

**VECTOR OPERATIONS****LEARNING GOALS**

Students will:

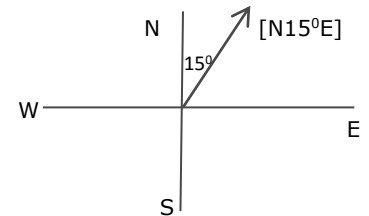
- Describe vectors graphically and mathematically
- Add and subtract vectors using mathematical methods

**VECTORS**

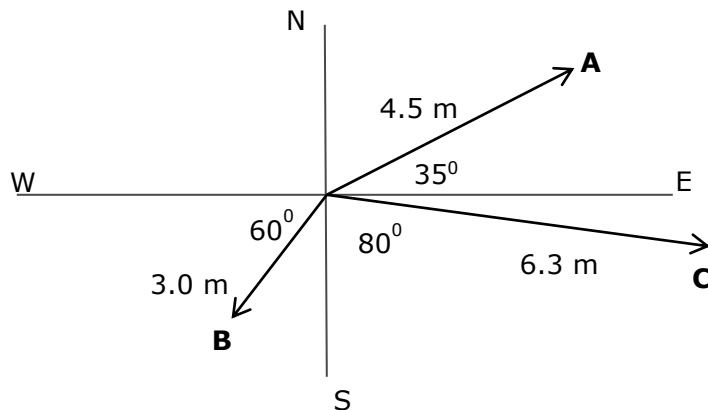
1. Write a definition for a vector:

**STEPS TO DRAWING VECTORS**

1. Draw an x,y axis.
2. Measure the angle starting from the x-axis or based on the letter direction provided. A direction like [N15°E] is read "north, fifteen degrees east". This direction is found by starting at the north line and measuring 15° towards the east. Note: [N15°E] can also be written as [15° E of N]

**WRITING VECTORS**

1. Here are some vectors drawn in a horizontal plane (not to scale):



- a) State each vector in the form *magnitude [direction]* (e.g. 5.0 m [E25°N]):
  - A**
  - B**
  - C**
- b) Each vector has components in two of the main directions. For example, **A** has a north component and an east component as it is in between north and east. Sketch the components of each vector and use trigonometry to find the magnitude of each component.
  - A**
  - B**
  - C**



6. Repeat the additions you performed above by adding the components of the vectors. Also add all three vectors using the component technique. Draw a diagram for each one.  
(answer  $\mathbf{A} + \mathbf{B} + \mathbf{C} = 8.5 \text{ m [E}8^{\circ}\text{S]}$ )

$\mathbf{A} + \mathbf{B}$

$\mathbf{A} + \mathbf{B} + \mathbf{C}$

7. Why do you think you were not asked to do  $\mathbf{A} + \mathbf{B} + \mathbf{C}$  using sine and cosine law?

## SUBTRACTING VECTORS

The easiest way to subtract vectors is to add the negative.

EXAMPLE:

$$\mathbf{A} - \mathbf{B} = \mathbf{A} + (-\mathbf{B})$$

$$\begin{aligned}\mathbf{A} - \mathbf{B} &= 4.5 \text{ m [E}35^{\circ}\text{N]} + (-3.0 \text{ m [W}60^{\circ}\text{S]}) \\ &= 4.5 \text{ m [E}35^{\circ}\text{N]} + 3.0 \text{ m [E}60^{\circ}\text{N]}\end{aligned}$$

Note that you are now adding **A** to the negative or opposite direction of **B**.

Now you can perform the addition as you did above.

8. Do the following. Draw a diagram for each one.

**A - B** (finish the example)

**A - C**

(answers: **A - B** = 7.3 m [E45°N] **A - C** = 4.5 m [W56°N])

## PRACTICE

- Do the following vector operations on the given velocities. Use whichever method you prefer, but make sure you practice **both** methods.
  - 2.4 m/s [E] + 3.2 m/s [W]
  - 2.4 m/s [E] + 3.2 m/s [N]
  - 2.4 m/s [E] + 3.2 m/s [E45°S]
  - 2.4 m/s [E] + 3.2 m/s [W35°N]
  - 2.4 m/s [E35°N] + 3.2 m/s [W35°N]
  - 2.4 m/s [E] - 3.2 m/s [W35°N]
  - 2.4 m/s [E] + 3.2 m/s [W35°N] + 4.2 m/s [S10°W]
- Optional Online Activity: ExploreLearning.com has a vector Gizmo you can play with.

Answers:

- a) 0.8 m/s [W]    b) 4.0 m/s [E53°N]    c) 5.2 m/s [E26°S]    d) 1.8 m/s [W83°N]  
 e) 3.3 m/s [W78°N]    f) 5.3 m/s [E20°S]    g) 2.5 m/s [S22°W]