Chapter C2: Vectors

Physics is an attempt to quantify aspects of our experience. Often this takes the following form. Quantities are operationally defined. The resulting quantities (mass, velocity, weight, torque, etc.) are some sort of a mathematical object. A mathematical language is then used to state relationships between different quantities.

Different questions about nature lead to different quantities.

1. Scalars:

2. Vectors:

In order for mathematics to come alive (and be of any use) we need to figure out how types of mathematical objects "interact." That is, we need to say how they "add" or "multiply" or something.

Vectors. To bring vectors to life we need to do two things. We must say what they are, and then figure out how to add them.

What is a Vector??

Examples: Fun with Maps

Important notes:

1. The idea of vectors is pretty intuitive. The notation and trigonometry can get confusing. If you get confused, try to take a step back and remind yourself of the concept.

2. There is essentially no physics in this chapter—it's all mathematics.

3. Vectors are not "attached" anywhere. "They're just arrows."

4. Like real numbers, vectors can have any unit attached to them. (See C2.7.)

5. The components of a vector are scalars, not vectors. Components can be negative, though.

6. Notation is important – be clear about what's a vector and what's a scalar.

Ok. What can we do with vectors?

Vector Addition:

Think of displacements. Vectors add “tip to tail.”

Scalar Multiplication:

What does multiplication of two numbers mean?

$$3 * 4 =$$

Multiplying a vector by a number is defined in the same way.

Subtraction

How do we define negative numbers?

We define “negative vectors” in the same way.

MDI Vectors

Consider the following vectors:

- $\vec{a}$ = the displacement from the intersection of Rts. 198 and 233 to COA.
- $\vec{b}$ = the displacement from COA to the Bar Harbor Airport.
- $\vec{c}$ = the displacement from Otter creek to Southwest harbor.

1. Specify vectors $\vec{a}, \vec{b}, \vec{c}$ by giving their magnitude and direction. Use units of centimeters.
2. Using your ruler and protractor, determine the magnitude and direction of the following:
   (a) $\vec{a} + \vec{b}$
   (b) $\vec{b} + \vec{c}$
   (c) $\vec{c} - \vec{a}$
3. Specify vectors $\vec{a}, \vec{b}, \vec{c}$ by giving their components. Do not use trigonometry.
4. Give the components of the following:
   (a) $\vec{a} + \vec{b}$
   (b) $\vec{c} - \vec{a}$
5. Give the magnitude, direction, and components, of the following:
   (a) $3\vec{a}$
   (b) $2\vec{b} - 3\vec{c}$
6. Consider a displacement vector, whose components are 1 km west and 3 km north. Find this vector's magnitude and direction.
7. Consider a displacement vector whose magnitude is 100 meters and whose direction is 37 degrees west of north. Find this vector's components.