Intro to Vectors

A vector is defined by direction and magnitude.

Vectors vs. Segments
Vectors are similar to segments in that they have a defined *length*. The *length* of a vector is called its **magnitude**.

Vectors vs. Rays
Vectors are similar to rays in that they travel in a certain **direction**, but rays continue on infinitely in the **direction** they travel. Vectors do not.

Examples of Vectors

Velocity = Driving 60 mph due east on the highway

Magnitude = 60 mph (Speed)
Direction = Which way you are moving (East)

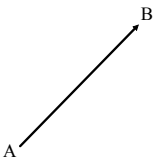
Wind Speed = 20 mph out of the North

Magnitude = 20
Direction = North

Force (Physics) = Pulling a wagon

Magnitude = How hard you are pulling the wagon
Direction = Which way you are pulling it

Labeling Vectors



$\overrightarrow{AB}$

A = Initial point
B = Terminal point

$|\overrightarrow{AB}|$ = Magnitude of vector AB = Length of AB

Equivalent vectors have the exact same magnitude and direction.

Opposite vectors have the exact same magnitude but opposite directions.

Labeling Vectors (Part 2)

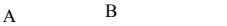
A negative in front of a vector gives you a vector with the same magnitude but in the opposite direction (**opposite vectors**).

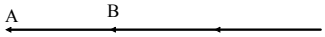
$\overrightarrow{AB}$ =

$-\overrightarrow{AB} = \overrightarrow{BA}$ = 

A **scalar** (a non-variable number) in front of a vector gives you a vector in the same direction but the magnitude that is multiplied by the scalar.

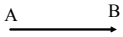
$\overrightarrow{AB}$ = 

$2\overrightarrow{AB}$ = 

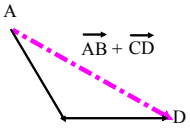
$-3\overrightarrow{AB}$ = 

Adding Vectors

Adding two vectors can be done using what is called the "tip to tail" method.

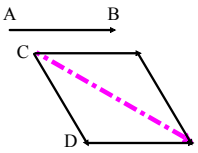
$\overrightarrow{AB}$ = 

$\overrightarrow{CD}$ = 



Adding Vectors (Part 2)

Another way to look at adding two vectors is using something called the **parallelogram law**. Instead of putting them tip to tail, place them together so their initial points are at the same location.

$\overrightarrow{AB} + \overrightarrow{CD}$ = 

Properties of parallelograms:

1.) Opposite sides are congruent
2.) Opposite sides are parallel

Thus, adding two vectors would be the vector formed by the diagonal of the parallelogram drawn to the opposite vertex.

Subtracting Vectors (Part 2)

Subtracting vectors works the same way as subtracting integers. Subtracting an integer is the same as adding the opposite of the integer.

Example: 2 - 4 = 2 + (-4)

$\overrightarrow{AB} - \overrightarrow{CD} = \overrightarrow{AB} + (-\overrightarrow{CD})$

$= \overrightarrow{AB} + (\overrightarrow{DC})$

Special Vectors

A vector with the same initial and terminating point is called a **null vector**.

Other names for a null vector include:

Zero vector

Trivial vector

Thus, a vector that has a magnitude is called a **non-trivial vector**.

Vector Summary

- Vectors have 2 components: magnitude and direction
- Opposite vectors have same magnitude but opposite direction
- A positive scalar multiple of a vector adjusts the magnitude, not the direction
- A negative scalar multiple adjusts magnitude and in the opposite direction
- Add vectors using tip-to-tail
- Subtract vectors by adding the opposite of the subtracted vector
- A vector with no magnitude is called a null vector (also trivial or zero)

Vector Properties

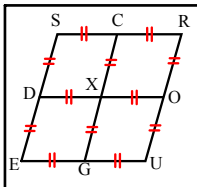
Define vectors **u**, **v**, and **w**

- Commutative Property $\mathbf{u} + \mathbf{v} = \mathbf{v} + \mathbf{u}$
- Associative Property $(\mathbf{u} + \mathbf{v}) + \mathbf{w} = \mathbf{u} + (\mathbf{v} + \mathbf{w})$
- Additive Identity $\mathbf{u} + \mathbf{0} = \mathbf{0} + \mathbf{u} = \mathbf{u}$
- Additive Inverse $\mathbf{u} + (-\mathbf{u}) = (-\mathbf{u}) + \mathbf{u} = \mathbf{0}$

Vector Properties with Scalars

Define vectors **u** and **v,** and scalars α and β

- Commutative Property $\alpha\mathbf{u} = \mathbf{u}\alpha$
- Associative Property $\alpha(\beta\mathbf{u}) = (\alpha\beta)\mathbf{u}$
- Distributive Property $\alpha(\mathbf{u} + \mathbf{v}) = \alpha\mathbf{u} + \alpha\mathbf{v}$
- Distributive Property $1\mathbf{v} = \mathbf{v}$
- Property of Zero $\mathbf{0v} = \mathbf{0}$ and $\alpha(\mathbf{0}) = \mathbf{0}$



Using only the letters in the diagram, find vectors with the same direction & magnitude as the vectors below. Only list vectors with no scalar and no negatives.

1.) $\overrightarrow{DO}$

2.) $\overrightarrow{GX}$

3.) $\overrightarrow{OC}$

4.) $\overrightarrow{UD}$

5.) $\overrightarrow{SU}$

6.) $-\overrightarrow{CR}$

7.) $-\overrightarrow{GR}$

8.) $2\overrightarrow{DG}$

9.) $1/2\overrightarrow{OD}$

10.) $-1/2\overrightarrow{SU}$

Homework

11A p.558 #1-2

11B p.562 #1-4