Lecture 2
(Vectors and Trigonometry Review)

Physics 160-01 Fall 2012

Douglas Fields

CPS Practice Question 1

- What is your class standing at UNM?

A. Freshman
B. Junior
C. Sophomore
D. Senior
E. Non-traditional

CPS Practice Question 2

- My mathematics background can be best described as:

A. I am currently enrolled in Calculus I
B. I have already taken and passed Calculus I
C. I had Calculus in High School
D. I have had no Calculus, and I am not currently enrolled in it
E. What is Calculus?

CPS Practice Question 3

- What is 2 + 2 = ?

A. 3
B. 5
C. 4
D. 2
E. No, really, what is Calculus?

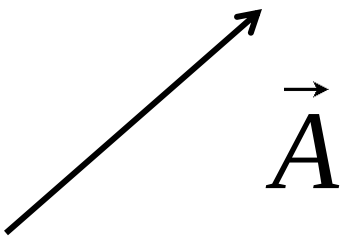
Scalars and Vectors

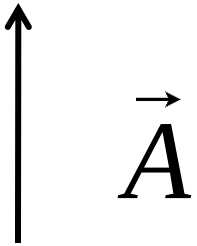
- A scalar only has a magnitude
  - Number of apples
  - Size of desk
  - Distance to Santa Fe
- A vector has a magnitude and a direction
  - If someone ask you how to get to Santa Fe from Albuquerque, your answer wouldn't be "Go sixty miles."

Vector

- http://www.youtube.com/watch?v=KbrEBpCw3Ag&feature=player_detailpage

Vectors

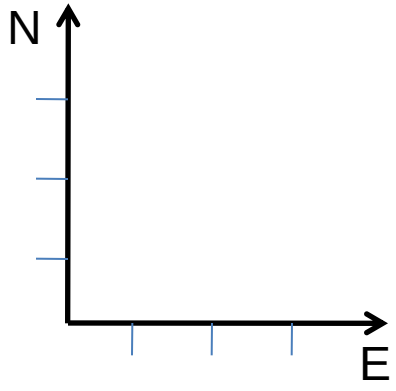
- Represented by an arrow:  $\vec{A}$
- The length of the arrow represents the magnitude.
- The orientation represents the direction.
- In which direction is the following arrow?

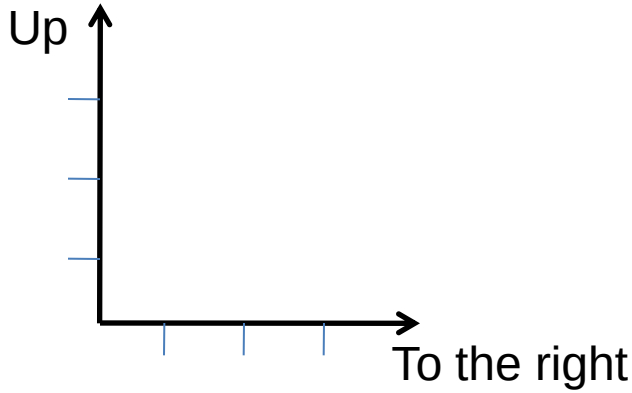
 $\vec{A}$

- What is its length?

Coordinate Systems

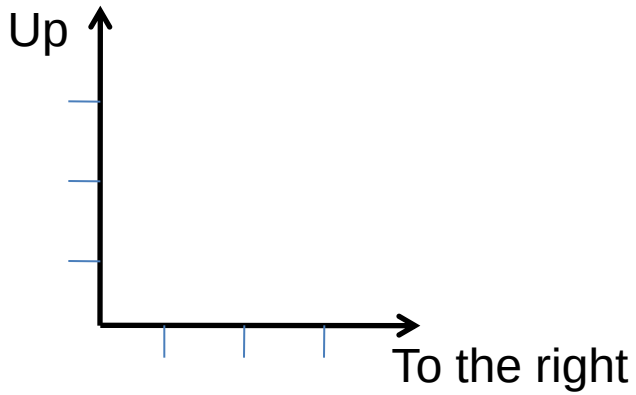
- A coordinate system is a reference for both direction and scale.
- Axes are perpendicular.
- Examples:

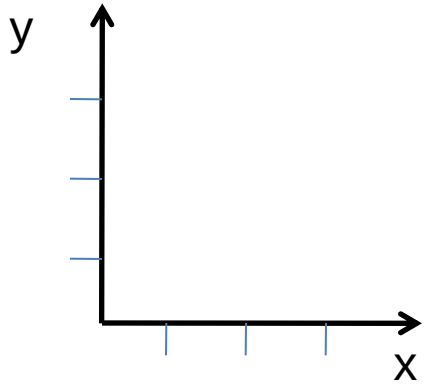




Coordinate Systems

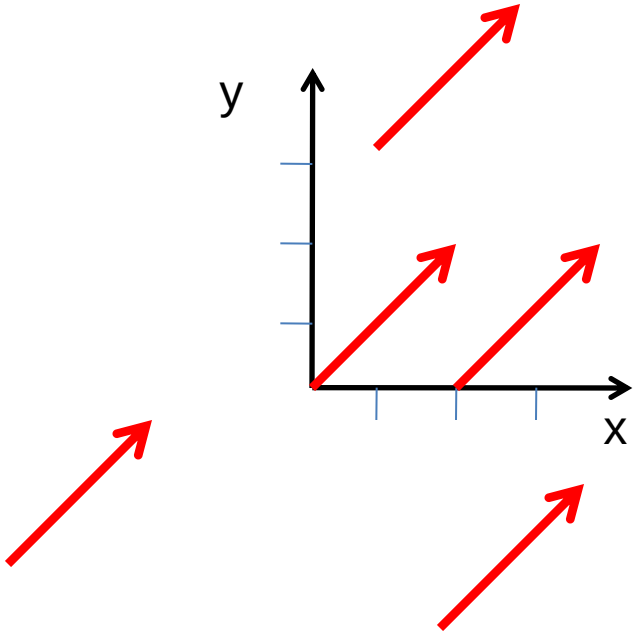
- In many cases, we generalize the directions using variable names.
  - So, instead of up and to the right, we can use the names “y” and “x”
  - This makes equations much more manageable…





Coordinate Systems

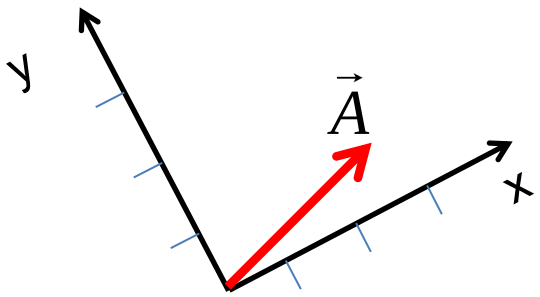
- Vectors can be drawn on a coordinate system in an infinite number of ways:

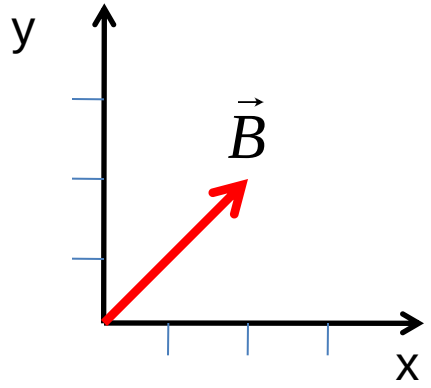


All of these vectors are the same – vectors ONLY have magnitude and direction!

Coordinate Systems

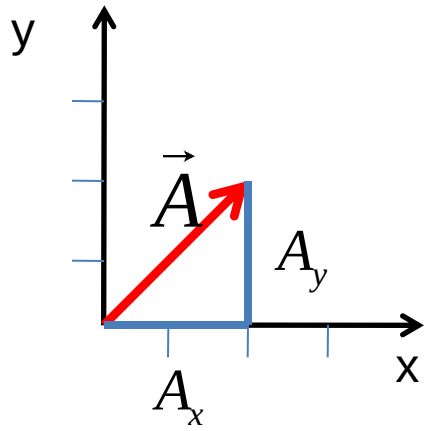
- However, you must remember that a vector is only defined uniquely when a coordinate system is defined, so vectors that are defined with different coordinate systems may LOOK the same but be different:

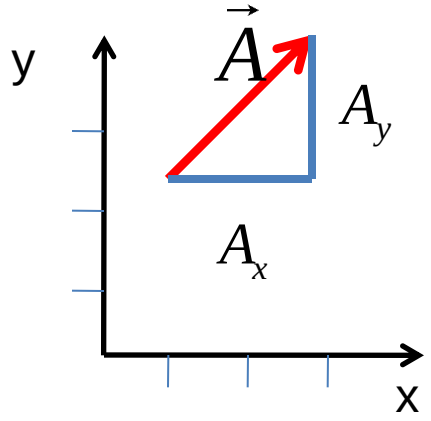




Components of Vectors

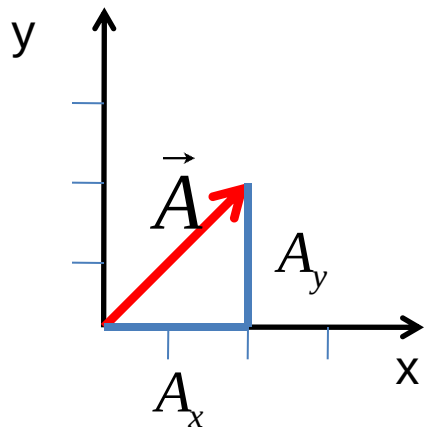
- Once we have a coordinate system as a reference, we can break down a vector in terms of its length along the direction of the coordinates:





Length of Vectors

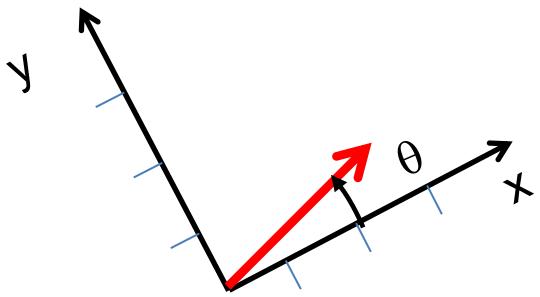
- The length of a vector can be found using Pythagorean theorem:

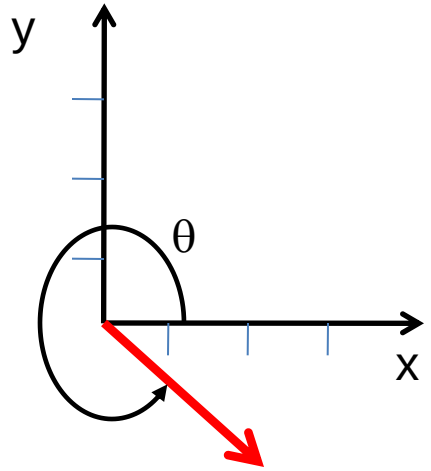


$$\left|\vec{A}\right|^2 = A_x{}^2 + A_y{}^2$$

Direction of Vectors

- The direction of a vector can be defined any way you choose relative to a coordinate system, but there is a conventional choice:
  - Angle from the positive x-axis with a positive angle in the counter-clockwise direction.



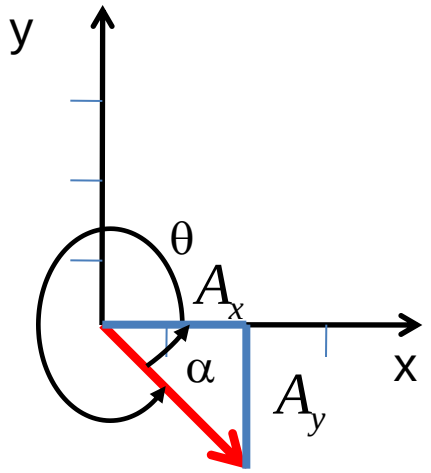


Angles

- Angles can be specified in two ways:
  - Degrees (360^o in one complete rotation)
  - Radians (2π radians in one complete rotation)
- It is best for you to get in the habit of using radians, since it will simplify calculations later in the semester.
- But even better is to use both so that you build up an intuitive feel for what radians mean.

Direction of Vectors

- The direction of a vector can be found using trigonometry:



$$\tan\alpha = \frac{A_y}{A_x} \Rightarrow$$

$$\alpha = \tan^{-1}\frac{A_y}{A_x} \Rightarrow$$

$$\theta = 2\pi - \alpha$$