Physics 1A, Lecture 2: Math Review and Intro to Motion

Summer Session 1, 2011

Your textbook should be closed, though you may use any handwritten notes that you have taken. You will use your clicker to answer these questions. If you do not yet have a clicker, please turn in your answers on a sheet of paper (some are available in the front if you do not have any). The quiz will commence at 9:33 AM.

JUST USE DEFAULT FREQUENCY: AA

<u>Key Questions: (Discuss with neighbors before quiz)</u>

1) Difference between scalars and vectors
2) Decomposing vectors into components
3) Average versus instantaneous velocity

Reading Quiz #1-1

- Which of the following is a scalar? (15 sec)

A. acceleration

B. displacement

C. velocity

D. mass

E. force

Reading Quiz #1-2

- Which of the following is a vector? (15 sec)

A. length

B. speed

C. density

D. age

E. displacement

Reading Quiz #1-3 (30 seconds)

- What does it mean to decompose a vector into its components?

A. To determine its magnitude and direction
B. To break it into vectors parallel to the axes
C. To break it apart into scalars
D. To determine its magnitude and direction in a rotated coordinate system
E. To break it apart into vectors of equal magnitude

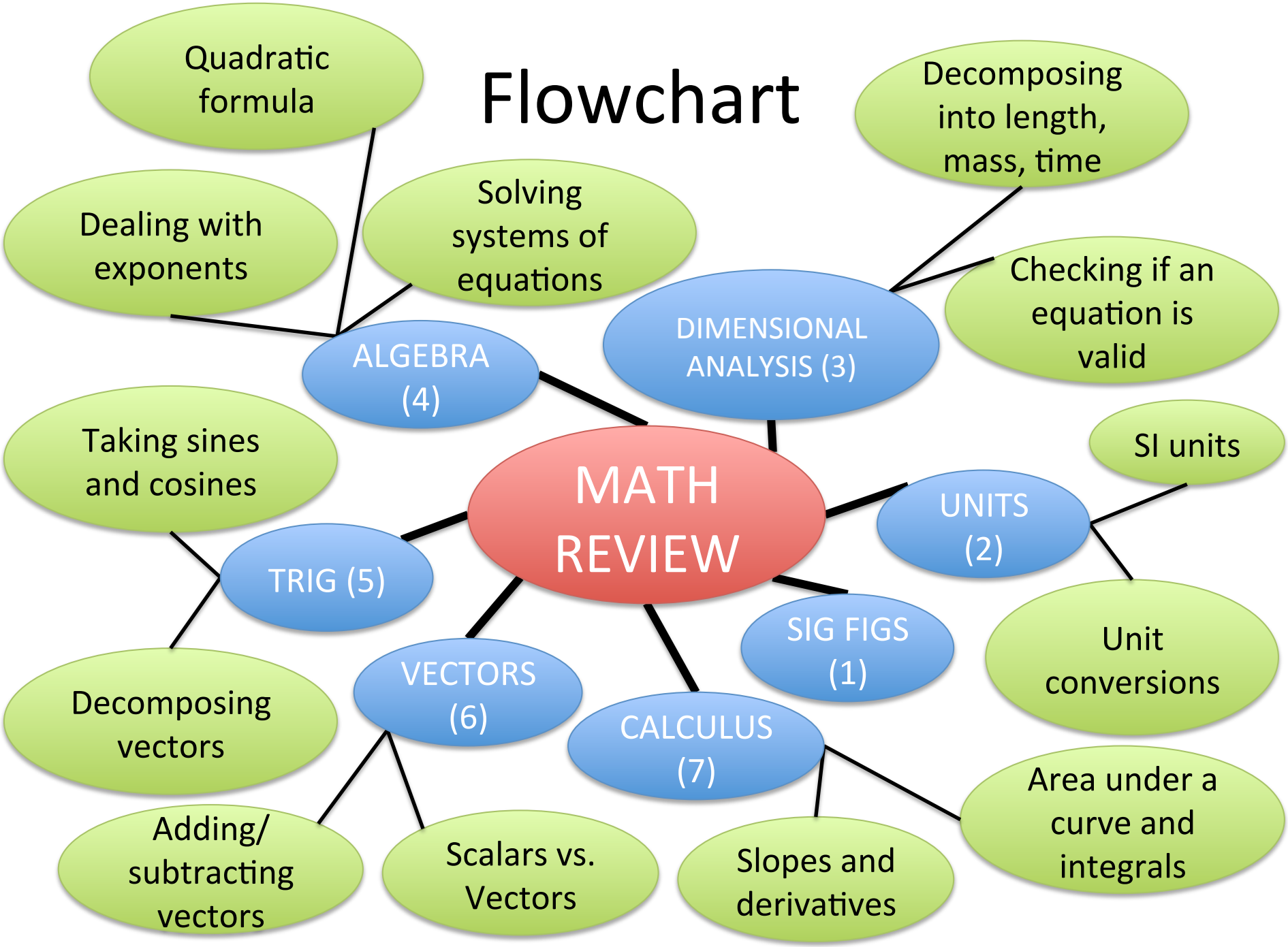
Reading Quiz #1-4 (30 seconds)

Which quantity can be found by taking a derivative of the displacement?

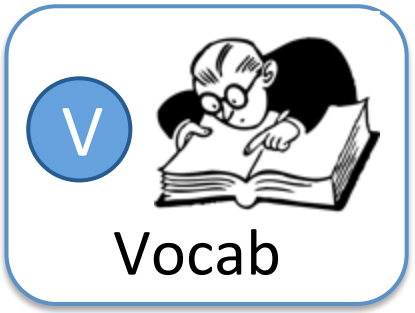
A. the instantaneous velocity
B. the average velocity
C. the average speed
D. the acceleration

Announcements

- Lab classes start today.
- Evan's office hours will be 1-2pm and 3-4pm tomorrow in the physics tutorial center (Mayer 2702)
- After this week they will be 1-3pm
- Register at iclicker.com with your PID (A#########)


Flowchart
MATH REVIEW
ALGEBRA (4)
Quadratic formula
Dealing with exponents
Solving systems of equations
DIMENSIONAL ANALYSIS (3)
Decomposing into length, mass, time
Checking if an equation is valid
UNITS (2)
SI units
Unit conversions
SIG FIGS (1)
TRIG (5)
Taking sines and cosines
Decomposing vectors
VECTORS (6)
Adding/ subtracting vectors
Scalars vs. Vectors
CALCULUS (7)
Slopes and derivatives
Area under a curve and integrals

Scalars vs. Vectors



- Scalars have magnitude
- Vectors have a magnitude *and* direction.
  - Importance of vectors:

- Suppose you ask an alien to tell you the time by looking at a clock.
- He reports to you that one of the arrows is 2 inches long and the other is 3 inches long.
- Then he reports to you that one of the arrows is pointing to a 2 and the other one is pointing to a 10.

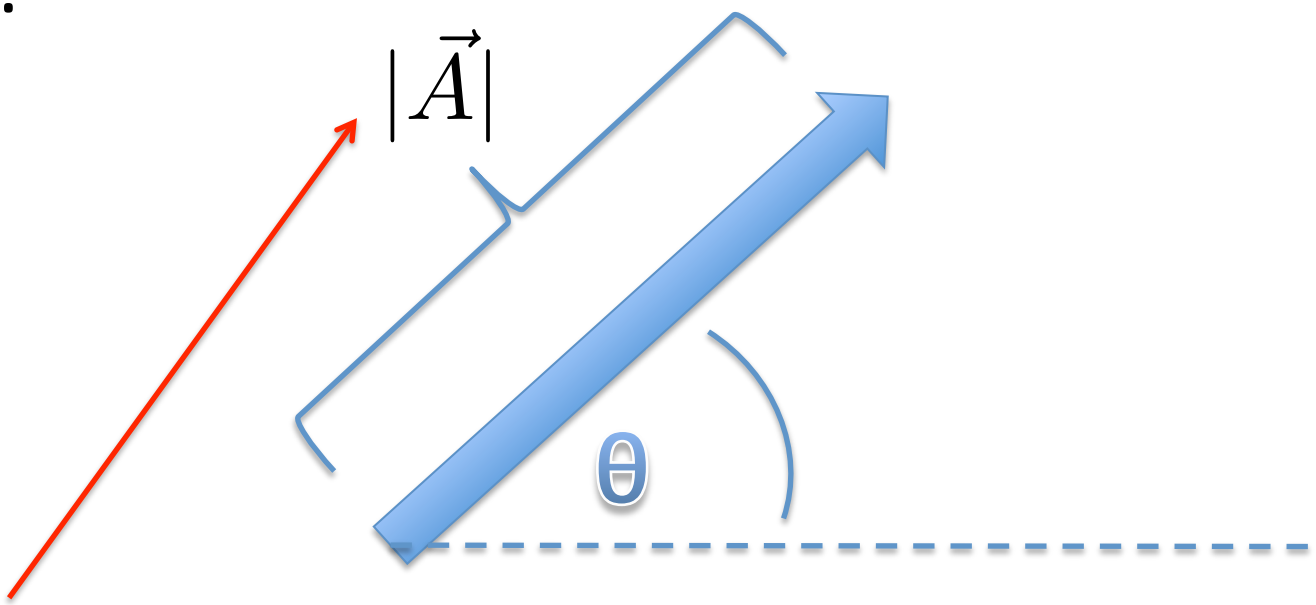
Scalars vs. Vectors

- Scalars:
  - time
  - mass
  - speed
  - length
  - area
  - density
  - pressure
  - energy
  - power
  - temperature
- Vectors:
  - displacement
  - velocity
  - acceleration
  - momentum
  - force
  - weight

Anatomy of a vector

A vector is identified by its magnitude and direction:

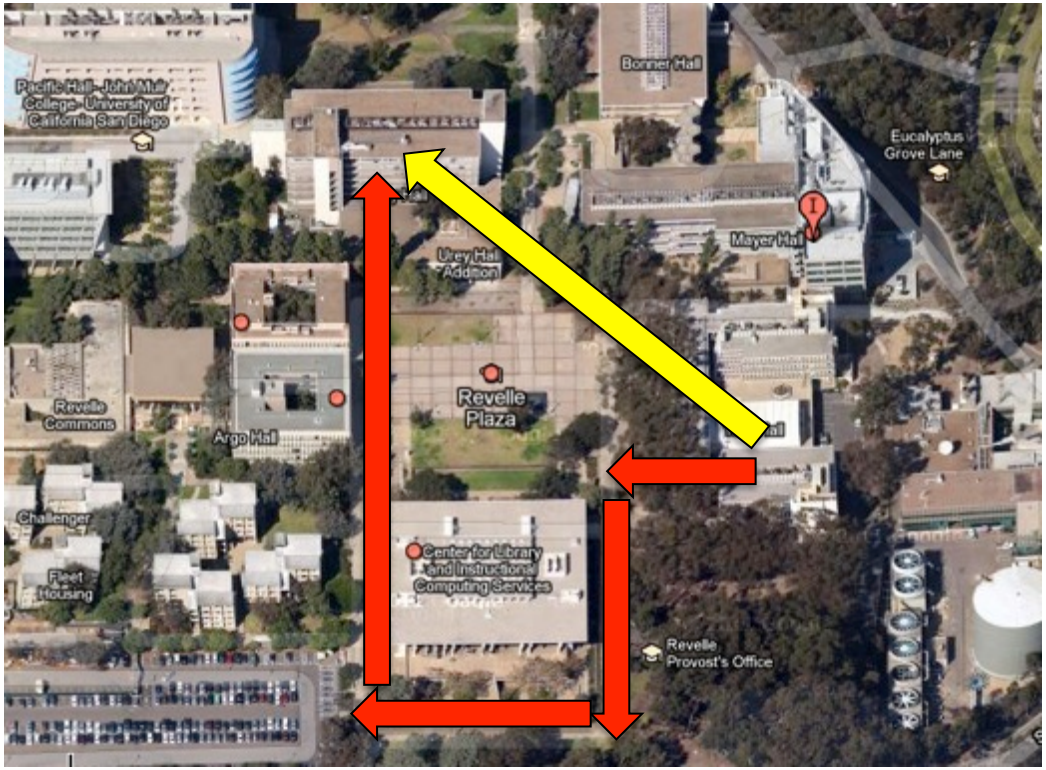
$\vec{A}$



Absolute value!

Adding and Subtracting Vectors

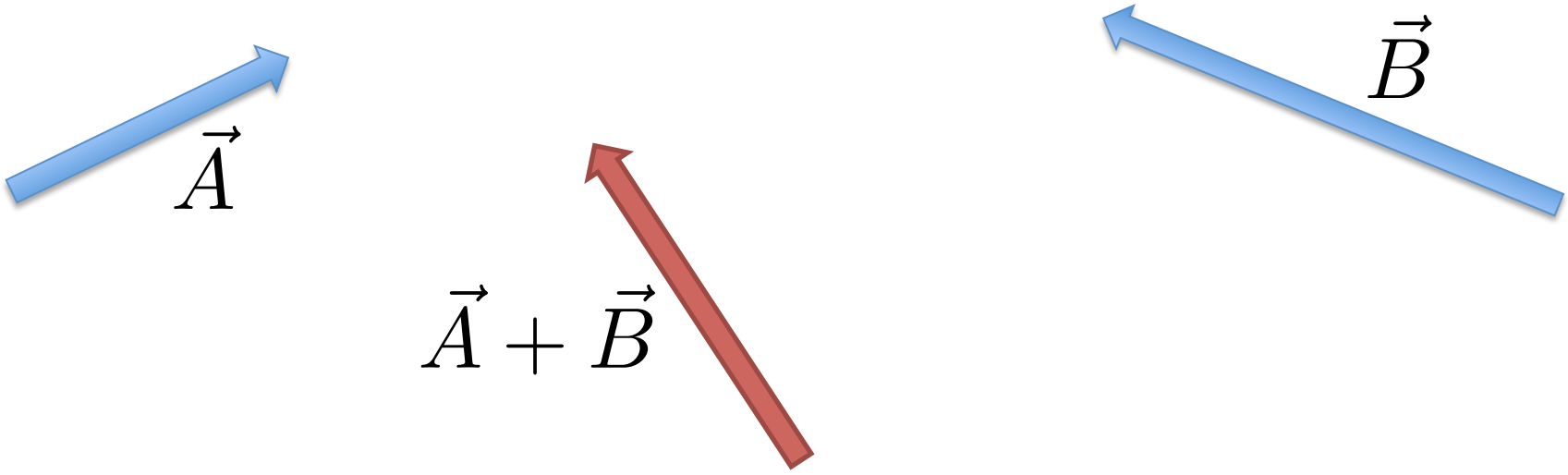
- Directions to my office:
  - 20 m West
  - 40 m South
  - 40 m West
  - 90 m North
  - Or resultant vector



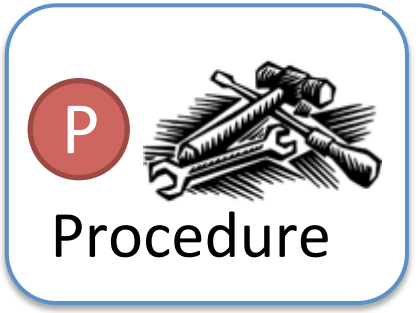
Adding Vectors

P Procedure

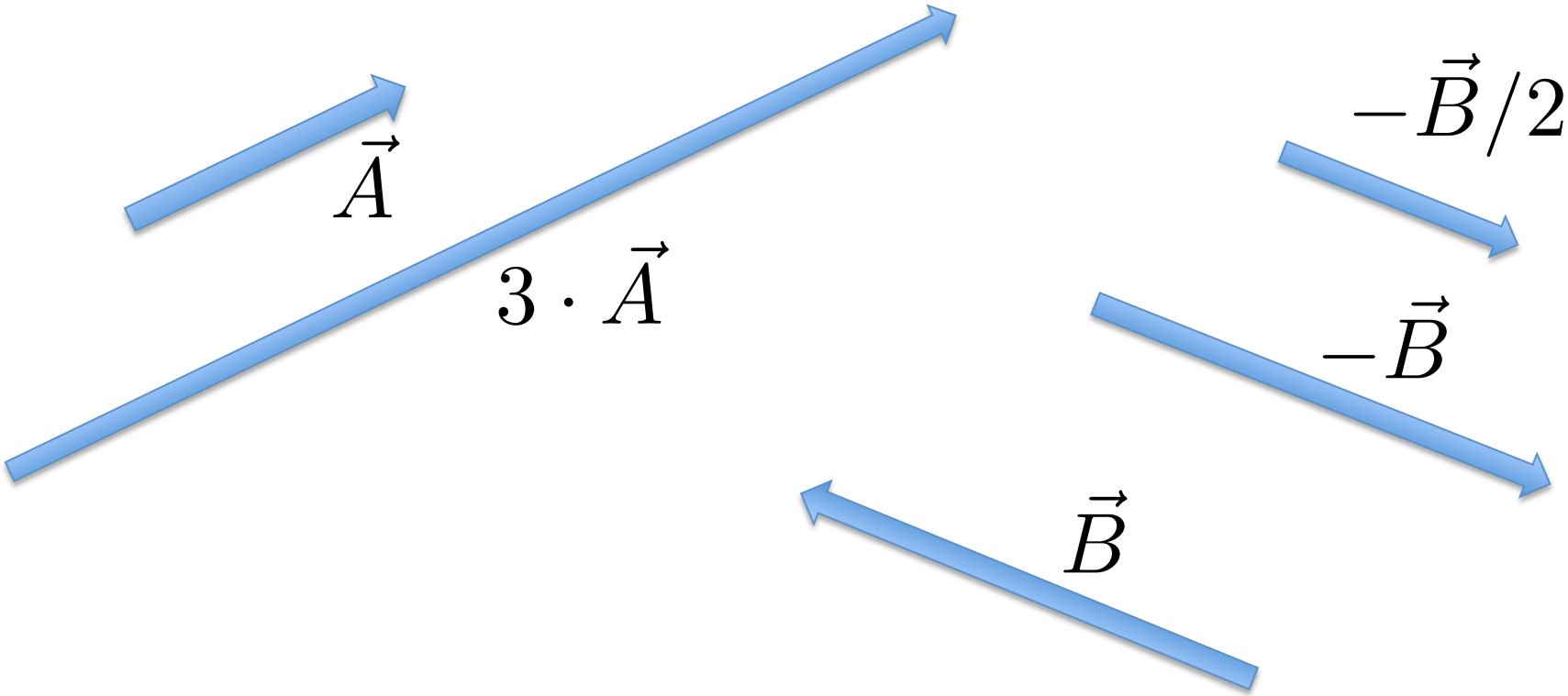
- To add vectors ($\vec{A} + \vec{B}$) place them head to tail and draw a resultant vector:



Multiplying Vectors



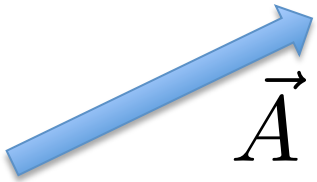
- Multiply vector by positive scalar ($3 \cdot \vec{A}$)
- Multiply vector by negative scalar ($-\frac{1}{2} \cdot \vec{B}$)

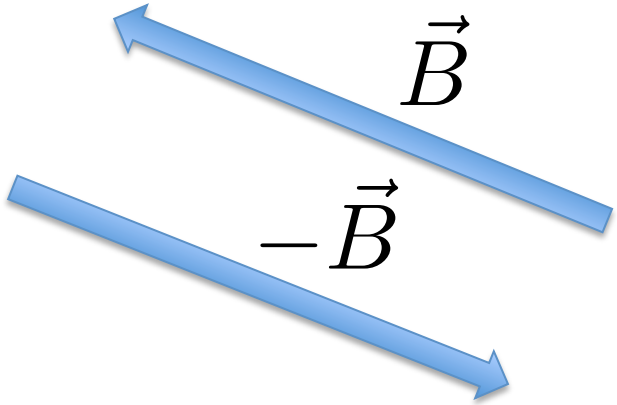


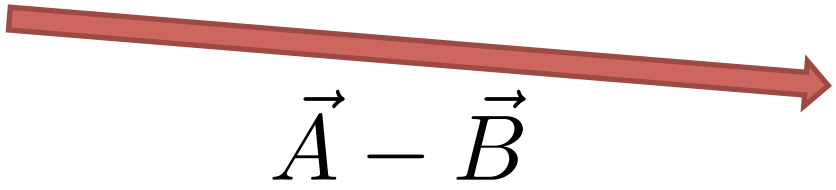
Subtracting Vectors

P Procedure

- To subtract vectors ($\vec{A} - \vec{B}$), flip B over, and then add ($\vec{A} + (-\vec{B})$)







Clicker Question 2-1
Vectors

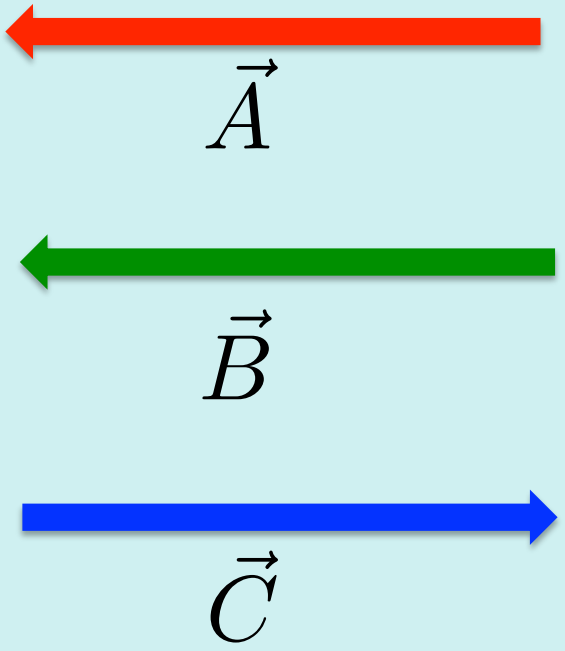
- Vectors A, B and C have the same magnitude. Which of the following equals zero?

A) $\vec{A} - \vec{B}$

B) $\vec{B} - \vec{A}$

C) $\vec{A} - \vec{C}$

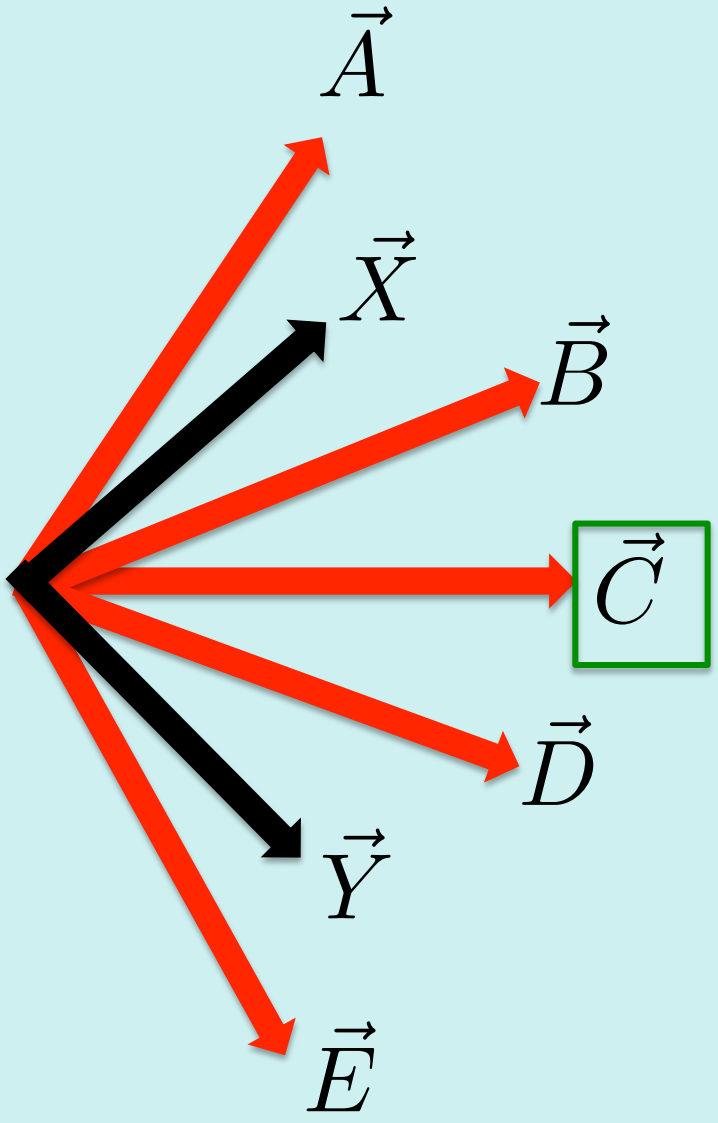
D) $\vec{C} - \vec{B}$



E) Choices A and B are both right

Clicker Question 2-2
Vectors

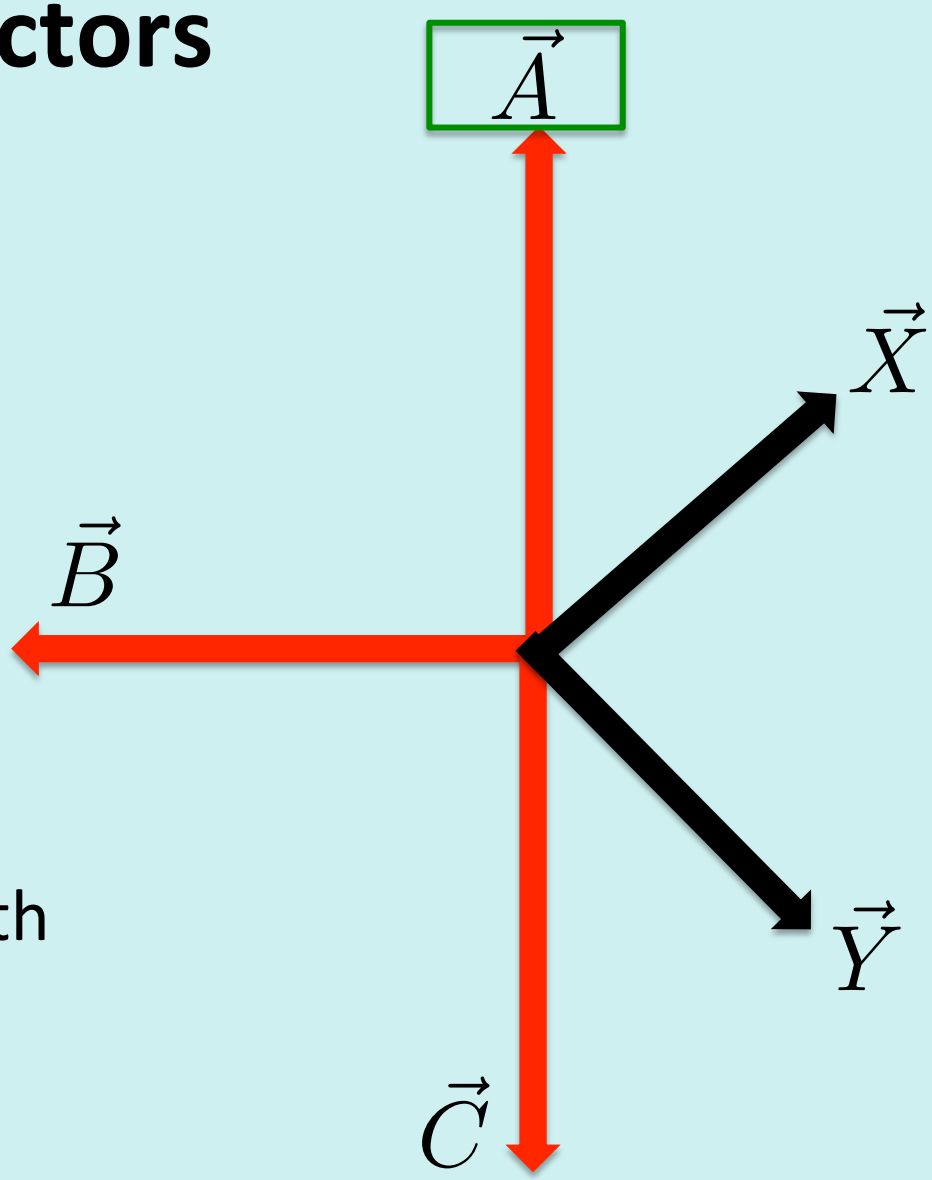
- Vectors $\vec{X}$ and $\vec{Y}$ have the same magnitude. Which vector is $\vec{X} + \vec{Y}$?



Clicker Question 2-3

Vectors

- Vectors $\vec{X}$ and $\vec{Y}$ have the same magnitude. Which vector is $\vec{X} - \vec{Y}$?



D) Non of these

E) Since the magnitudes are equal it is a vector with zero magnitude

Trig Review: Sines and Cosines

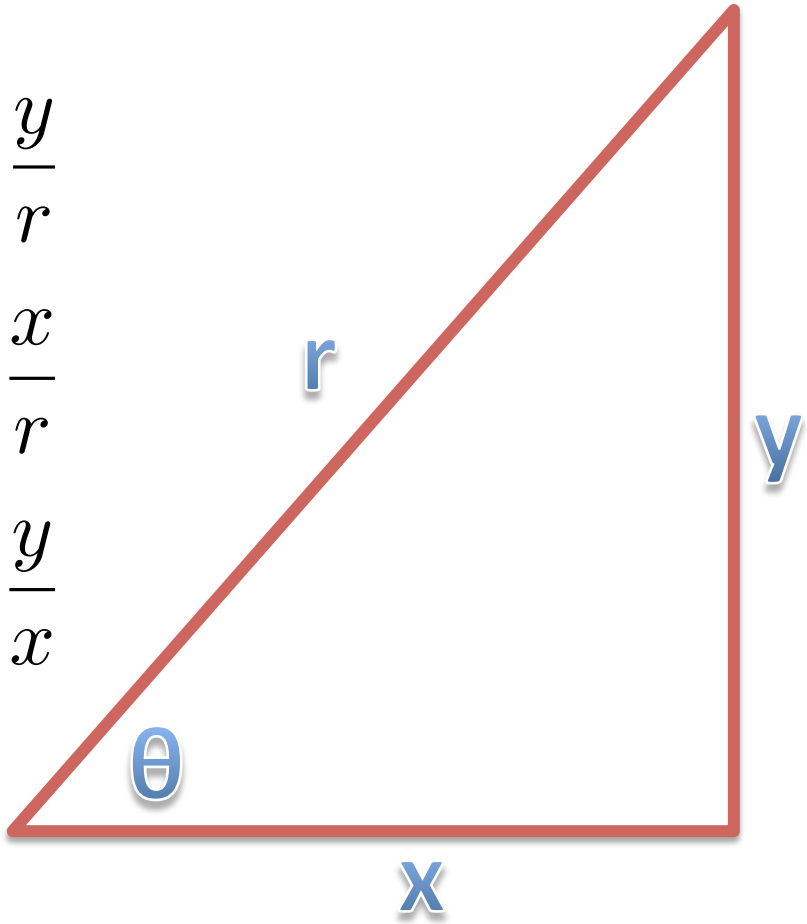
$$\sin\theta = \frac{\text{side opposite } \theta}{\text{hypotenuse}} = \frac{y}{r}$$

$$\cos\theta = \frac{\text{side adjacent } \theta}{\text{hypotenuse}} = \frac{x}{r}$$

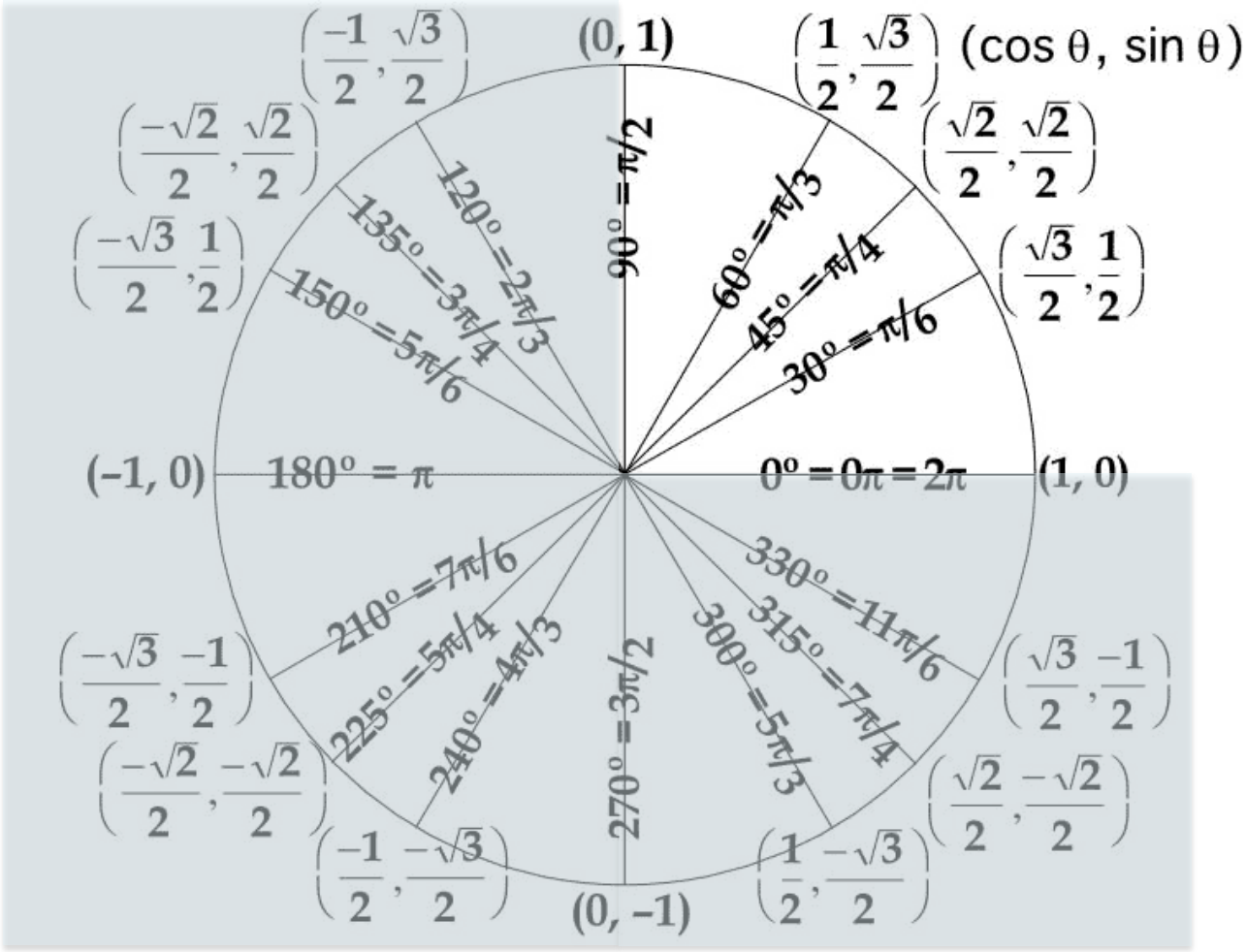
$$\tan\theta = \frac{\text{side opposite } \theta}{\text{side adjacent } \theta} = \frac{y}{x}$$

$$r = \sqrt{x^2 + y^2}$$

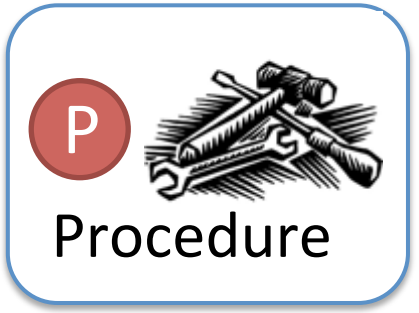
$$\theta = \tan^{-1}\frac{y}{x}$$



Trig Review: Unit circle with important angles



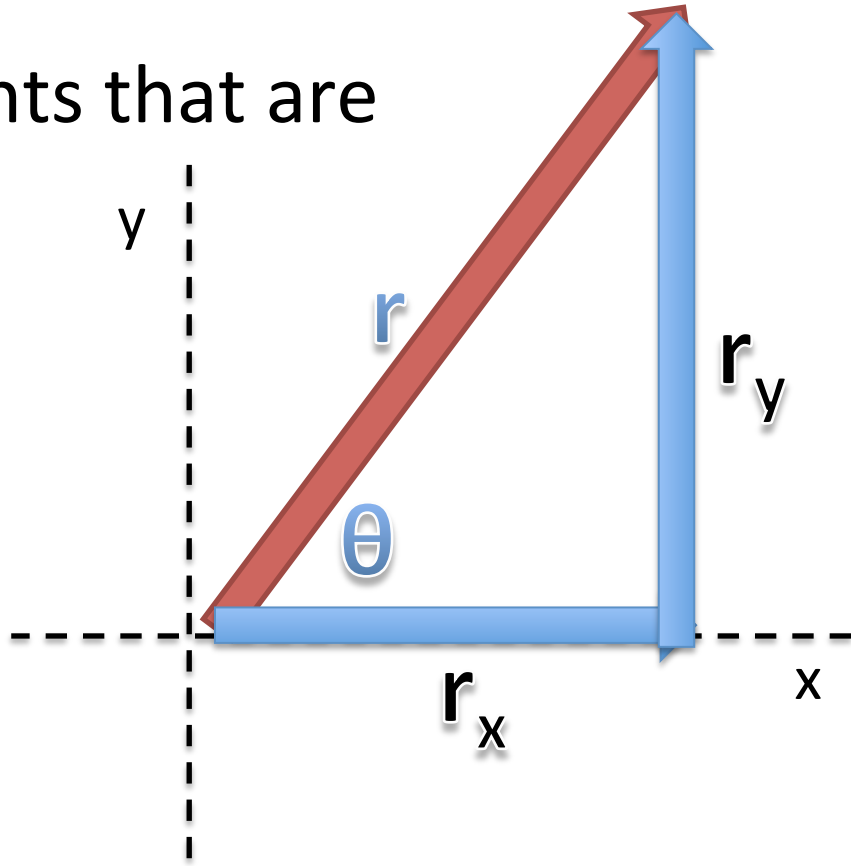
Trig Review: Decomposing vectors



- Place vector r in a coordinate system of your choosing:
- Break up r into components that are parallel to the axes:

$$r_x = |r| \cdot \cos\theta$$

$$r_y = |r| \cdot \sin\theta$$



Clicker Question 2-4

Vectors

- The magnitude of vector A is 6. Which of the following is the magnitude of A_x?

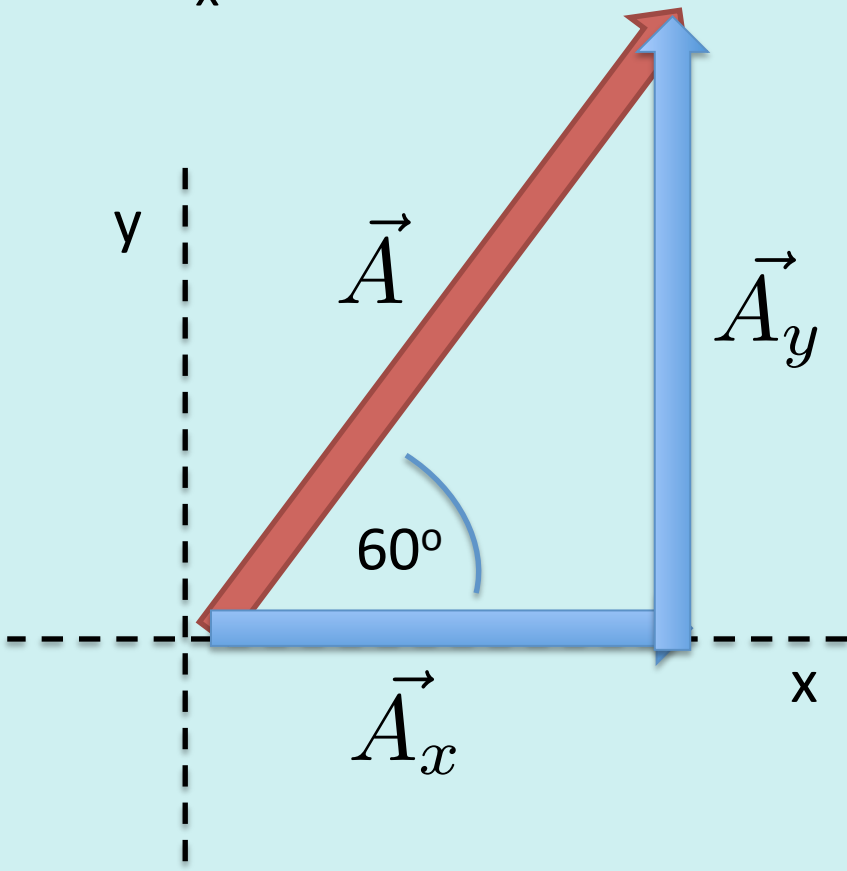
A) 2

B) 3

C) $3\sqrt{2}$

D) $3\sqrt{3}$

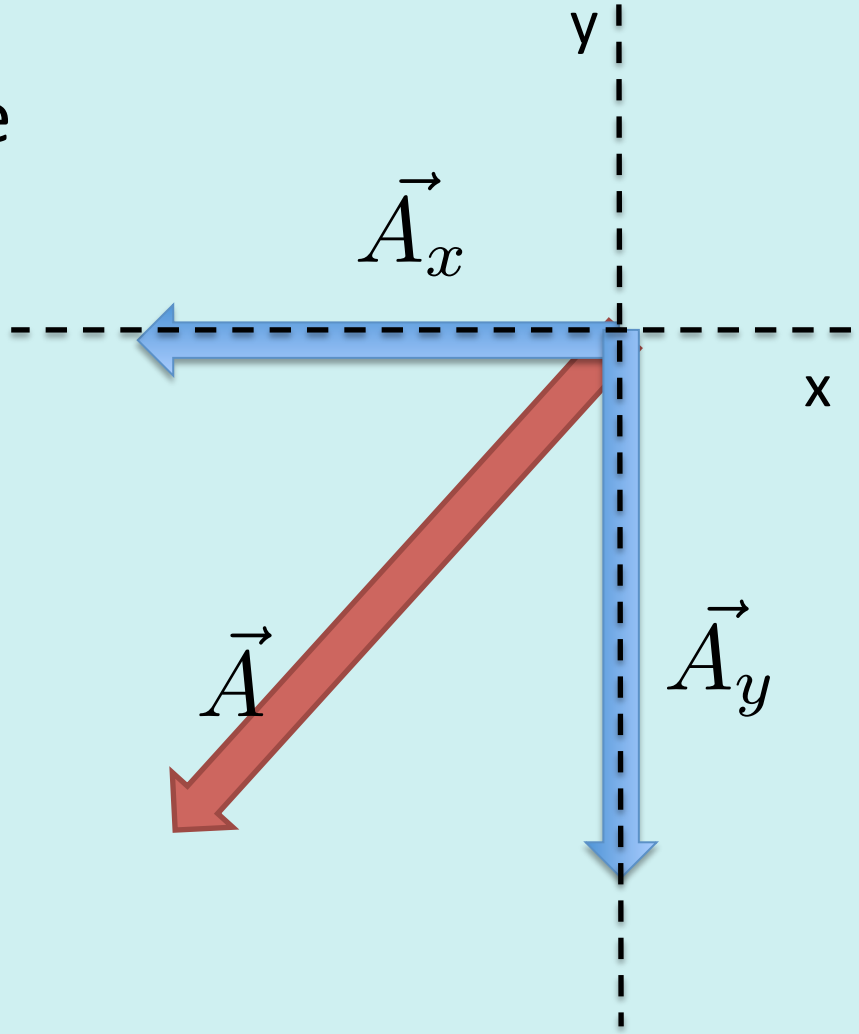
E) 6



Clicker Question 2-5
Vectors

- A_x and A_y both have magnitude 5. What is the magnitude of vector $\vec{A}$?

A) $5\sqrt{2}/2$
B) 5
C) $\sqrt{100}$
D) $5\sqrt{2}$
E) $5\sqrt{3}$



Clicker Question 2-6

Vectors

- $A_x = -4$ and $A_y = -3$, What angle does $\vec{A}$ make with the x axis?

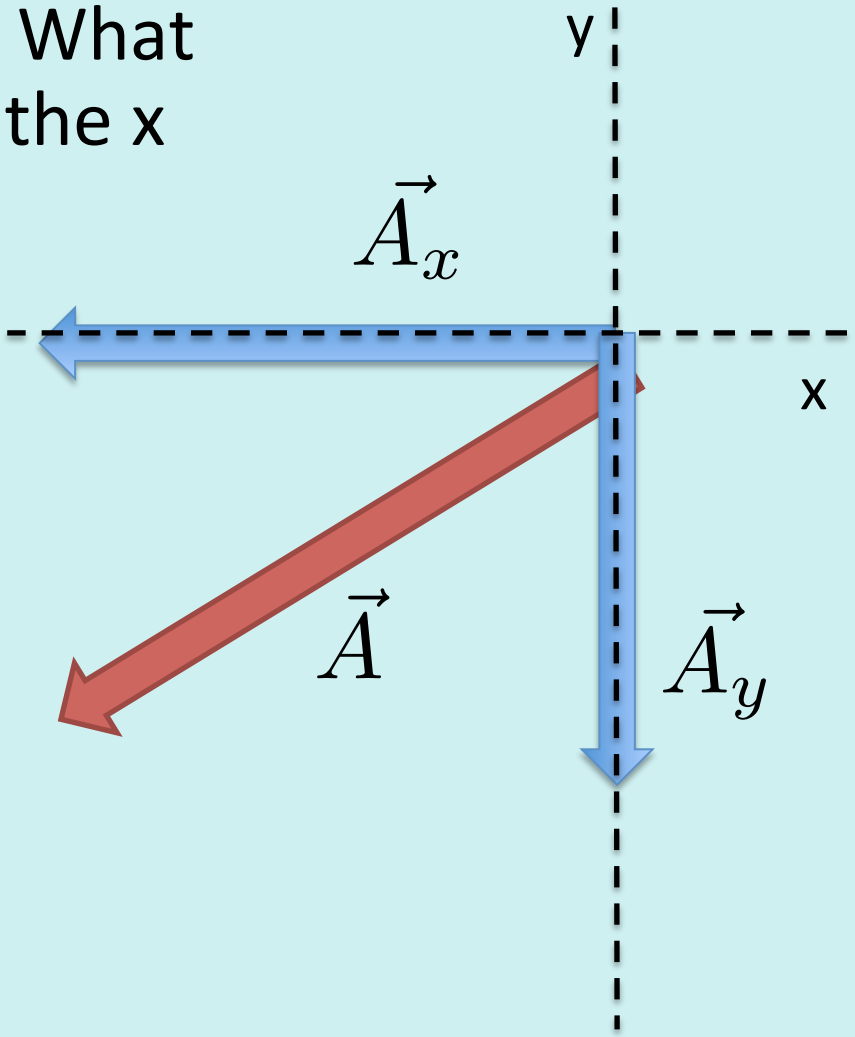
A) $\tan^{-1}(4/3)$

B) $\tan^{-1}(3/4)$

C) $\tan(4/3)$

D) $\tan(3/4)$

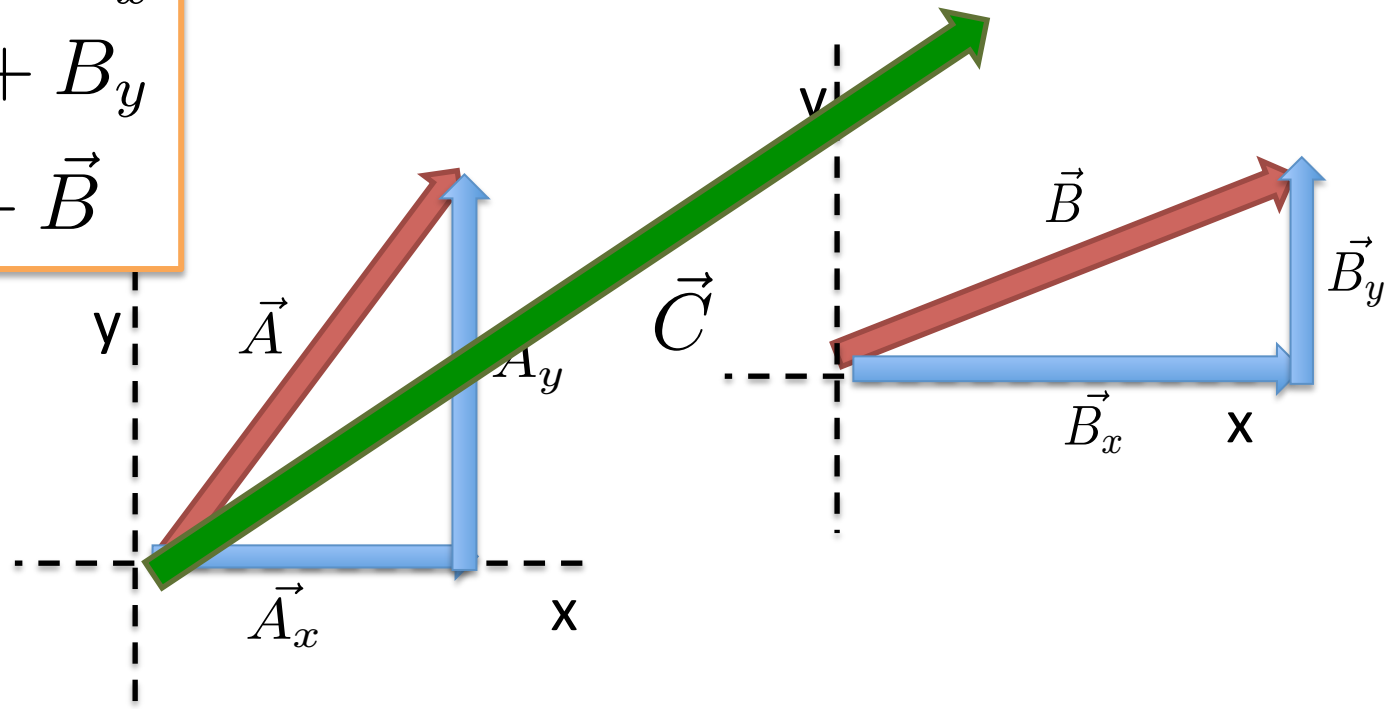
E) $\tan(9/16)$



Adding vectors with components

- Break up vectors into components so that we can add them together:

$$C_x = A_x + B_x$$
$$C_y = A_y + B_y$$
$$\vec{C} = \vec{A} + \vec{B}$$



Clicker Question 2-7

Vectors

$$A_x = 3, A_y = 4$$

$$B_x = 5, B_y = 3$$

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

- Find the magnitude of vector $\vec{C}$

It was the square root of 5.

A) $|\vec{C}| = \sqrt{3}$

B) $|\vec{C}| = \sqrt{8}$

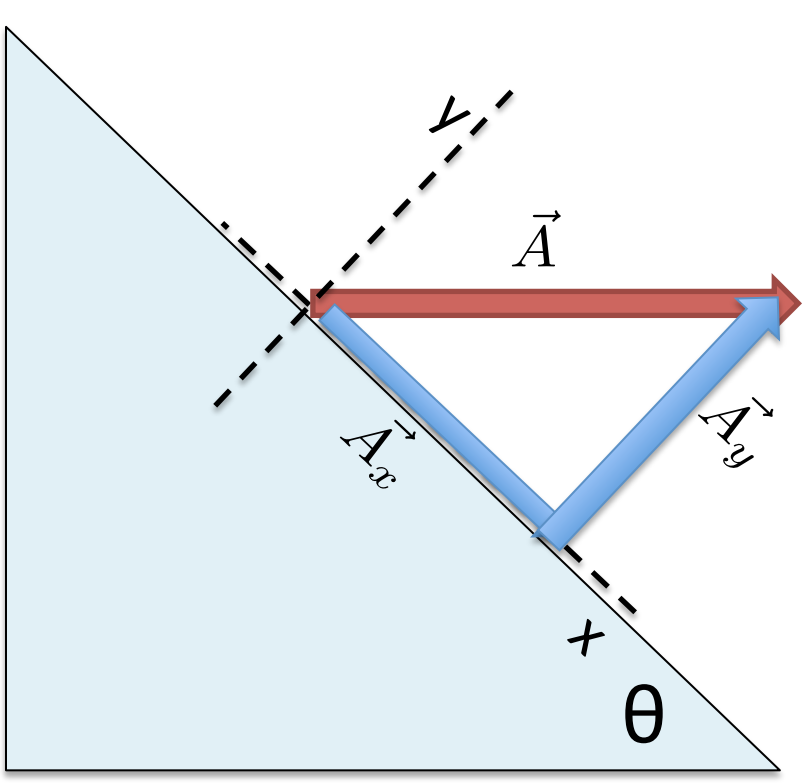
C) $|\vec{C}| = 5 + \sqrt{34}$

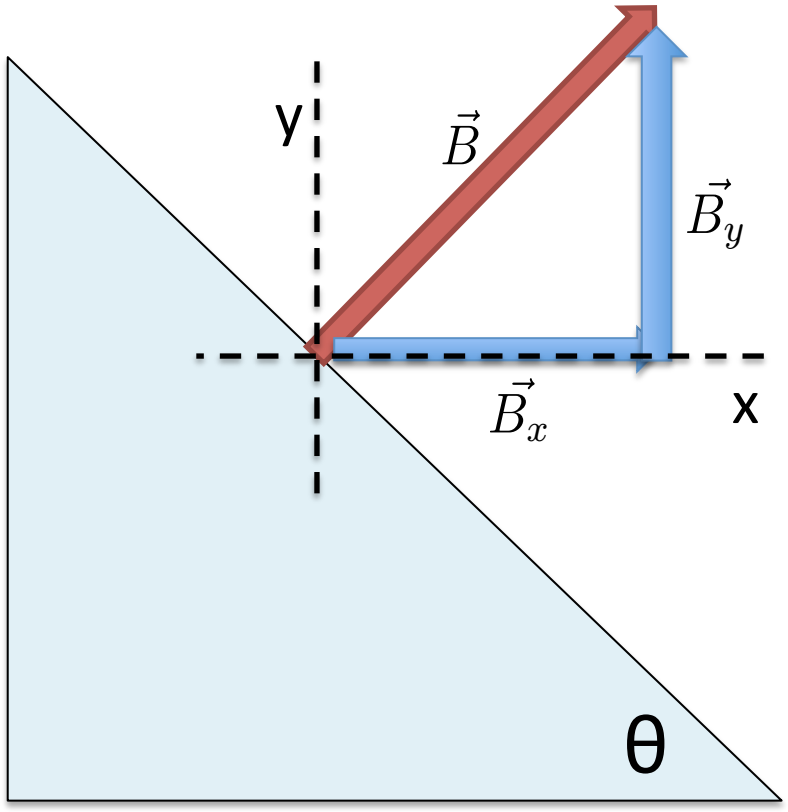
D) $|\vec{C}| = \sqrt{104}$

E) $|\vec{C}| = \sqrt{208}$

Rotated coordinate systems

- Sometimes it's best to rotate the whole coordinate system (like when you're sking…)





Clicker Question 2-8
Vectors

- For θ=30° and |A|=10, what is A_x?

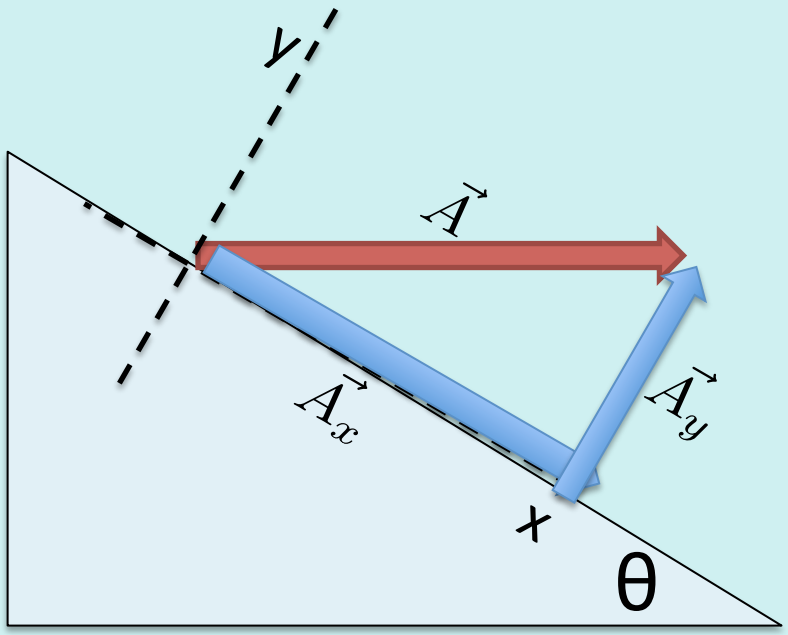
A) $10\sqrt{3}$

B) 5

C) $5\sqrt{2}$

D) $5\sqrt{3}$

E) $10\sqrt{2}/3$



Clicker Question 2-9
Vectors

- For θ=30° and |B|=3, what is B_x?

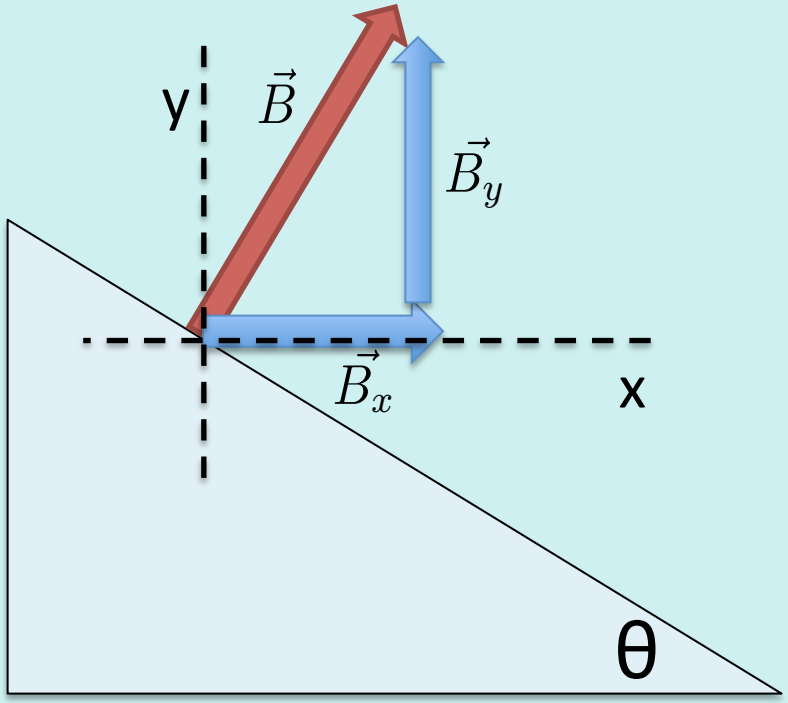
A) $\sqrt{3}/3$

B) $\sqrt{2}$

C) $3/2$

D) $3\sqrt{2}$

E) $3\sqrt{3}/2$



Reading Assignment

- Sections 2.4-2.7
- Key questions:

1) What is a motion diagram?
2) What is acceleration?
3) What is the acceleration due to gravity?

Homework

- Get ready for tomorrow's reading quiz
  - See assignment and questions posted on website
  - Tomorrow's reading quiz is for credit
- Work on Homework #1, which is due this Thursday
  - Turn it in Thursday morning, you'll get it back next Tuesday in class
- Homework #2 will be due next Wednesday. I'll have it posted by Thursday.
- Buy a clicker. After you use it in class register it at iclicker.com
  - Credit for clickers starts tomorrow