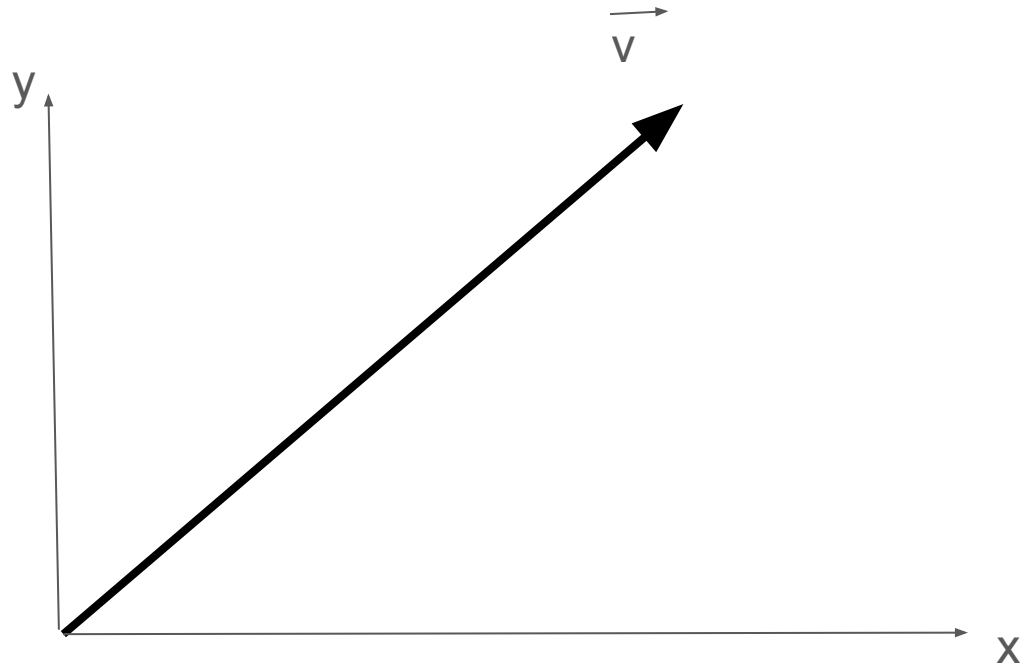
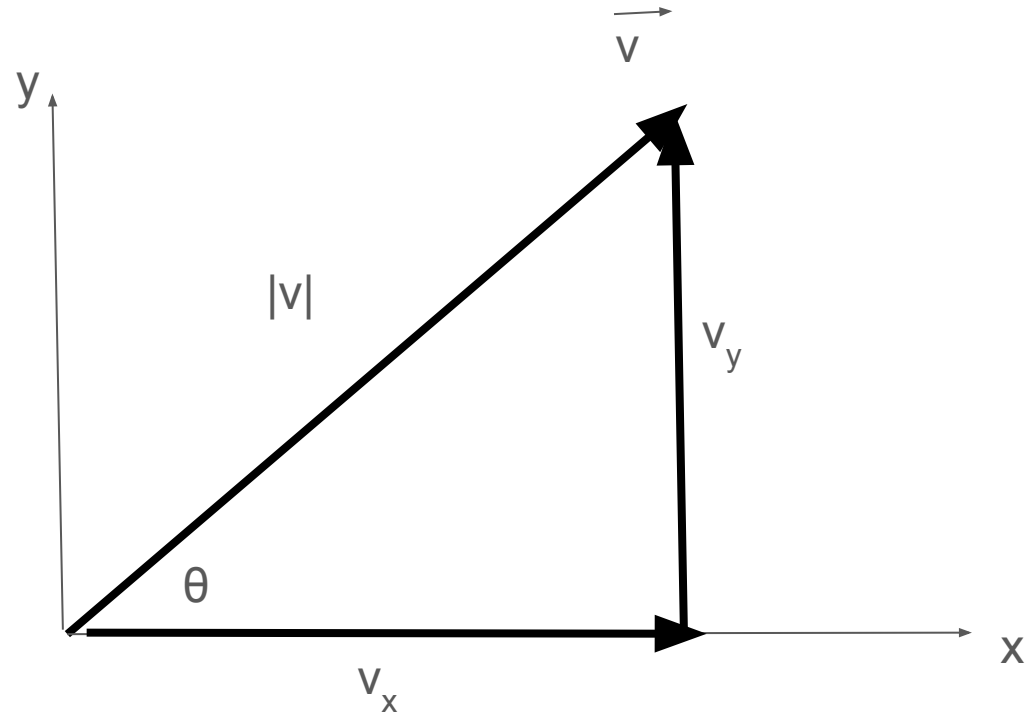
Vectors

1. Magnitude
    - Length of the vector
2. Direction
    - Where the vector points
    - Usually express as the angle vector makes with the +x-axis
    - Traditionally between 0 and 360°

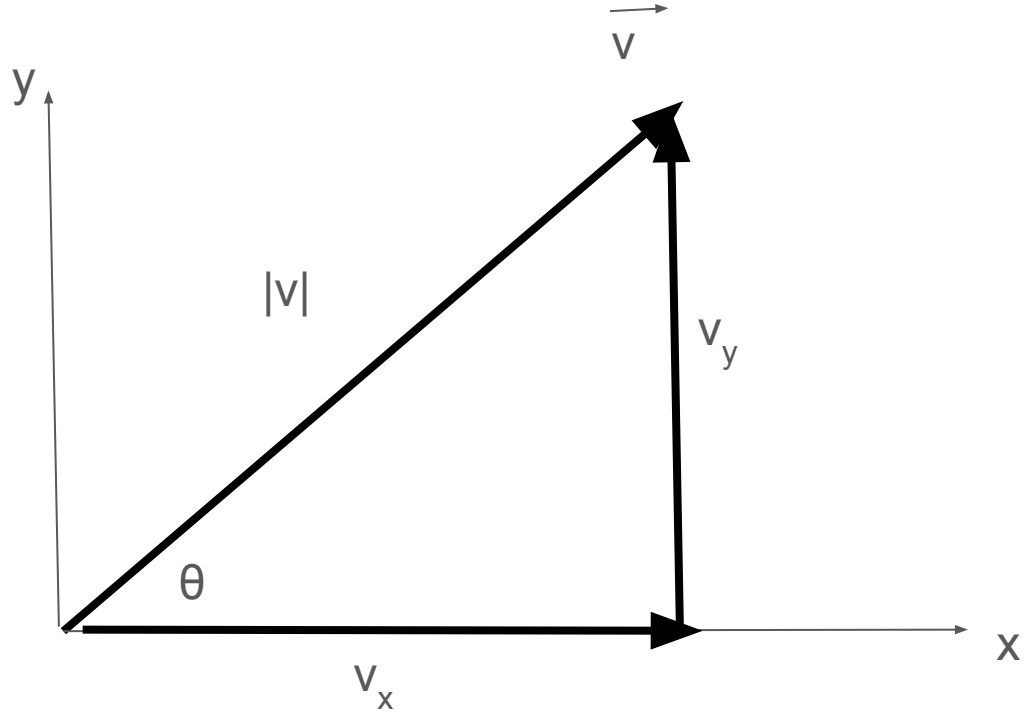
Vectors



Vectors



Vectors



$v_x = |v| \cos(\theta)$

$v_y = |v| \sin(\theta)$

$\theta = \tan^{-1}(v_y / v_x)$

$|v|^2 = v_x^2 + v_y^2$

Vectors — Expressing vectors

1. Component form
   - $v = \langle v_x, v_y \rangle$
   - eg. — $v = \langle 3, -4 \rangle$
2. Magnitude and direction
   - $v = 5 \text{ @ } 306.9^\circ$

$$v_x = |v| \cos(\theta)$$

$$v_y = |v| \sin(\theta)$$

$$\theta = \tan^{-1} (v_y / v_x)$$

$$|v|^2 = v_x^2 + v_y^2$$

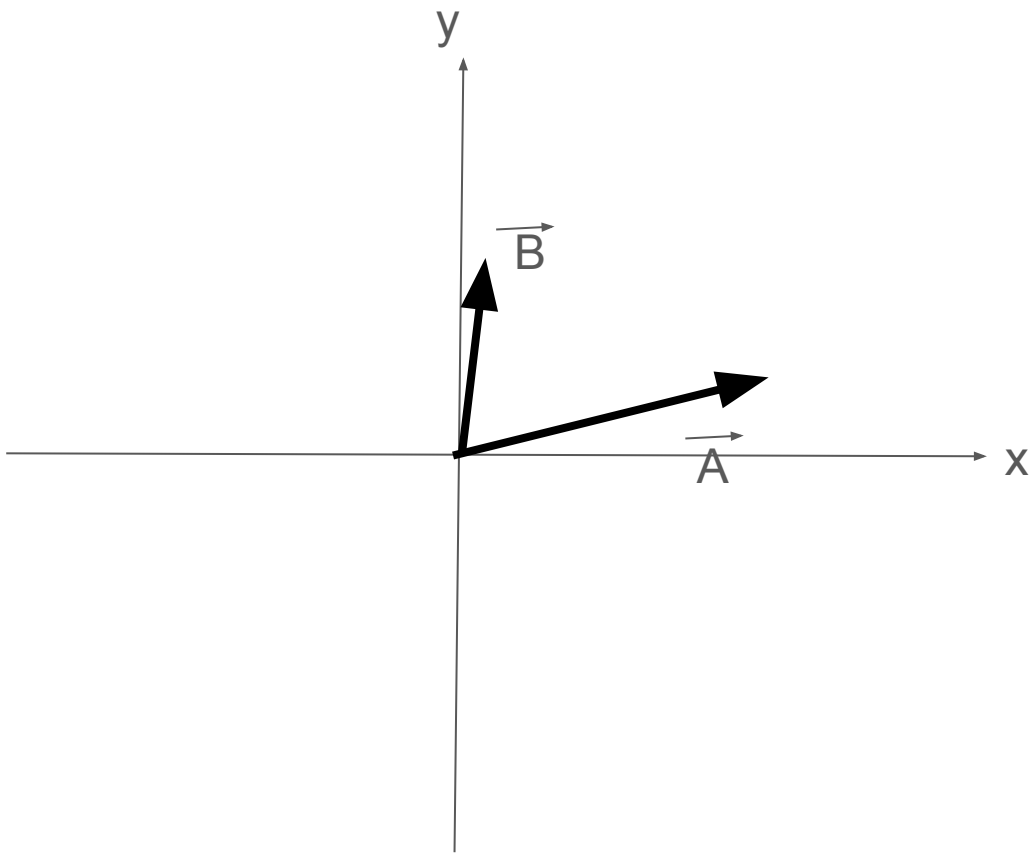
Vectors — Example

1. Vector A has magnitude 10 and makes a 30° with the +x-axis.

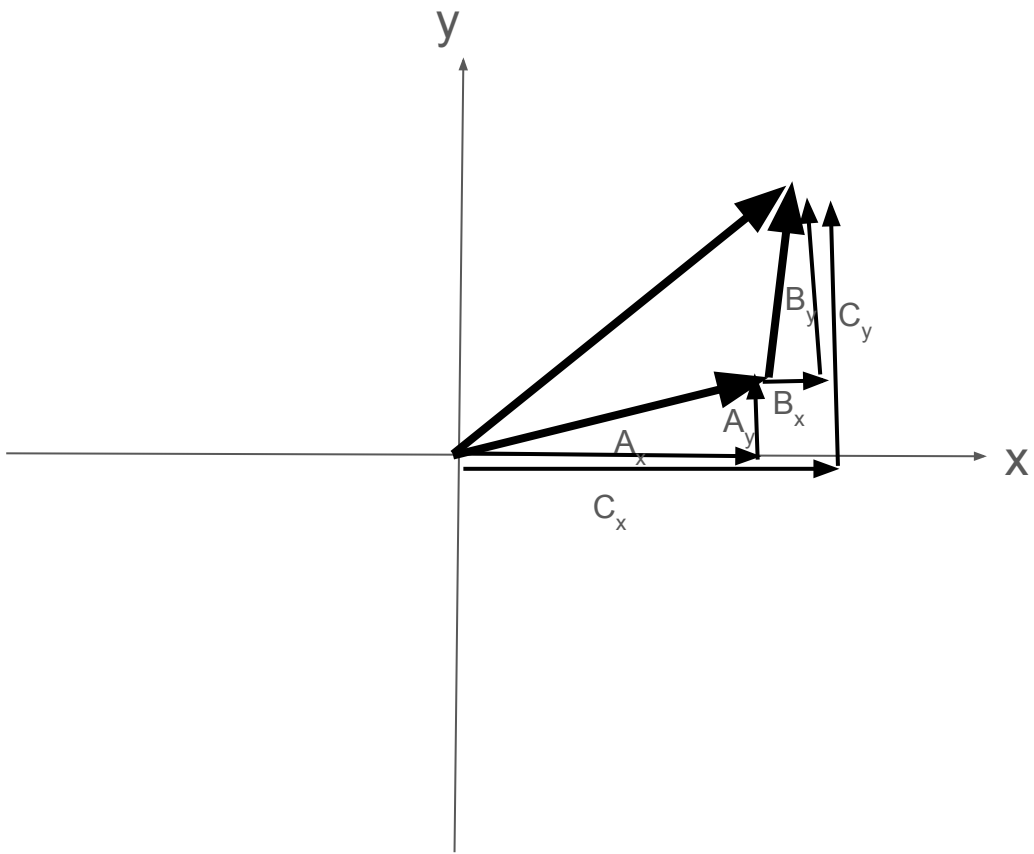
Vectors — Vector Addition

- Graphically, place vectors “tail-to-tip”
- Add components of each vector to add two vectors
- $C = A + B$
- $C_x = A_x + B_x$
- $C_y = A_y + B_y$

Vectors — Vector Addition



Vectors — Vector Addition



Vector Addition — Class Example

1. Vector A has magnitude $|A|=13$ and direction $\theta=112.62°$ and Vector B has magnitude $|B| = 5$ and direction $\theta=53.13°$.
   a. Calculate the components of vectors A and B.
   b. Calculate the vector sum A+B. Report the magnitude and direction.

Temperature

A measure of the kinetic energy of atoms/molecules that make up a substance.

Temperature — Scale

1. Fahrenheit (°F)
    - Water freezes at 32°F, boils at 212°F
2. Celsius (°C)
    - Water freezes at 0°C, boils at 100°C
3. Kelvin (K)
    - Direct measure of kinetic energy
    - “Absolute zero” –> 0 K

Temperature — Converting between systems

1. Fahrenheit <--> Celsius
    - F = 1.8 C +32
    - C = 5/9 *(F-32)
2. Kelvin <--> Celsius
    - K = C +273.15
    - C = K -273.15

Temperature — ΔT

- Often, problems require us to work in change in temperature (ΔT).
  - $\pm 1^{\circ}$ C = $\pm 1.8^{\circ}$F
  - $\pm 1^{\circ}$ C = ± 1 K

Converting temperature — Example

The Sun has a surface temperature of T=5780 K. Convert this temperature to Fahrenheit.