Friday Jan 13, 2017

Last time

- Atomic structure: insulators and conductors
- Charging macroscopic objects via friction
- Balloon demo
- The electrostatic force: Coulomb's Law

This time

- Brief review of scalars vs vectors, vector notation, etc.
- Unit vectors and their importance in physics
- Group activity

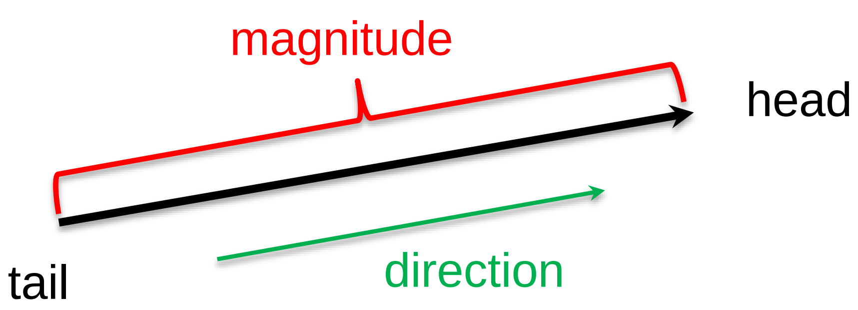
Scalars *vs.* Vectors

A **scalar** is any physical quantity that can be described by a single number (magnitude).

- The temperature in the room is 20°C.

A **vector** is a physical quantity has both a magnitude and a direction.

- Edmonton is 300 km north of Calgary.

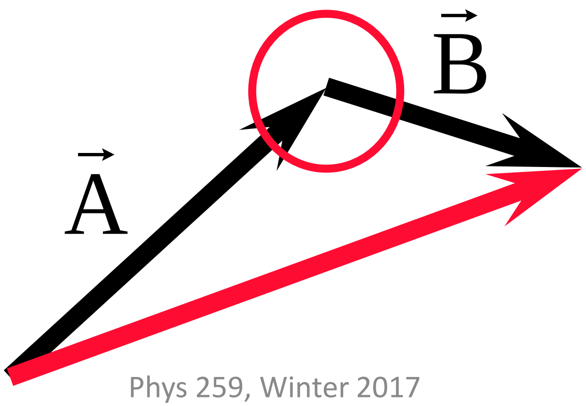


Vector Addition (graphical method)

Adding vectors requires taking not only their magnitudes into account, but also their directions.

To find the sum of two vectors:

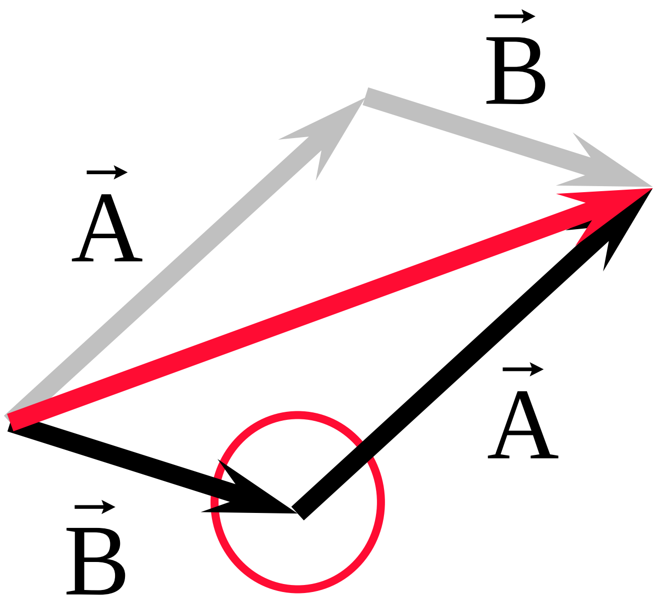
- Draw the first vector.
- Draw the second vector with the tail starting where the tip of the first vector ended.
- Draw a final vector from the tail of the first vector to the tip of the second vector.



$$\vec{C} = \vec{A} + \vec{B}$$

Vector Addition (graphical method)

We could also have done it the other way around:



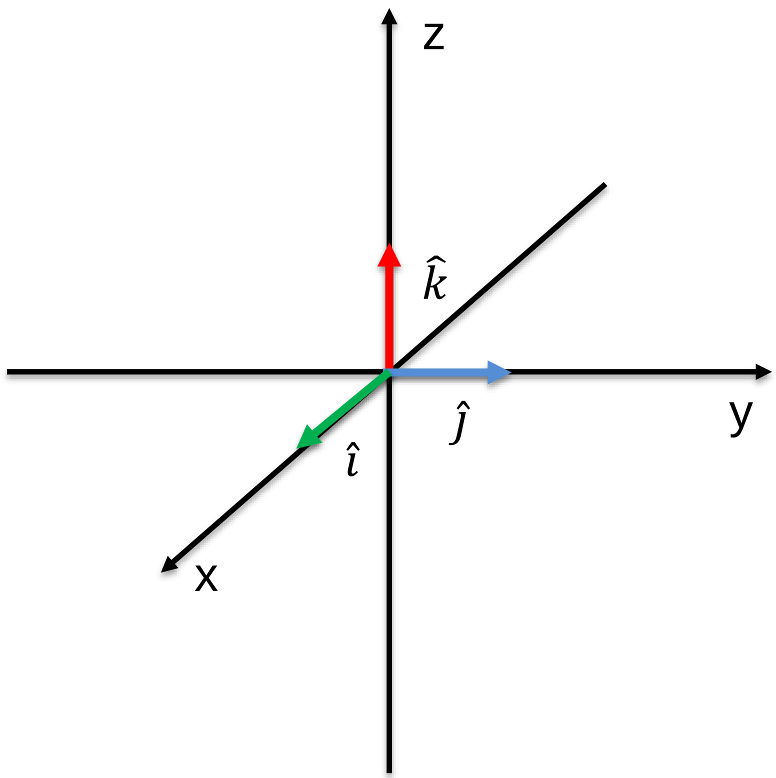
$$\vec{C} = \vec{A} + \vec{B} = \vec{B} + \vec{A}$$

The order of adding does not matter.

Notice the parallelogram

Unit vectors

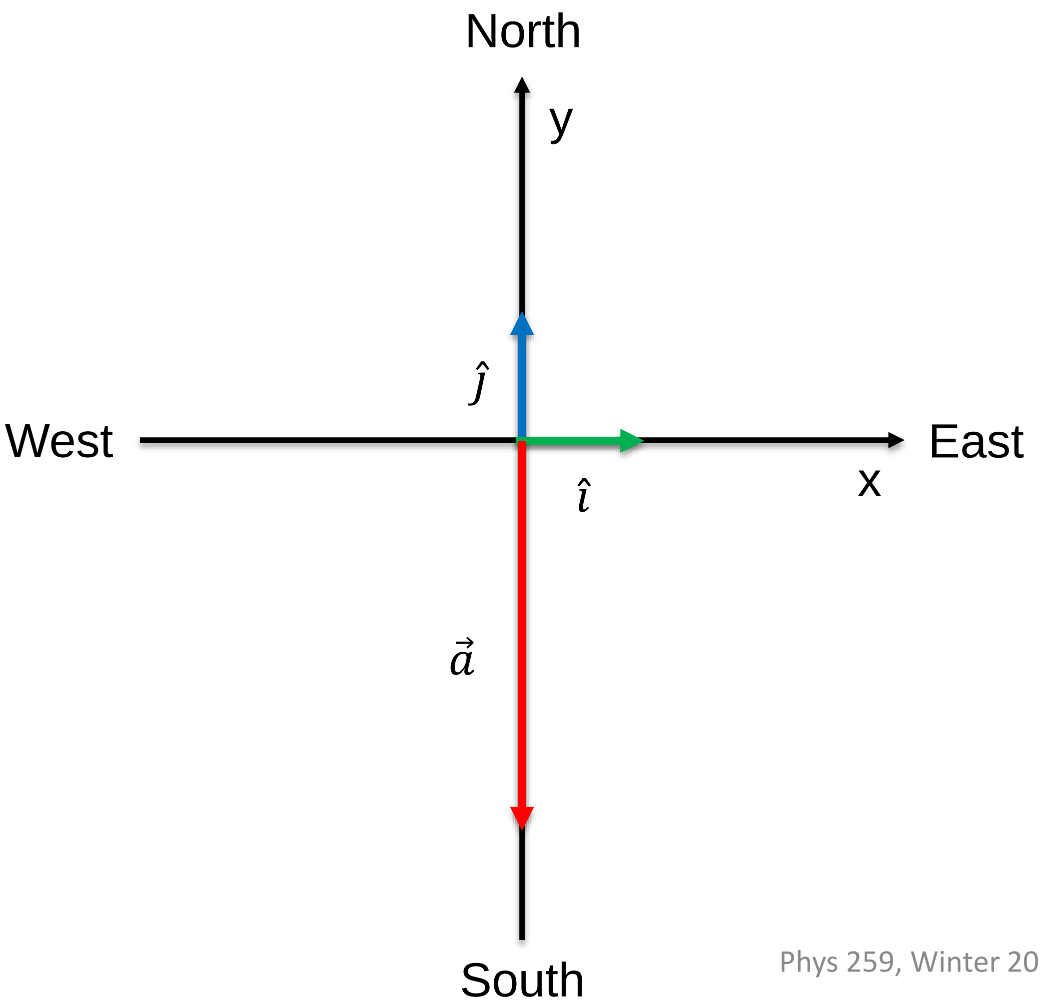
- Magnitude = 1; direction along the axis



$$unit\ vector = \frac{vector}{its\ magnitude}$$

Unit vectors

- Magnitude = 1; direction along the axis



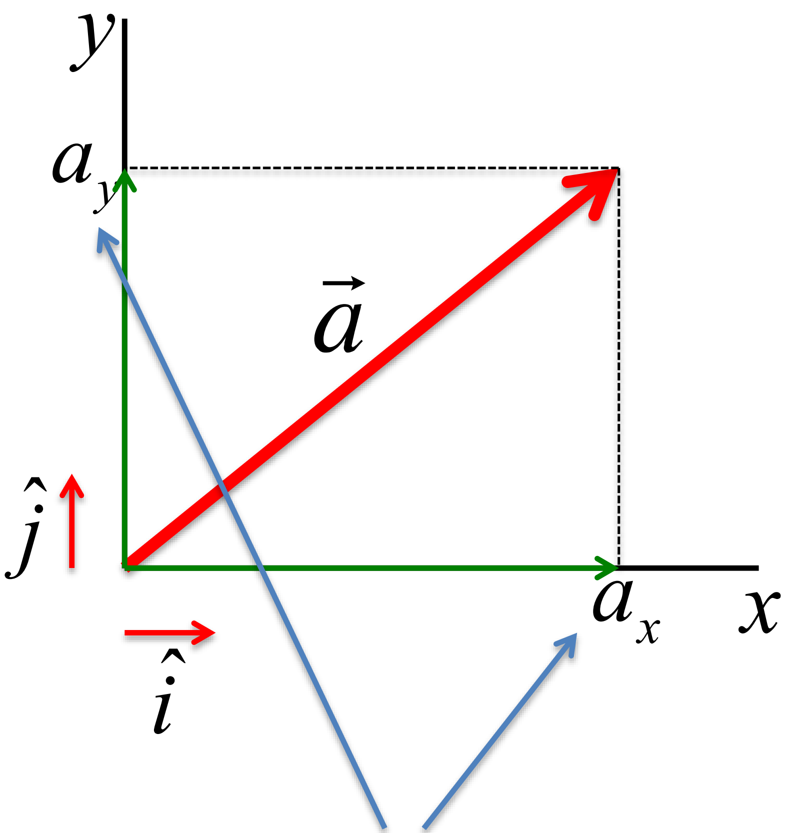
If $\vec{a} = 3m\ south$

$$unit\ vector = \frac{vector}{its\ magnitude}$$

$$\hat{a} = \frac{3m\ south}{3\ m}$$

Vector Components

Scalars are usually easier to use than vectors. So let's replace our vectors with scalar quantities called vector components.



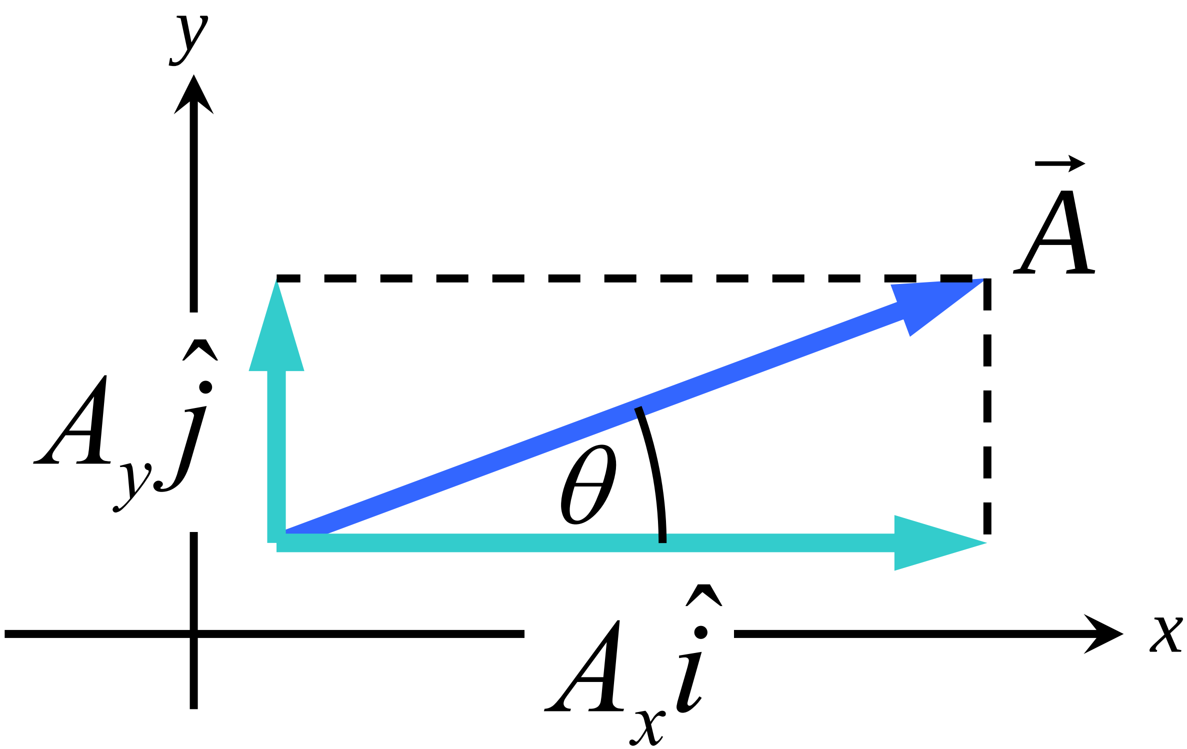
$$\vec{a} = a_x \hat{i} + a_y \hat{j}$$

x-component y-component

$$|\vec{a}| = \sqrt{a_x^2 + a_y^2}$$

magnitude is always positive

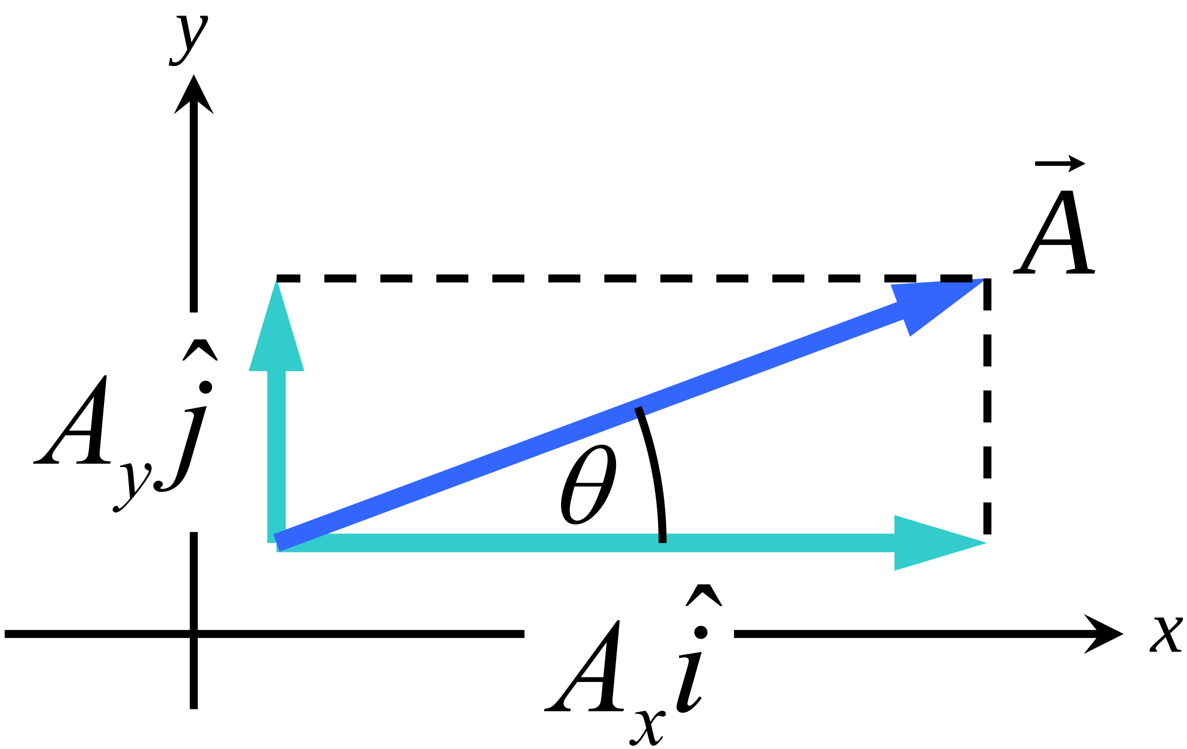
Finding Components of Vectors



$$A_x = A\cos q \qquad A_y = A\sin q$$

The direction tells us the sign.

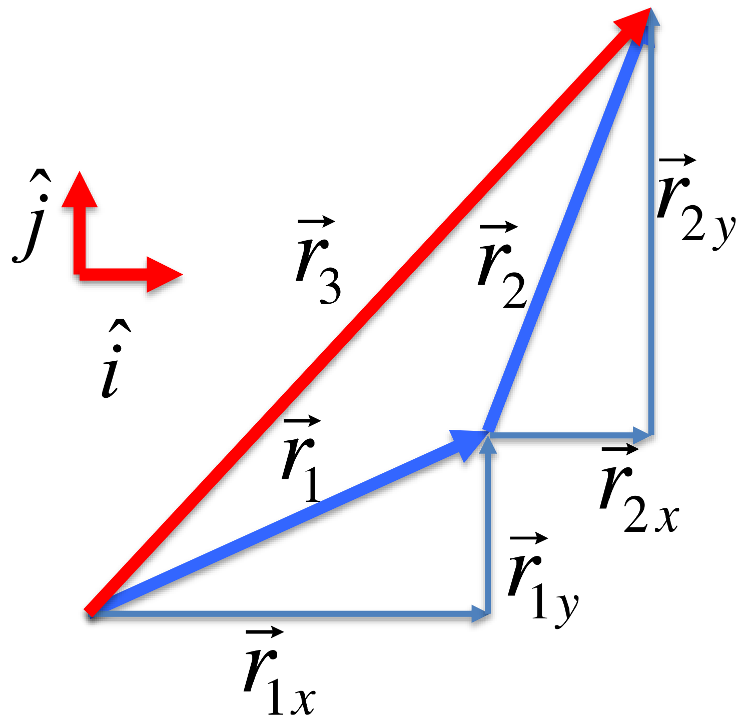
What if we already know the components?



$$A^2 = A_x^2 + A_y^2 \qquad \theta = \tan^{-1}\left|\frac{A_y}{A_x}\right|$$

Vector Addition using Components

$$\boxed{\vec{r}_3 = \vec{r}_1 + \vec{r}_2}$$



$$\vec{r}_1 = r_{1x}\hat{i} + r_{1y}\hat{j}$$

$$\vec{r}_2 = r_{2x}\hat{i} + r_{2y}\hat{j}$$

$$\vec{r}_3 = \left(r_{1x} + r_{2x}\right)\hat{i} + \left(r_{1y} + r_{2y}\right)\hat{j}$$

Group assignment – L03

- Category:
  - PHYS259_L01
  - PHYS259_L02
  - PHYS259_L03
  - PHYS259_L04
- Group number given on the paper

Group #	Student	Last Name	First Name
12	1		
	2		
	3		
	4		

Group activity 1

- **(10 marks)** In a two dimensional Cartesian system $\hat{r}$ is located 30^{o} north of east. What is the mathematical expression for $\hat{r}$ in terms of Cartesian unit vectors?