Vector and Scalars

Auburn Mountainview: Physics
Karl Steffin, 2006
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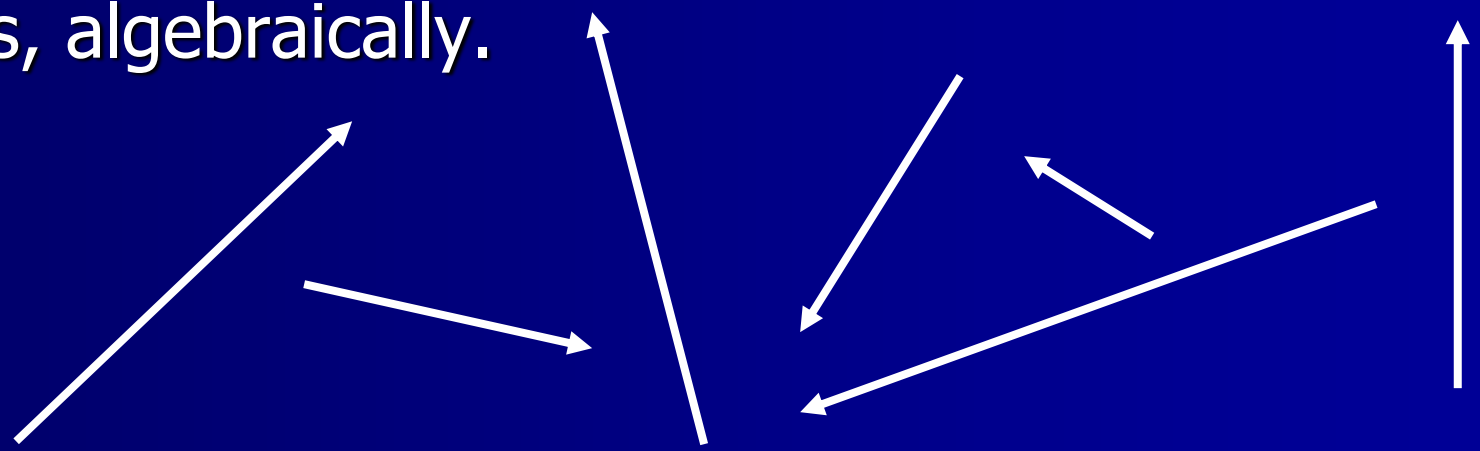
Scalars versus Vectors

- Scalar: A quantity that has a magnitude but no direction.
- Vector: A quantity that has both a magnitude (aka displacement) and direction.
  - Vectors can be represented graphically or more often in this class, algebraically.

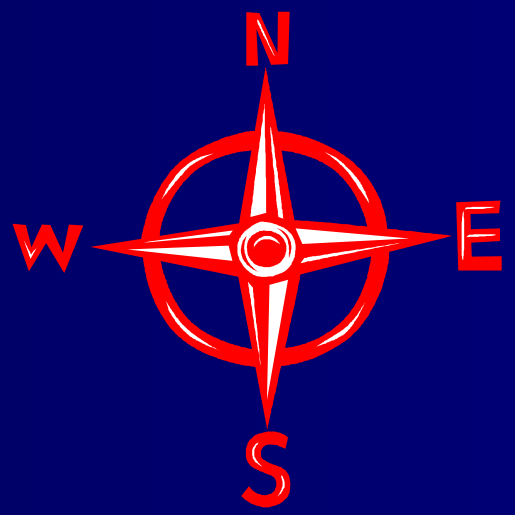


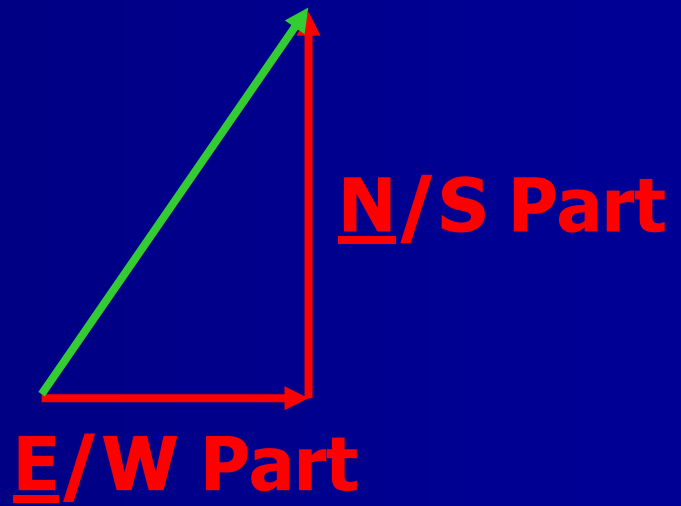
Magnitude/Displacement

- Graphically, magnitude is drawn as an arrow's length.
  - Longer arrows, larger magnitude.
- Algebraically, magnitude is assigned a number value.
  - The magnitude must have a unit such as meters for distances: 15.00-m.

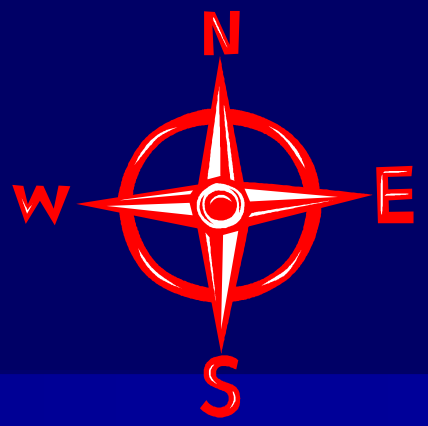
Direction

- Graphically direction is represented by an arrow (show direction: from tip to tail).
  - Direction can be broken down into two parts.
  - N/S, E/W: Cartesian Coordinate System.

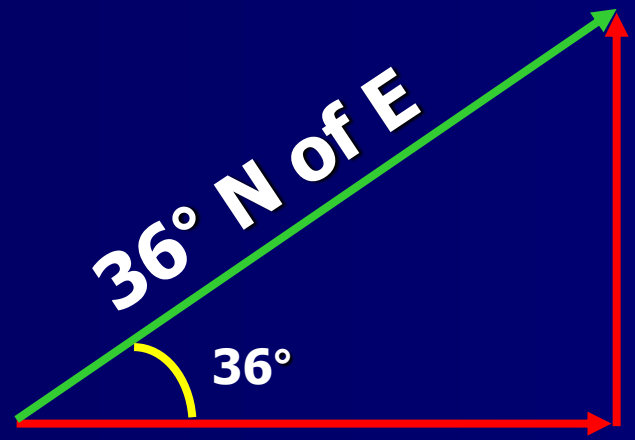


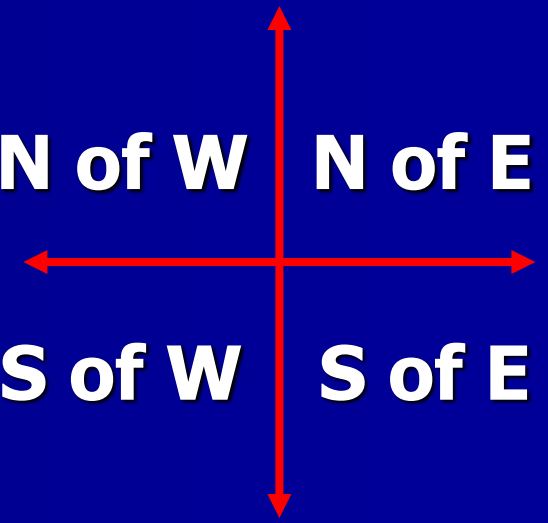


Direction



- Algebraically represent direction in degrees.
  - Use degrees not radians in class (check your calculator)
- Use the form x° N/S of E/W
  - Protractor is always lined up on the horizon



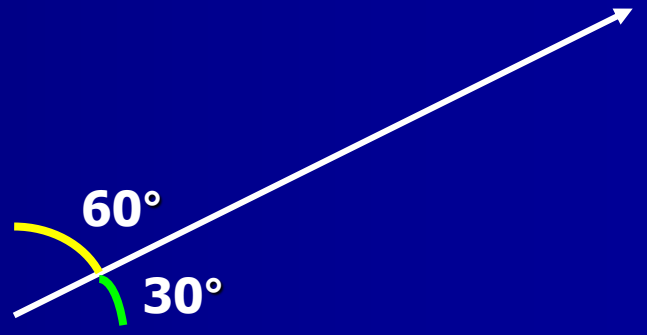


Quick Conventions I

- Looking at this vector:

60.00° E of N

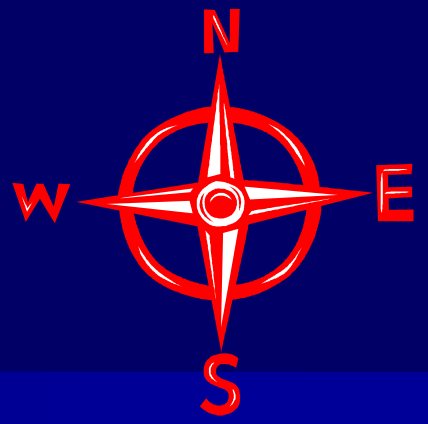
30.00° N of E



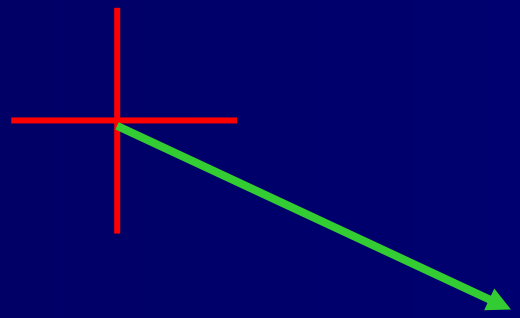
While both are true always put a protractor on the horizontal axis (E/W) and measure up to the north or down to the south.

- Again: Always use format: N/S of E/W

Vector Examples

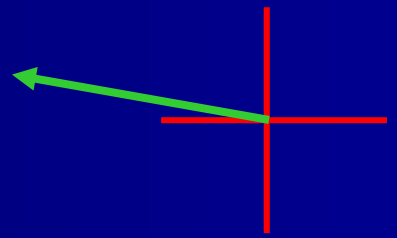


- All vectors need a magnitude and direction.
  - Measure magnitude with a ruler.
  - Measure direction with a protractor.



6.50-cm

25.00° S of E



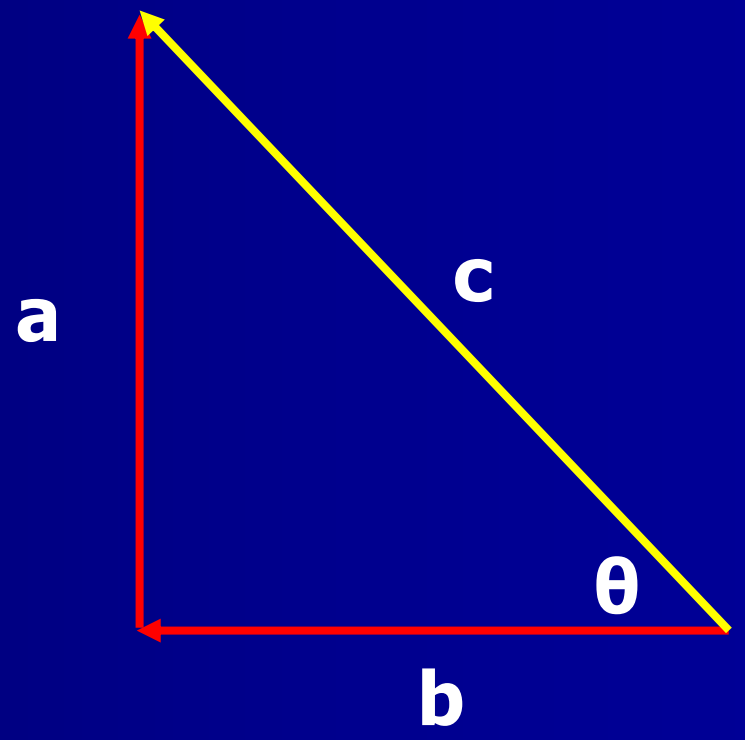
3.00-cm

10.00° N of W

Using Trig Formulas for Direction

- For 90° vectors:
  - $a^2 + b^2 = c^2$
  - $\sin \theta = a/c$
  - $\cos \theta = b/c$
  - $\tan \theta = a/b$
- Calculators…

  DEGREES MODE!



Basic math and vectors

$vector \pm vector = vector$

$9 - N\ N + 3 - N\ S = 6.00 - N\ N$

$vector \times or \div vector = scalar$

$6 - N\ E \times 2 - m\ N = 12.00 - J$

$vector \times or \div scalar = vector$

$5 - m\ E \times 2 = 10.00 - m\ E$

$vector \pm or\ scalar = undefined$

$5 - m\ W + 10 - s = ????$

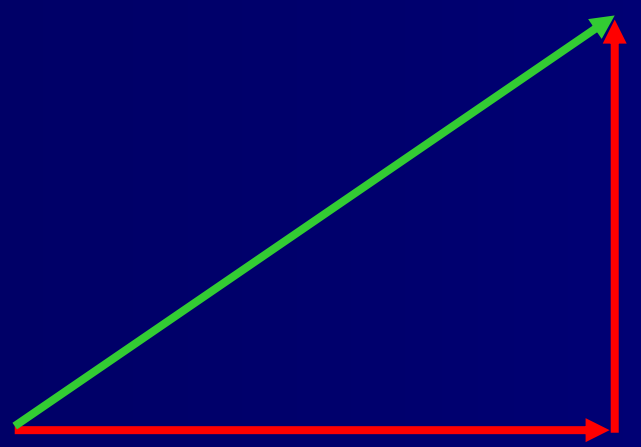
Always determine if the result is a vector or scalar.

Vectors and scalars

- When multiplying or dividing a vector by a scalar you only need to track two things:
  - Either multiply or divide the magnitude of the vector.
  - If the scalar is a negative number, reverse the direction of the vector.

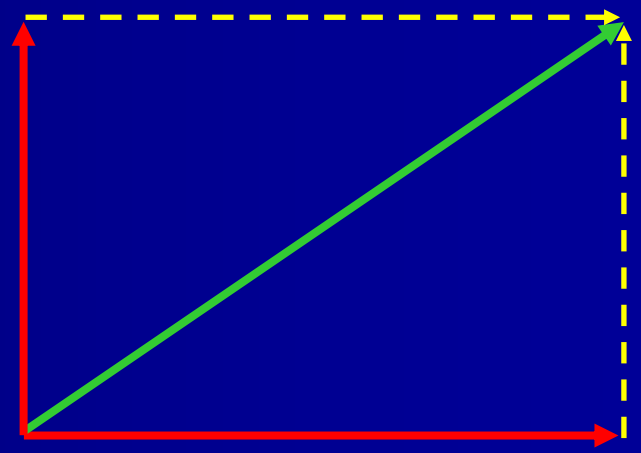
Breaking Down Vectors

- If you have a vector you can break it down into an x and y component.
  - Calculus (x~i, y~j)
  - ($6i$, $4j$) → tail at (0,0) tip at (6,4)



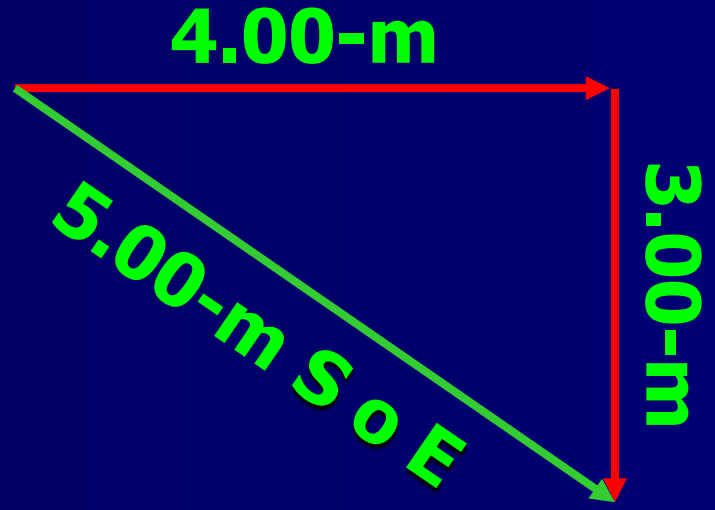
N-S comp: j

E-W comp: i



Class Convention

- The word magnitude is normally used to denote an absolute value.
  - Note if a vector is S or W graphically it should be written as a positive value, algebraically it should be negative.



4-m E **-3-m S**

$(4\text{-m})^2 + (-3\text{-m})^2 = c^2$

c = 5-m

(hypotenuse always +)