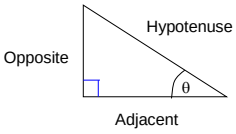
Physics 131: Lecture 5

Today's Agenda

- Scientific Notation
- Quick review of trigonometry
- Vectors
  - What is a vector?
  - How to express a vector.
  - Addition of vectors.
  - Vectors in component form
  - Examples

Right Triangle Trigonometry

- This is one of the most common things people are rusty with.

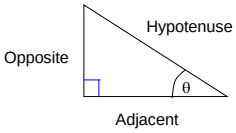


SOH CAH TOA

- Sin θ = Opp./Hyp.
- Cos θ = Adj./Hyp.
- Tan θ = Opp./Adj.

Clicker Question 1:

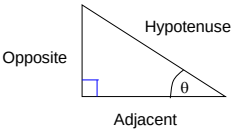
- If the hypotenuse below is 6m and the angle is 38°, what is the length of the adjacent side?



(a) 6 m Sin 38
(b) 6 m Tan 38
(c) 6 m Cos 52
(d) 6 m Cos 38
(e) Not enough information

Clicker Question 2:

- If the adjacent side below is 6.00 m and the opposite side is 7.00 m, what is the angle θ?



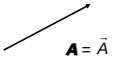
(a) $\tan^{-1}[6/7]$
(b) $\cos^{-1}[6/7]$
(c) $\cos^{-1}[7/6]$
(d) $\tan^{-1}[7/6]$
(e) $\sin^{-1}[7/6]$

Vectors

- There are two kinds of Physical quantities we will deal with:
  - Scalar (Only has a size)
    - Quantity that can be described with only one number.
      - This quantity is called magnitude.
    - Ex: time, speed (just a magnitude say 5 miles per hour)
  - Vector: (Has size and a direction)
    - Quantity that is described with two numbers
      - Magnitude
      - Direction
    - Ex: Position, velocity (magnitude say 5 miles per hour and direction say north)

Vectors...

- There are two common ways of indicating that something is a vector quantity:
  - Boldface notation: $\boldsymbol{A}$
  - Arrow notation: $\vec{A}$



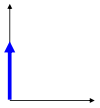
- Magnitude represented by italics A or like $|\boldsymbol{A}|$

Vector Math

- We are fairly familiar with the mathematics of scalars
- However we need to change our rules for the mathematics of Vectors

Two ways to represent a vector

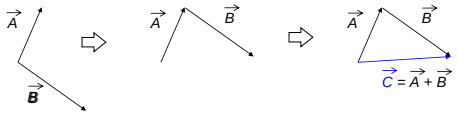
- First way: Analytical (mathematically)
  - $\vec{V}$ = (5m/s, north)
  - $\vec{V}$ = (5m/s, 90 degrees from the x-axis)



➡ Second way: Geometrically (Arrow method)
Arrow points in the direction vector does.
Length of arrow is it's magnitude.

Vector addition: Geometrical method

- Consider the vectors $\vec{A}$ and $\vec{B}$. Find $\vec{A} + \vec{B}$.

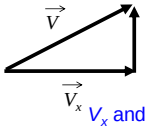


- Put the vectors head to tail, and connect them

This is not a convenient method if we wish to do calculations with the vectors!

Component form

- We can represent a vector $\vec{V}$ with two others $\vec{V_x}$ and $\vec{V_y}$ like so:



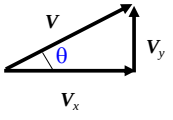
$\vec{V} = \vec{V_x} + \vec{V_y}$

V_x and V_y are head to tail, so they add to make V

We will learn to represent the vector as: $\vec{V} = (V_x, V_y)$

Back to Trig

- If we know the angle θ we can use trigonometry to solve for A and B



$$\text{Sin } \theta = \frac{\text{opp}}{\text{hyp}}$$

$$\text{Sin } \theta = \frac{V_y}{V}$$

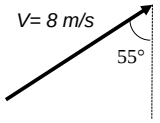
So ➡ $V \text{ Sin } \theta = V_y$ This is the y-component

Similarly ➡ $V \text{ Cos } \theta = V_x$ is the x-component

Clicker Question 3:

- What would be the correct representation of this vector in component form (V_x, V_y)?

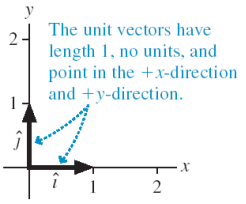
(a) (6.55 m/s, 5.34 m/s)
(b) (5.34 m/s, 6.55 m/s
(c) (6.55 m/s, 4.59 m/s)
(d) (4.59 m/s, 6.55 m/s)
(e) (13.94 m/s, 4.58 m/s)

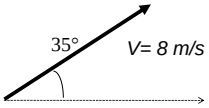


Sin 55 = 0.819
Cos 55 = 0.573
Tan 55 = 1.42

Unit Vectors

FIGURE 3.21 The unit vectors $\hat{\imath}$ and $\hat{\jmath}$.





$$V = 6.55\,m/s\,\hat{i} + 4.59\,m/s\,\hat{j}$$

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Announcements

- The first term test will be on Tuesday, October 2, from 6:00pm to 7:30pm.
- If you have a conflict at that time with an academic activity (test, lecture, tutorial, lab), you must register to write at the alternate sitting of this test by coming (no email!) to MP129 no later than September 27 at 5:00pm.
- As indicated at the beginning of the Physics section in the Faculty Course Timetable, this alternate sitting will be held just before the main sitting. Therefore, you are expected to have kept the time between 4:30 and 6:00pm free if you wish to write at the alternate sitting.
- There is **no third sitting** and there will be **no make-up test**. Students who miss Test 1 for documented medical reasons will have Test 2 count for 30% of their mark.

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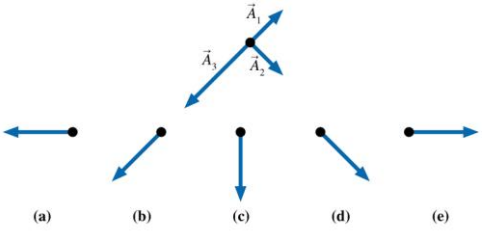
Clicker Question 4:

Which figure shows the sum of the three vectors?



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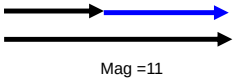
Adding vectors in the same direction

- Suppose we add these two vectors:

- The result is one vector in the same direction with magnitude of 11



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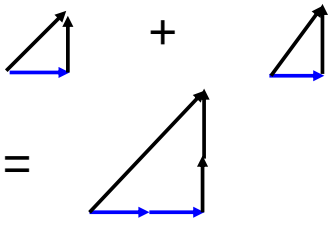
Adding vectors by components

- So we break our vectors into components. Then we add these components to get our resultant vector.



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Adding vectors by components

- So to add vectors with the component method we:
- 1) Break the vectors into x and y components
- 2) Add the x-components and add the y components for the vectors
- 3) This gives us the vector we want in component form.

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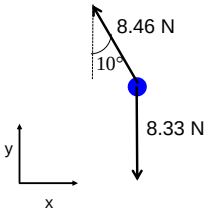
Clicker Question 5:

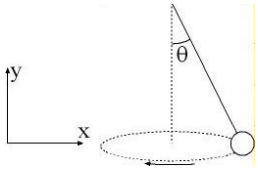
- What would be the correct representation of the force of gravity in component form (F_x, F_y)?

(a) (1.44 N, 8.20 N)
(b) (8.20 N, -1.44 N)
(c) (8.33 N, 0)
(d) (0, 8.33 N)
(e) (0, -8.33 N)



Example from a previous PHY131 Mid-Term Test

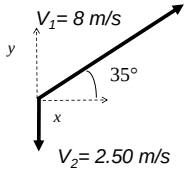
A ball is suspended on a string, and moves in a horizontal circle as shown in the figure. The string makes a constant angle θ = 10.0° with the vertical. The tension in the string is 8.46 N, and the force of gravity on the ball is 8.33 N, in the negative-y direction. What is the net force on the ball?



Clicker Question 7:

- What vector would result by adding these two vectors? Or what is $V_1 + V_2$?

(a) (6.11 m/s, 17.6°)
(b) (6.87 m/s, 17.6°)
(c) (7.5 m/s, 23°)
(d) (6.11 m/s, 45°)
(e) (6.87 m/s, 23°)



The angle here is the angle above the x-axis.