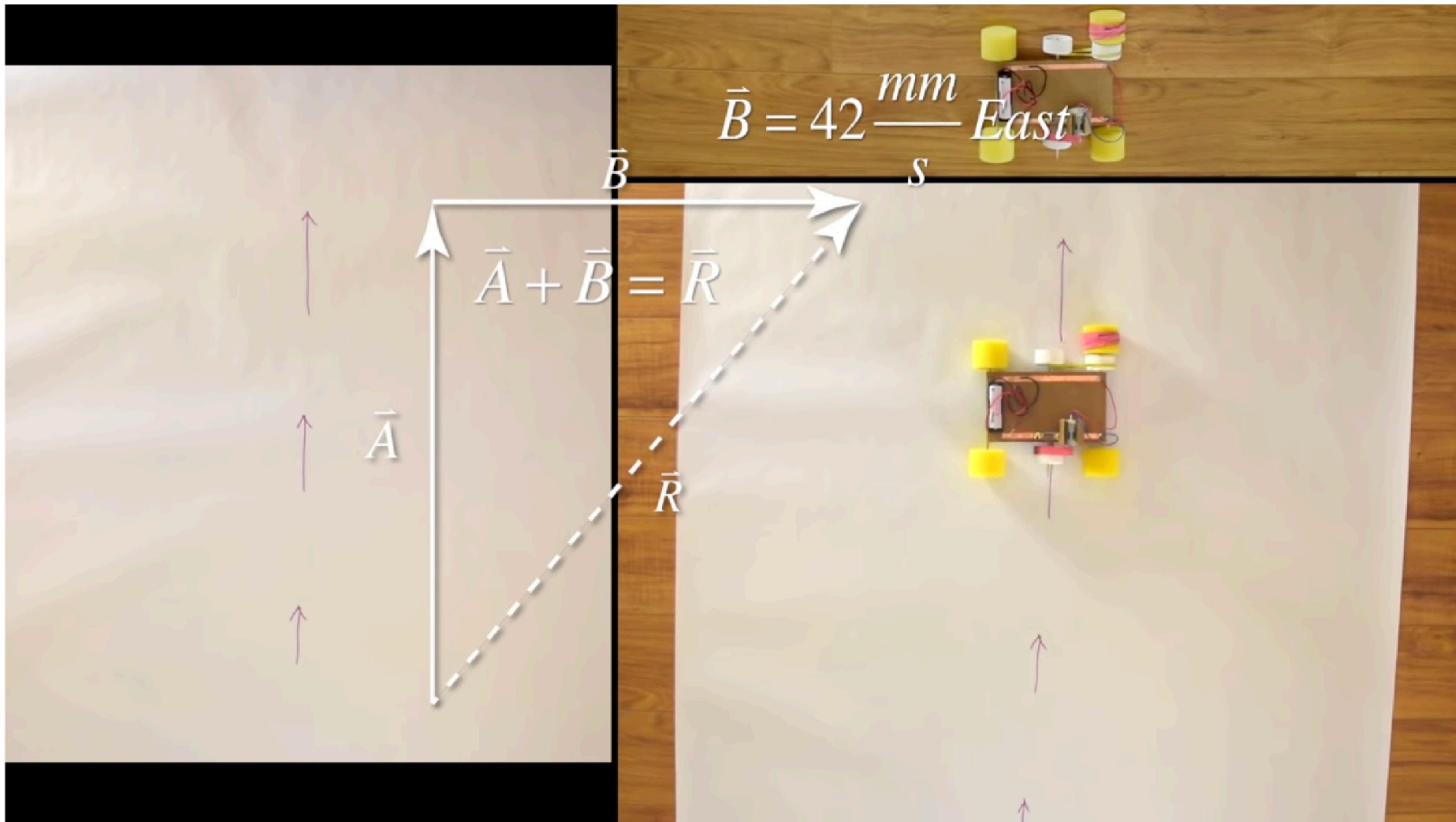


(c) Subtraction of two vectors

$\vec{D}$  is the difference of vectors  $\vec{A}$  and  $\vec{B}$ .



### 3. Introductory Tip-to-Tail Vector Addition Problem

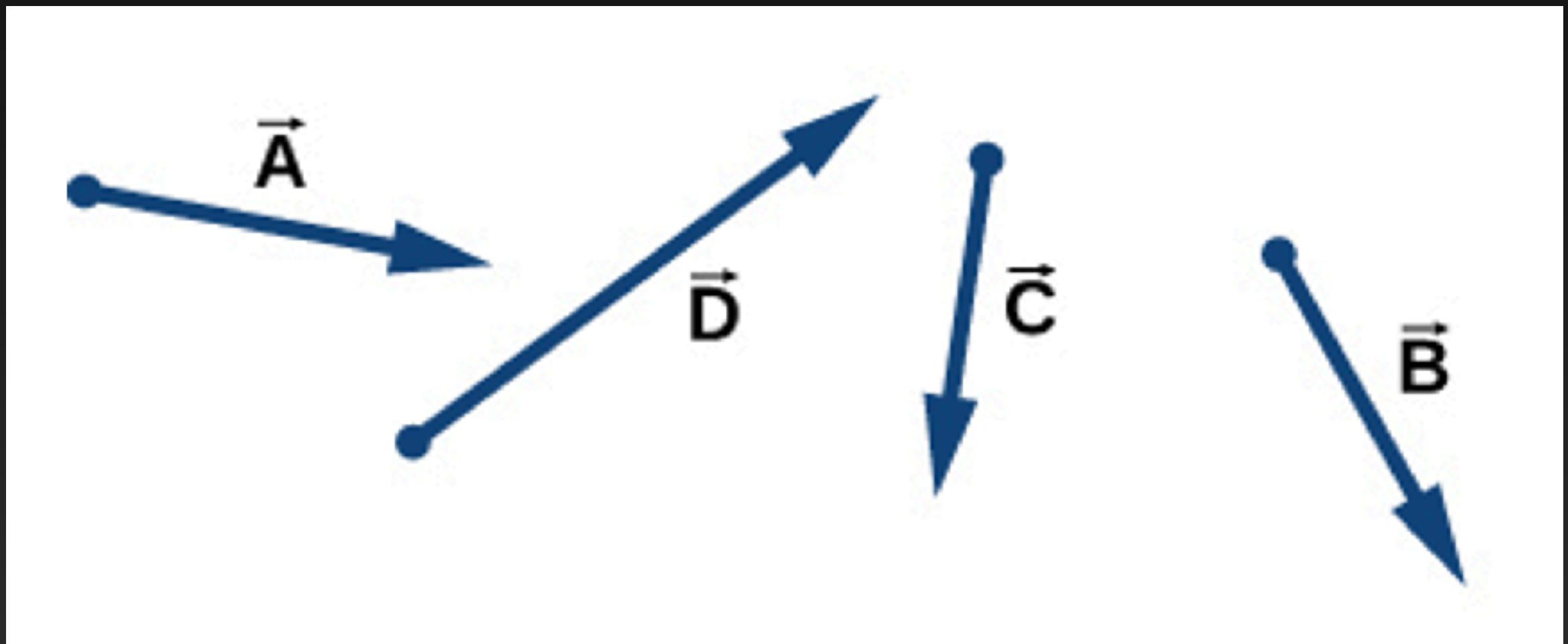


# Tail-to-head Method

Here are four vectors, with varying lengths and directions.

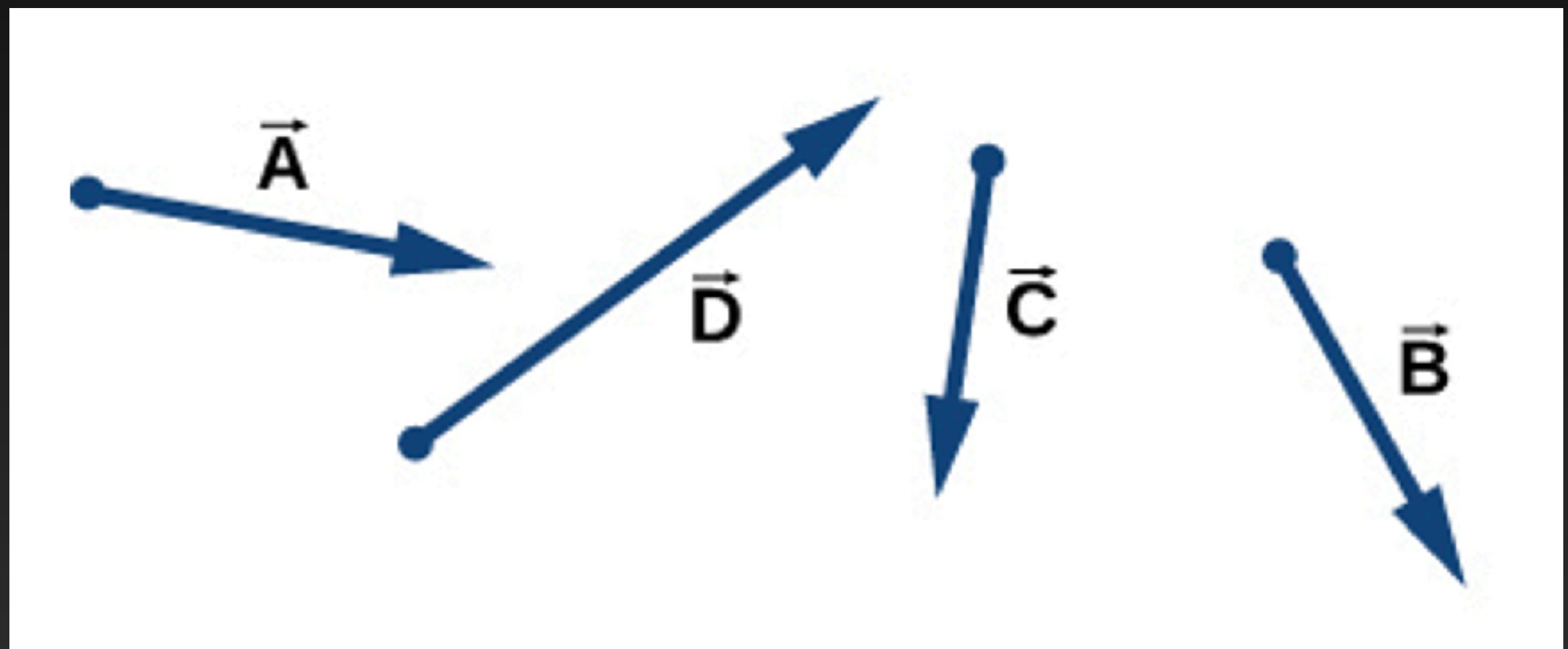
What is the resultant vector?

$$\vec{R} = \vec{A} + \vec{B} + \vec{C} + \vec{D}$$



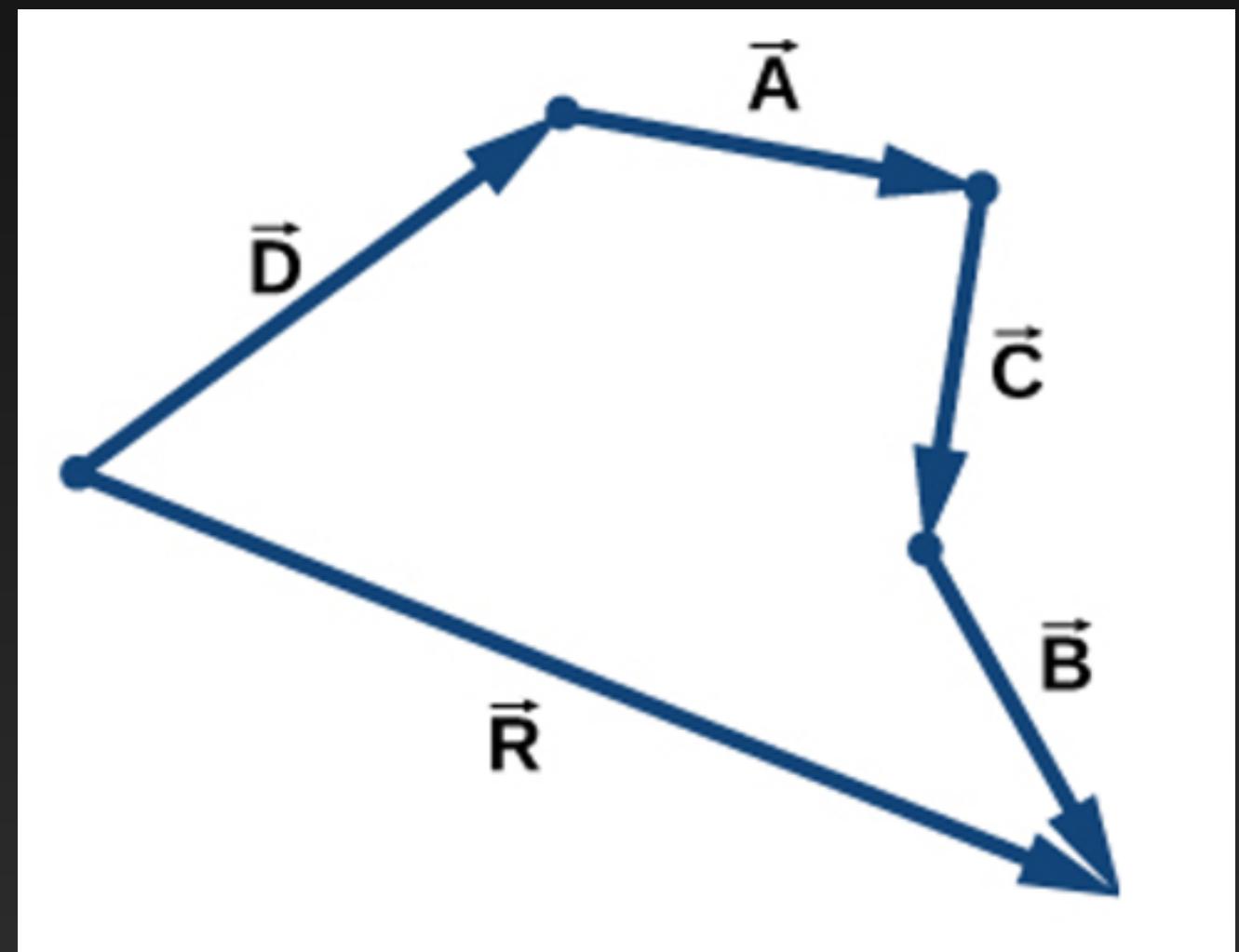
# Tail-to-head Method

Here are four vectors, with varying lengths and directions.

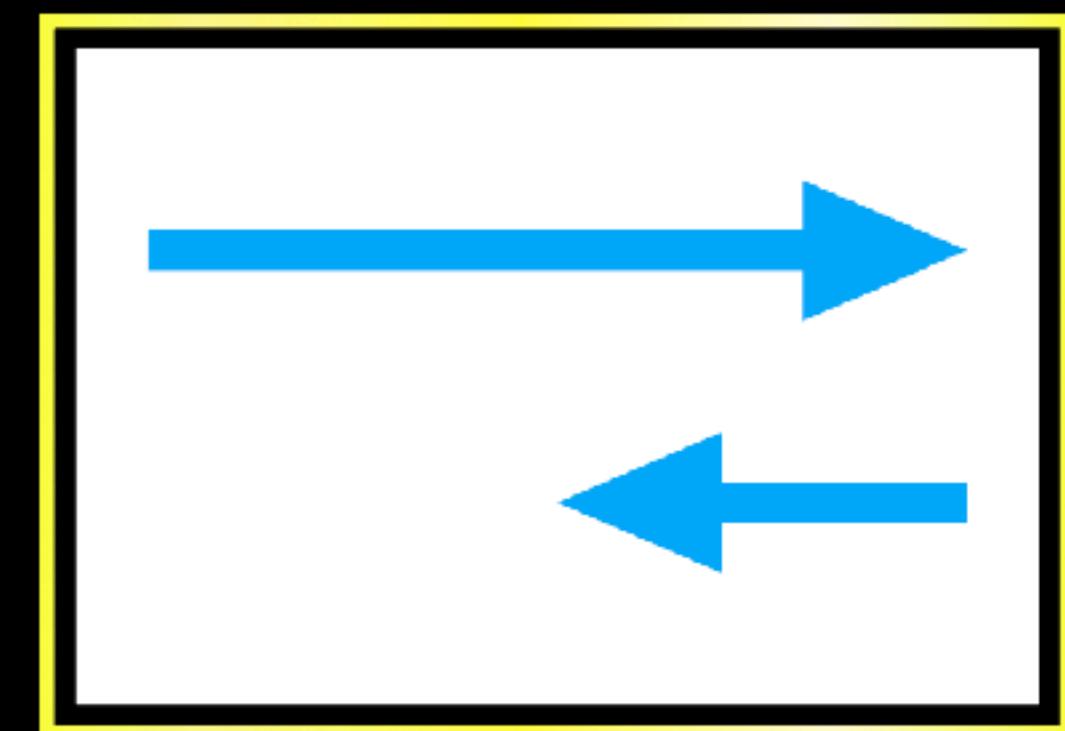


What is the resultant vector?

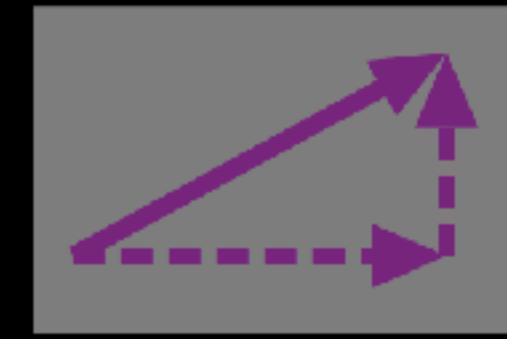
$$\vec{R} = \vec{A} + \vec{B} + \vec{C} + \vec{D}$$



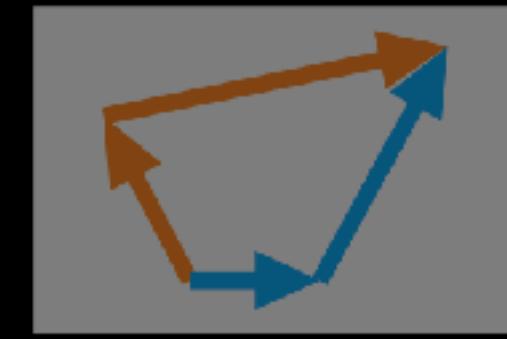
# Vector Addition



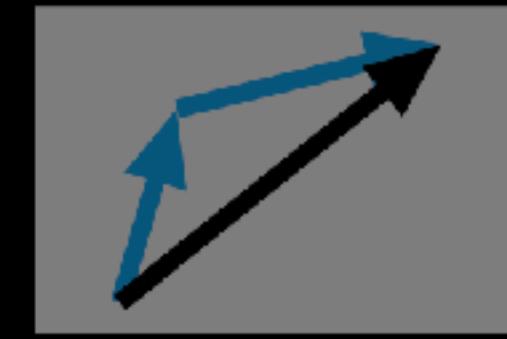
Explore 1D



Explore 2D

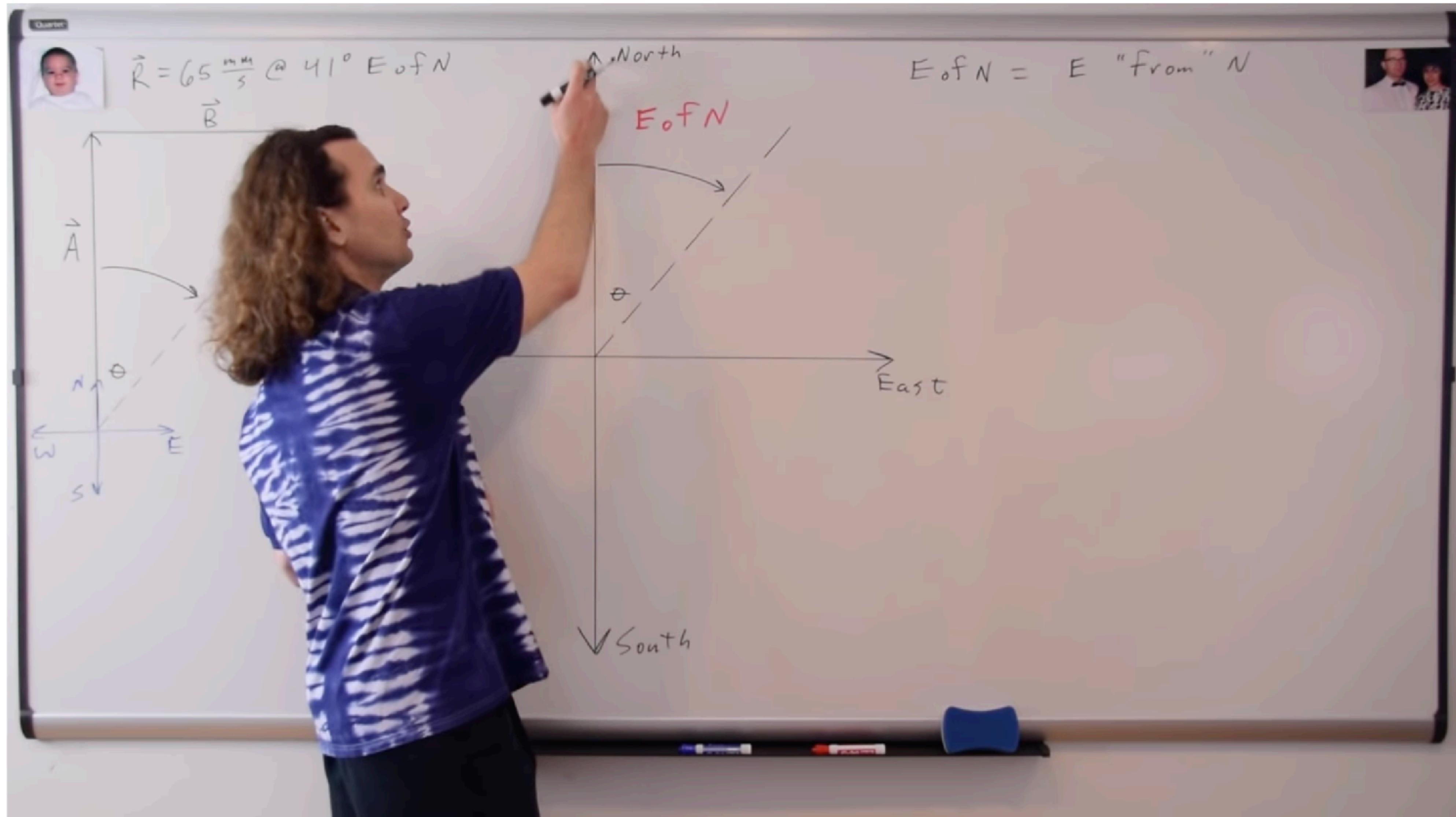


Lab



Equations

## 5. How to use Cardinal Directions with Vectors



# Clicker Questions

# CQ.2.1

Terry walks south 39 m, then north 27 m, and then north again 16 m. What are the distance and displacement of her motion?

- a) Terry covers a total distance of 82 m, and her displacement is 4 m towards east.
- b) Terry covers a total distance of 82 m, and her displacement is 4 m towards west.
- c) Terry covers a total distance of 82 m, and her displacement is 4 m towards north.
- d) Terry covers a total distance of 82 m, and her displacement is 4 m towards south.

A

B

C

D

E

# CQ.2.2

Maud sends her bowling ball straight down the center of the lane, getting a strike. The ball is brought back to the holder mechanically. What are the ball's net displacement and distance traveled?

- a) Displacement of the ball is twice the length of the lane, while the distance is zero.
- b) Displacement of the ball is zero, while the distance is twice the length of the lane.
- c) Both the displacement and distance for the ball are equal to zero.
- d) Both the displacement and distance for the ball are twice the length of the lane.

A

B

C

D

E

## CQ.2.3

A ship sailing in the Gulf Stream is heading  $25.0^\circ$  west of north at a speed of 4.00 m/s relative to the water. Its velocity relative to the Earth is 4.80 m/s  $5.00^\circ$  west of north. What is the velocity of the Gulf Stream? (The velocity obtained is typical for the Gulf Stream a few hundred kilometers off the east coast of the United States.)

- a) 8.67 m/s,  $14.1^\circ$  N of W
- b) 1.72 m/s,  $42.3^\circ$  N of W
- c) 1.72 m/s,  $42.3^\circ$  N of E
- d) 8.80 m/s,  $30.0^\circ$  W of N

# Problem Solving Template

PHYSICAL REVIEW PHYSICS EDUCATION RESEARCH **16**, 010123 (2020)

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## Template for teaching and assessment of problem solving in introductory physics

E. W. Burkholder<sup>1,\*</sup>, J. K. Miles,<sup>2</sup> T. J. Layden,<sup>2</sup> K. D. Wang,<sup>3</sup>  
A. V. Fritz<sup>4</sup> and C. E. Wieman<sup>1,3</sup>

# 1. Framing

Visual Representation

Assumptions and Simplifications

Relevant Concepts

Information Needed

Similar Problems

# 2. Planning

Solution Plan

Rough Estimate

# 3. Execution

Carry-out Plan for solving

- Work in algebra/symbols until the BITTER end
- Plug in numbers at the LAST step

# 4. Answer Checking

Compare to Estimate

Units Check

Limits Test

Getting (UnStuck)

# Growth Mindset

## Why Does Mindset Matter?

Designed by GA-CTL Workgroup: Crystal Edenfield  
Rhonda Porter  
Deborah Walker  
Joyce Weinsheimer  
Lisa Yount



# Why Does Mindset Matter?

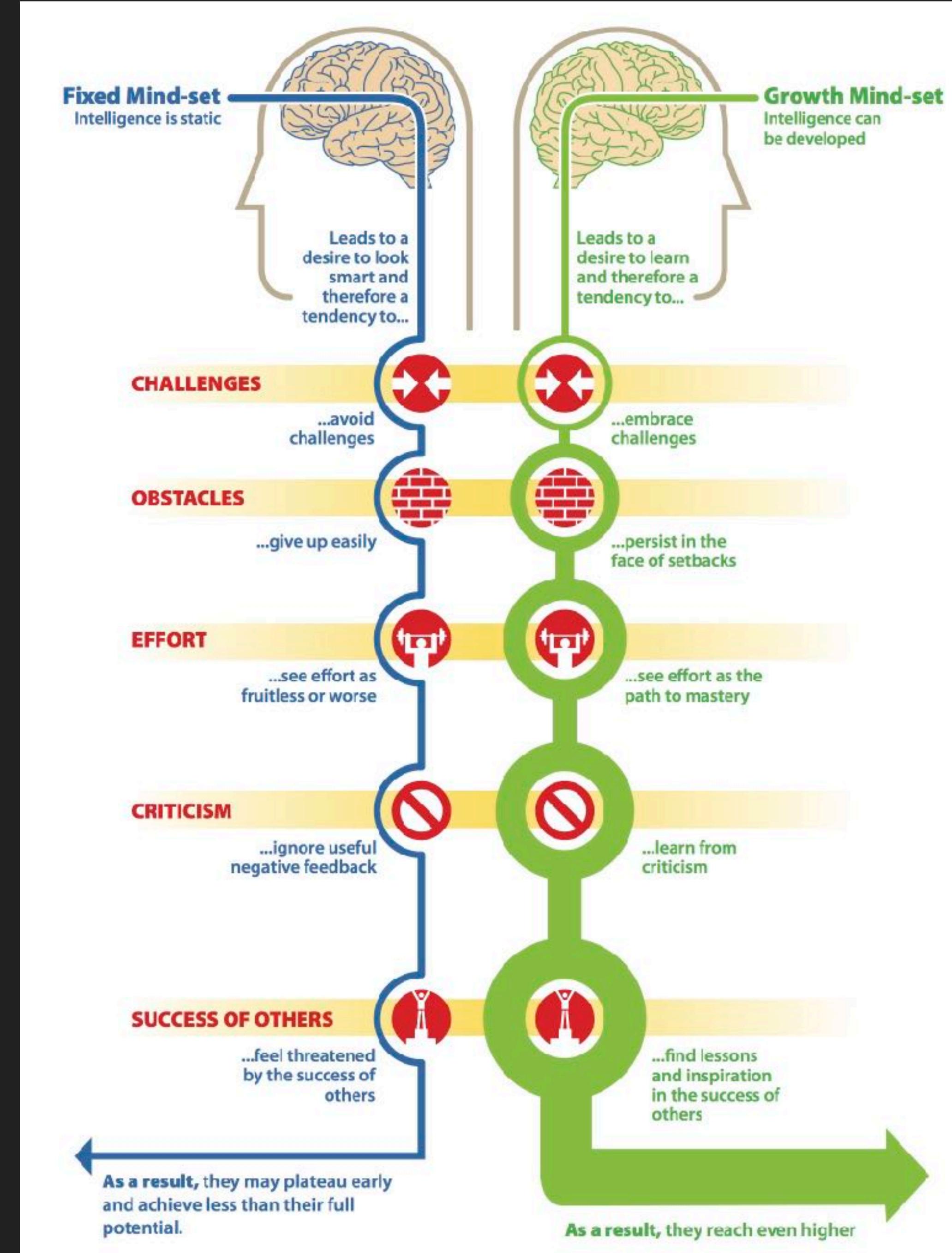
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Lisa Yount

# What is mindset?

Mindsets are beliefs and perceptions about learning.

# Fixed vs. Growth

- A fixed mindset is based on the belief that your qualities are carved in stone
- A growth mindset is based on the belief that your basic qualities are things you can cultivate through your **efforts**, your **strategies**, and **help from others**



By [Nigel Holmes](#) based on the work of Carol Dweck

# Why does mindset matter?

# Resources

## Books

- Dweck, C. (2016). Mindset: The new psychology of success. Penguin Random Hofuse, New York, New York.
- Major, C. H., Harris, M. S., & Zakrajsek, T. (2016). Teaching for learning: 101 intentionally designed educational activities to put students on the path to success. Taylor & Francis, New York, New York.
- McGuire, S. Y. (2015). Teach students how to learn: Strategies you can incorporate into any course to improve student metacognition, study skills, and motivation. Stylus Publishing, Sterling, Virginia.

## Websites

- <https://www.mindsetkit.org/topics/about-growth-mindset/what-is-growth-mindset>
- <http://mindsetscholarsnetwork.org/>

# Activity

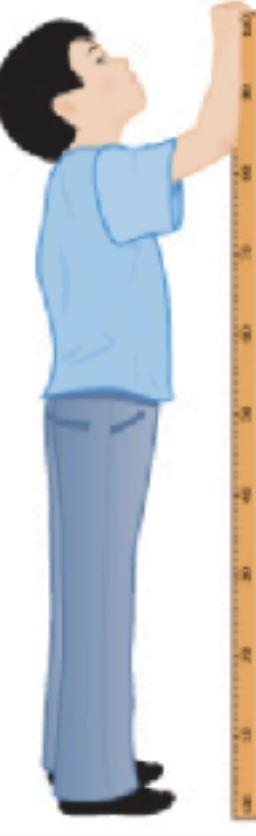
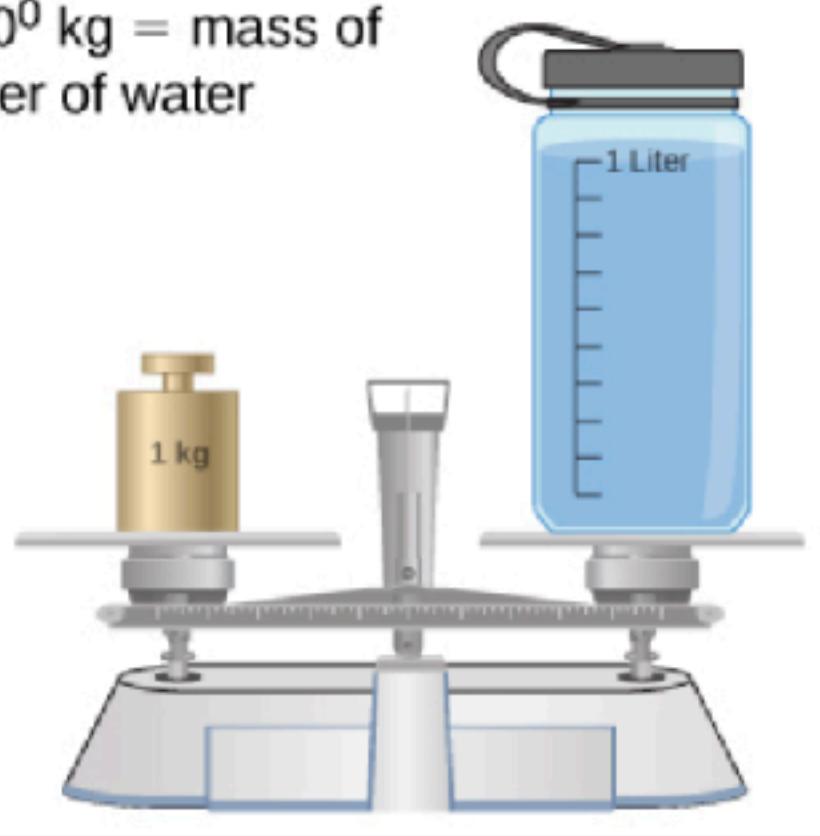
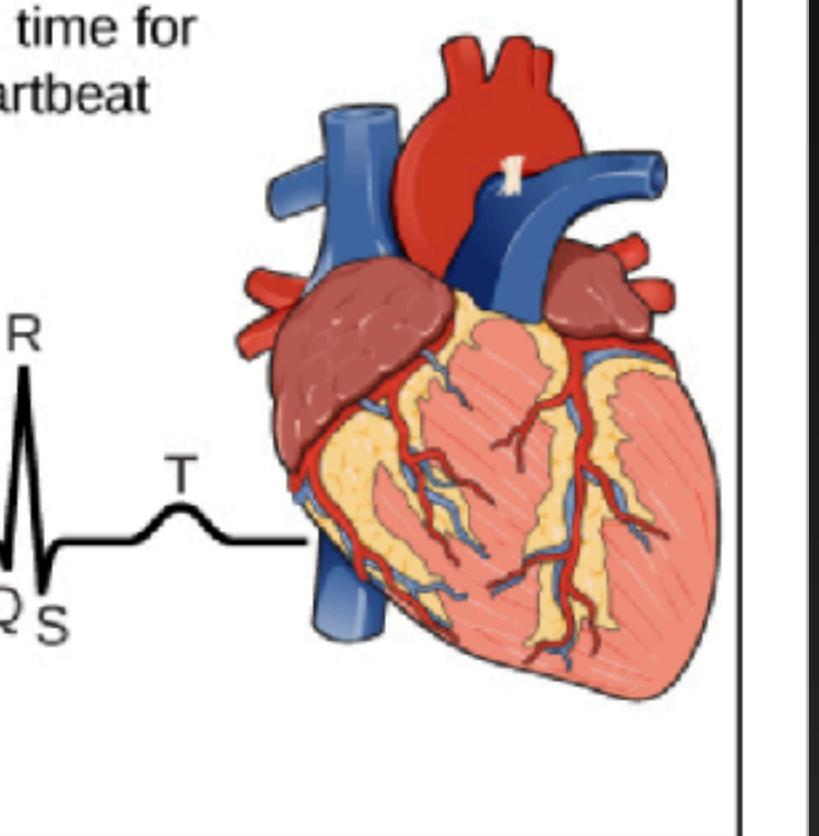
Length in Meters (m)	Masses in Kilograms (kg)	Time in Seconds (s)
$10^{-15}$ m = diameter of proton	$10^{-30}$ kg = mass of electron	$10^{-22}$ s = mean lifetime of very unstable nucleus
$10^{-14}$ m = diameter of large nucleus	$10^{-29}$ kg = mass of proton	$10^{-16}$ s = time for single floating-point operation in a supercomputer
$10^{-10}$ m = diameter of hydrogen atom	$10^{-28}$ kg = mass of bacterium	$10^{-15}$ s = time for one oscillation of visible light
$10^{-9}$ m = diameter of typical virus	$10^{-27}$ kg = mass of mosquito	$10^{-13}$ s = time for one vibration of an atom in a solid
$10^{-2}$ m = pinky fingernail width	$10^{-26}$ kg = mass of hummingbird	$10^{-9}$ s = duration of a nerve impulse
$10^0$ m = height of 4 year old child	 $10^0$ kg = mass of liter of water	 $10^0$ s = time for one heartbeat
$10^1$ m = length of football field	$10^2$ kg = mass of person	 $10^1$ s = one day
$10^2$ m = diameter of Earth	$10^{19}$ kg = mass of atmosphere	$10^2$ s = one year
$10^3$ m = diameter of solar system	$10^{22}$ kg = mass of Moon	$10^3$ s = human lifetime
$10^{16}$ m = distance light travels in a year (one light-year)	$10^{24}$ kg = mass of Earth	$10^{17}$ s = recorded human history
$10^{24}$ m = Milky Way diameter	$10^{30}$ kg = mass of Sun	$10^{17}$ s = age of Earth
$10^{26}$ m = distance to edge of observable universe	$10^{53}$ kg = upper limit on mass of known universe	$10^{17}$ s = age of the universe

Figure 1.4 This table shows the orders of magnitude of length, mass, and time.

**See you next class!**