PHY 2053 announcements: January 8, 2009

•Textbook: College Physics I by Serway/Vuille

soft cover with white background

•Optional course packet (blue book):

available at Target copy on Friday

•Webassign: free for 11 more days

please logon and enter the code from textbook

email me if you have problems with login

1st assignment not for credit

•Clickers: will start practice today

please get one!

Units

- To convey certain physical property of an object.
- Units of length: meter, foot, inches, lightyears….
- SI -Systéme International (MKS=Meters-Kilograms-Second)
- CGS – Gaussian system (Centimeters-Grams-Second)
- US Customary (foot-slug-second)



- you will need a few more defined units in PHY 2054
- Units can be treated as algebraic quantities
  - add, subtract, multiply, divide
    Time remaining = 50 min – 20 min = 30 min
    Area = width x height = 4 cm x 5 cm = 20 cm^2
  - e.g., SI unit of area: $meter^2$ (m^2)
    SI Unit of speed: meter/second (ms^{-1})

Dimensions

- Length [L]
- Mass [M]
- Time [t]
- Temperature [T]

Dimensional Analysis

- Technique to check the correctness of an equation. Both sides of equation must have the same dimensions
  - 1 hour = 3600 s
    dimension t on both sides
  - Area = width x height
    4 cm x 5 cm = 20 cm^2
    dimension L^2 on both sides

Significant Figures

- There is uncertainty in every measurement
- A significant figure is one that is reliably known
  - 3.1416
- All non-zero digits are significant
  - 13 2 significant figure
  - 13.14 4 significant figures
- Significant figures ≠ decimal places
- Zeros are significant when
  - between other non-zero digits
    1004 4 significant figures
  - after the decimal point and another significant figure
    1.00 3 significant figures
  - can be clarified by using scientific notation
    1000 ? significant figures
    1.00×10^3 3 significant figures

Rounding Off

- When adding or subtracting, round the result to the smallest number of decimal places of any term in the sum
- If the last digit to be dropped is less than 5, drop the digit
- If the last digit dropped is greater than or equal to 5, raise the last retained digit by 1

15.54 + 0.141 = 15.681 = 15.68

15.54 + 0.146 = 15.686 = 15.69

When multiplying or dividing two or more quantities, the number of significant figures in the final result is the same as the number of significant figures in the least accurate of the factors being combined

56.7 x 10.002 = 567.1134 = 567

Unit Conversions

Units can be treated like algebraic quantities that can "cancel" each other

- See the inside of the text front cover for an extensive list of conversion factors

Convert inches to Centimeters:

$$15.0\ \text{in} \times \left(\frac{2.54\ \text{cm}}{1.00\ \text{in}}\right) = 38.1\ \text{cm}$$

Problem Solving Summary

- Equations are the tools of physics
  - Understand what the equations mean and how to use them
- Carry through the algebra as far as possible
  - Substitute numbers at the end
- Be organized

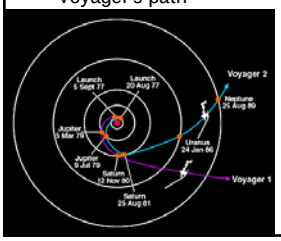
Chapter 2: Dynamics

- The branch of physics involving the motion of an object and the relationship between that motion and other physics concepts
- ***Kinematics*** is a part of dynamics
  - In kinematics, you are interested in the *description* of motion
  - *Not* concerned with the cause of the motion

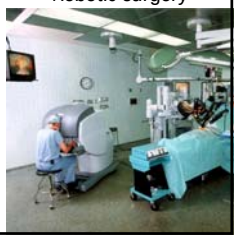
Quantities in Motion

- Any motion involves three concepts
  - Displacement
  - Velocity
  - Acceleration
- These concepts can be used to study objects in motion

Voyager's path



Robotic surgery



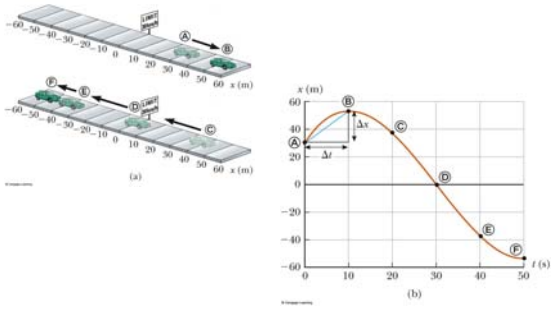
Position

- Choose coordinate axes
- In one dimension, generally the x- or y-axis

Displacement

- Defined as the change in position
  - $\Delta x \equiv x_f - x_i$
    - f stands for final and i stands for initial
  - May be represented as Δy if vertical
  - Units are meters (m) in SI

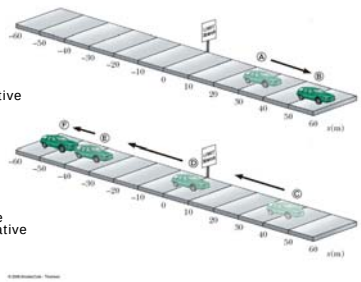
Graph: position vs time



Displacement example

$$\Delta x \equiv x_f - x_i$$

- From A to B
  - x_i = 30 m
  - x_f = 52 m
  - Δx = 22 m
  - The displacement is positive, indicating the motion was in the positive x direction
- From C to F
  - x_i = 38 m
  - x_f = -53 m
  - Δx = -91 m
  - The displacement is negative, indicating the motion was in the negative x direction



Vector vs. scalar

- Vector quantities need both magnitude (size) and direction to completely describe them
  - Generally denoted by boldfaced type and an arrow over the letter (**x** or $\vec{x}$)
  - + or – sign is sufficient for this chapter (for motion in 1 dimension)
- Scalar quantities are completely described by magnitude only

- Displacement is a vector.
- Distance is a scalar.

Distance is not the same as displacement.

- Example: Throw a ball straight up and then catch it at the same point you released it
  - The distance is twice the height
  - The displacement is zero

Speed vs. velocity

scalar	vector
Average speed	Average velocity
$= \frac{\text{Total distance}}{\text{Total time}}$	$= \frac{\text{Total displacement}}{\text{Total time}}$
$= \frac{d}{t}$	$\vec{v}_{average} = \frac{\Delta \vec{x}}{\Delta t} = \frac{\vec{x}_f - \vec{x}_i}{\Delta t}$

Units: meter/second (m/s)

Same average velocity

Different speed

Average Velocity

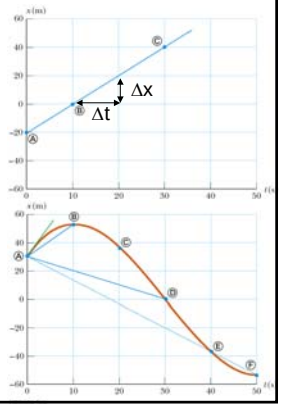
$$\vec{v}_{average} = \frac{\Delta \vec{x}}{\Delta t}$$

Constant Velocity

- The straight line indicates constant velocity
- The slope of the line is the value of the average velocity

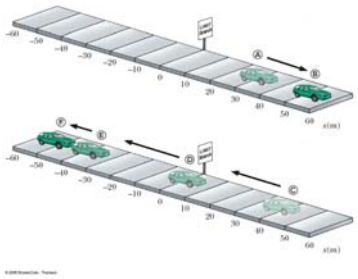
Non-Constant Velocity

- The motion is non-constant velocity
- The average velocity is the slope of the blue line joining two points



Displacement example

- From A to B
  - x_i = 30 m
  - x_f = 52 m
  - Δx = 22 m
- From A to F
  - x_i = 30 m
  - x_f = -53 m
  - Δx = -83 m

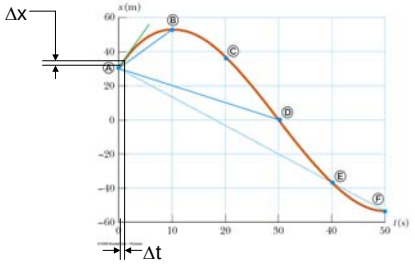


If the time between successive snapshots is 1 second,

$V_{average}$ from A to B = $\Delta X_{AB}/\Delta t_{AB}$ = 22 m/1s = 22 ms^{-1}

Instantaneous Velocity:

keep making Δt smaller:



The slope of the line tangent to the position-vs.-time graph is defined to be the instantaneous velocity at that time

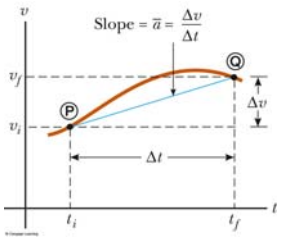
Acceleration

- Changing velocity means an acceleration is present
- Acceleration is the rate of change of the velocity

$$\bar{a} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$$

- Units are m/s^2 (SI), cm/s^2 (cgs), and ft/s^2 (US Cust)
- Vector quantity

Average Acceleration



Instantaneous acceleration

= slope of tangent of velocity-time graph