PHYS 1441 – Section 004
Lecture #3

Wednesday, Jan. 28, 2004
Dr. Jaehoon Yu

- Chapter two: Motion in one dimension
  - Fundamentals
  - Velocity and Speed (Average and instantaneous)
  - Acceleration (Average and instantaneous)
  - One dimensional motion at constant acceleration
    - Free Fall

Today's homework is homework #2, due 1pm, next Wednesday!!

Announcements

- Reading Assignments: Sections 2.6 – 2.8, follow through the examples
- Homework Registration: 58/61 (56 of you submitted it)
  - You must download, print, solve and submit electronically your homework to obtain 100% credit for homework #1
  - Homework #1 due 1pm, Today
  - Roster will close 6pm, Today
- E-mail distribution list (phys1441-004-spring04)
  - 33 of you subscribed as of 9am this morning
  - Send an e-mail to listserv@listserv.uta.edu with
    - "subscribe phys1441-004-spring04 fn ln"
    - Without a subject. Put the above in the body ONLY!
  - 3 points extra credit if done by 6pm Wednesday, Jan. 28
  - 1 point extra credit if done by 6pm Monday, Feb. 2
- Lab begins next Monday, Feb. 2 ➔ Pick up the information sheet if haven't already
- Utilize the Physics Clinic
  - When: MWF: 12-7pm, T,Th: 12-7:30pm
  - Where: SH114 this week, SH010 from next week onward

Survey Results

- Class composition
  - Mixture of many disciplines, biology and architecture are majority
  - Excellent opportunity to work together with people in other discipline ➔ Learn from each other
- Previous physics experience
  - 33 yes, 11 no
    - 14 mechanics
    - 12 electromagnetism
- Math: most of you had sufficient math training for this course
- Why take this course?
  - Mandatory: 42
  - Like physics: 7

PHYS 1441 sec. 004 CLASS ROLL			1/28/2004	Homework registration	e-mail		
	Last Name	First Name					
	Ahmed	Iqbal		1/22/2004			
4557	Aye,	Ayodeji		1/23/2004	1/22/2004		
2804	Baapa	Giacob		1/24/2004			
1025	Barsaradegan,	Tiffany		1/22/2004	1/22/2004		
2901	Bergman,	Timothy					
5803	Bibe,	Hal		1/22/2004	1/22/2004		
4393	Bishop,	Candace		1/22/2004			
2359	Blackman,	Adam		1/22/2004	1/27/2004		
3867	Buckley,	Michael		1/22/2004			
1753	Caldwell,	Amanda		1/22/2004	1/22/2004		
9727	Cantu,	Chanda		1/22/2004			
1492	Carr,	Paul		1/22/2004	1/26/2004		
9133	Chavez,	Debra		1/22/2004	1/22/2004		
2304	Coates,	Elizabeth		1/22/2004	1/22/2004		
9433	Cofey,	Arthur		1/25/2004	1/29/2004		
3200	Cooper,	Lance		1/24/2004			
3864	Coron,	James					
9730	Crouse,	Jennifer		1/22/2004	1/26/2004		
3037	Cumpian,	Lighmon		1/24/2004			
3110	Do,	Tuan		1/22/2004	1/26/2004		
2553	Fitch,	Michelle		1/22/2004	1/26/2004		
4915	Floyd	Jennifer					
3333	Gaskill,	Katherine		1/24/2004	1/29/2004		
2538	Godley,	William		1/24/2004	1/26/2004		
2583	Gonzales,	Karen		1/22/2004			
9743	Govind,	Hiren		1/27/2004			
1882	Ha,	Tuong		1/24/2004			
1533	Hall,	Anthony					
234	Hatchel,	Kathryn		1/23/2004			
2532	Kills,	Jared		1/24/2004			
8038	Lac,	Anh		1/27/2004	1/27/2004		
3333	Larkin,	Erin		1/22/2004	1/22/2004		
5583	Le,	Lan		1/25/2004			
5538	Le,	Steven		1/25/2004	1/29/2004		
4727	Lee,	Ji-Young		1/22/2004	1/26/2004		
4191	Lohey,	Kristin		1/22/2004	1/26/2004		
2214	McNabb,	Micah		1/23/2004	1/29/2004		
7849	McCammon,	Kelly		1/22/2004	1/22/2004		
1745	McKethan,	Jessica		1/22/2004	1/29/2004		
3233	Medina,	Jason		1/23/2004	1/27/2004		
3313	Melendez,	Jaqueline		1/27/2004			
1328	Nagai,	Toni					
4472	Newby,	Jerry		1/25/2004			
	Onyuneme	Ijeoma		1/27/2004	1/27/2004		
5171	Parikh,	Andrea		1/25/2004	1/27/2004		
5733	Parma,	Kevin		1/22/2004	1/26/2004		
6564	Patel,	Meera		1/22/2004	1/29/2004		
3832	Pavlic,	Maja		1/22/2004	1/26/2004		
2313	Pearson,	Joshua		1/22/2004	1/26/2004		
4787	Pham,	Hanh		1/24/2004	1/26/2004		
4745	Pope,	Angela		1/24/2004			
8105	Price,	Michael		1/24/2004	1/27/2004		
3533	Quinn,	Victoria		1/23/2004	1/23/2004		
4504	Ralir,	Stephen		1/24/2004			
3867	Rayba,	Tiffany					
1041	Rios,	Guadalupe					
5433	Robinson,	Ashley		1/25/2004			
2130	Shinnell,	Bryan		1/22/2004			
8183	Smith,	Olayemi		1/22/2004			
2300	Stoltz,	Jason		1/27/2004	1/27/2004		
4805	Tumbleson,	Jay		1/25/2004			
5181	Vargas,	Jaime		1/22/2004	1/23/2004		
2831	Viggiano,	Katherine		1/25/2004	1/26/2004		
2332	Wall,	Michael		1/24/2004			
6763	Williams,	Felipe		1/22/2004	1/22/2004		

Some Fundamentals

- Kinematics: Description of Motion without understanding the cause of the motion
- Dynamics: Description of motion accompanied with understanding the cause of the motion
- Vector and Scalar quantities:
  - Scalar: Physical quantities that require magnitude but no direction
    - Speed, length, mass, etc
  - Vector: Physical quantities that require both magnitude and direction
    - Velocity, Acceleration, Force, Momentum
    - It does not make sense to say "I ran with velocity of 10miles/hour."
- Objects can be treated as point-like if their sizes are smaller than the scale in the problem
  - Earth can be treated as a point like object (or a particle)in celestial problems
  - Any other examples?

Some More Fundamentals

- Motions:Can be described as long as the position is known at any time (or position is expressed as a function of time)
  - Translation: Linear motion along a line
  - Rotation: Circular or elliptical motion
  - Vibration: Oscillation
- Dimensions
  - 0 dimension: A point
  - 1 dimension: Linear drag of a point, resulting in a line ➔ Motion in one-dimension is a motion on a line
  - 2 dimension: Linear drag of a line resulting in a surface
  - 3 dimension: Perpendicular Linear drag of a surface, resulting in a stereo object

Displacement, Velocity and Speed

One dimensional displacement is defined as:

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

Displacement is the difference between initial and final potions of motion and is a vector quantity

Average velocity is defined as:

$$v_x \equiv \frac{x_f - x_i}{t_f - t_i} = \frac{\Delta x}{\Delta t}$$

Displacement per unit time in the period throughout the motion

Average speed is defined as:

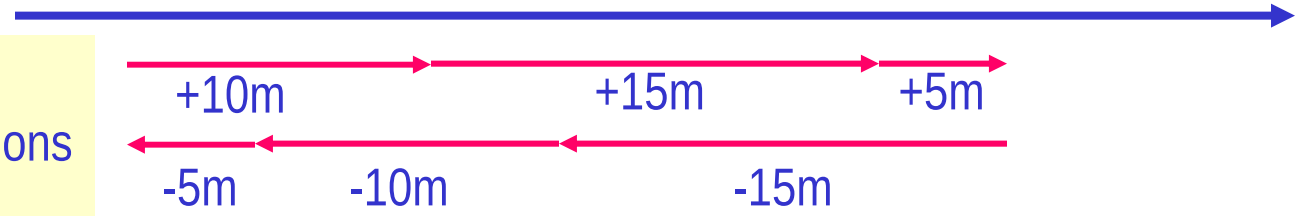
$$v \equiv \frac{\text{Total Distance Traveled}}{\text{Total Time Interval}}$$

Can someone tell me what the difference between speed and velocity is?

Difference between Speed and Velocity

- Let's take a simple one dimensional translation that has many steps:

Let's call this line as X-axis



Let's have a couple of motions in a total time interval of 20 sec.

Total Displacement: $\Delta x \equiv x_f - x_i = x_i - x_i = 0(m)$

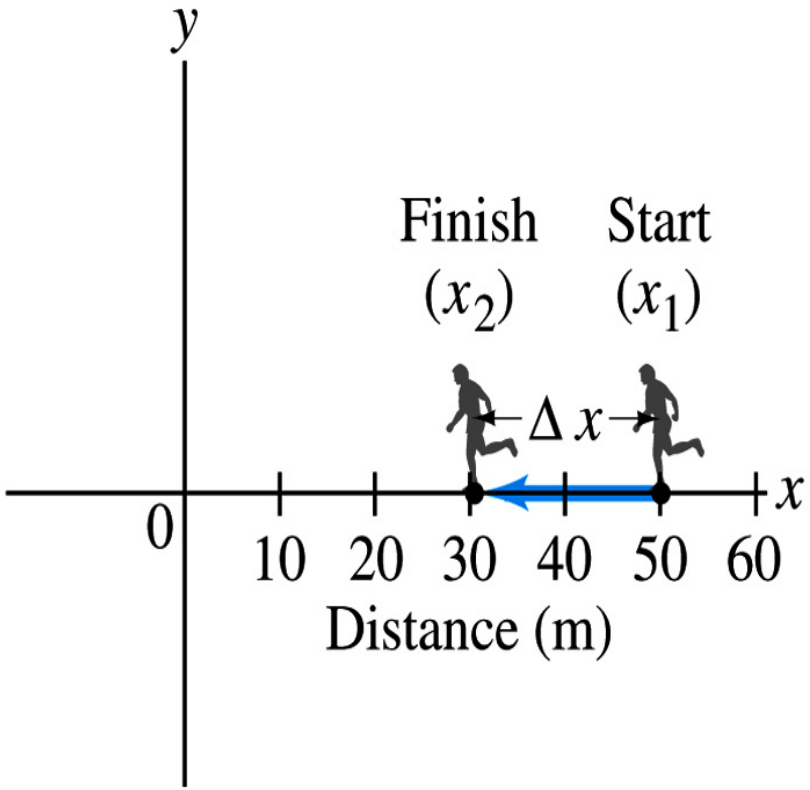
Average Velocity: $v_x \equiv \frac{x_f - x_i}{t_f - t_i} = \frac{\Delta x}{\Delta t} = \frac{0}{20} = 0(m/s)$

Total Distance Traveled: $D = 10 + 15 + 5 + 15 + 10 + 5 = 60(m)$

Average Speed: $v \equiv \frac{\text{Total Distance Traveled}}{\text{Total Time Interval}} = \frac{60}{20} = 3(m/s)$

Example 2.1

The position of a runner as a function of time is plotted as moving along the x axis of a coordinate system. During a 3.00-s time interval, the runner's position changes from x_1=50.0m to x_2=30.5 m, as shown in the figure. What was the runner's average velocity? What was the average speed?



- Displacement:

$$\Delta x \equiv x_f - x_i = x_2 - x_1 = 30.5 - 50.0 = -19.5(m)$$

- Average Velocity:

$$v_x \equiv \frac{x_f - x_i}{t_f - t_i} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t} = \frac{-19.5}{3.00} = -6.50(m/s)$$

- Average Speed:

$$v \equiv \frac{\text{Total Distance Traveled}}{\text{Total Time Interval}}$$

$$= \frac{50.0 - 30.5}{3.00} = \frac{+19.5}{3.00} = +6.50(m/s)$$

Instantaneous Velocity and Speed

- Can average quantities tell you the detailed story of the whole motion?
- Instantaneous velocity is defined as:
  - What does this mean?
    - Displacement in an infinitesimal time interval
    - Mathematically: Slope of the position variation as a function of time

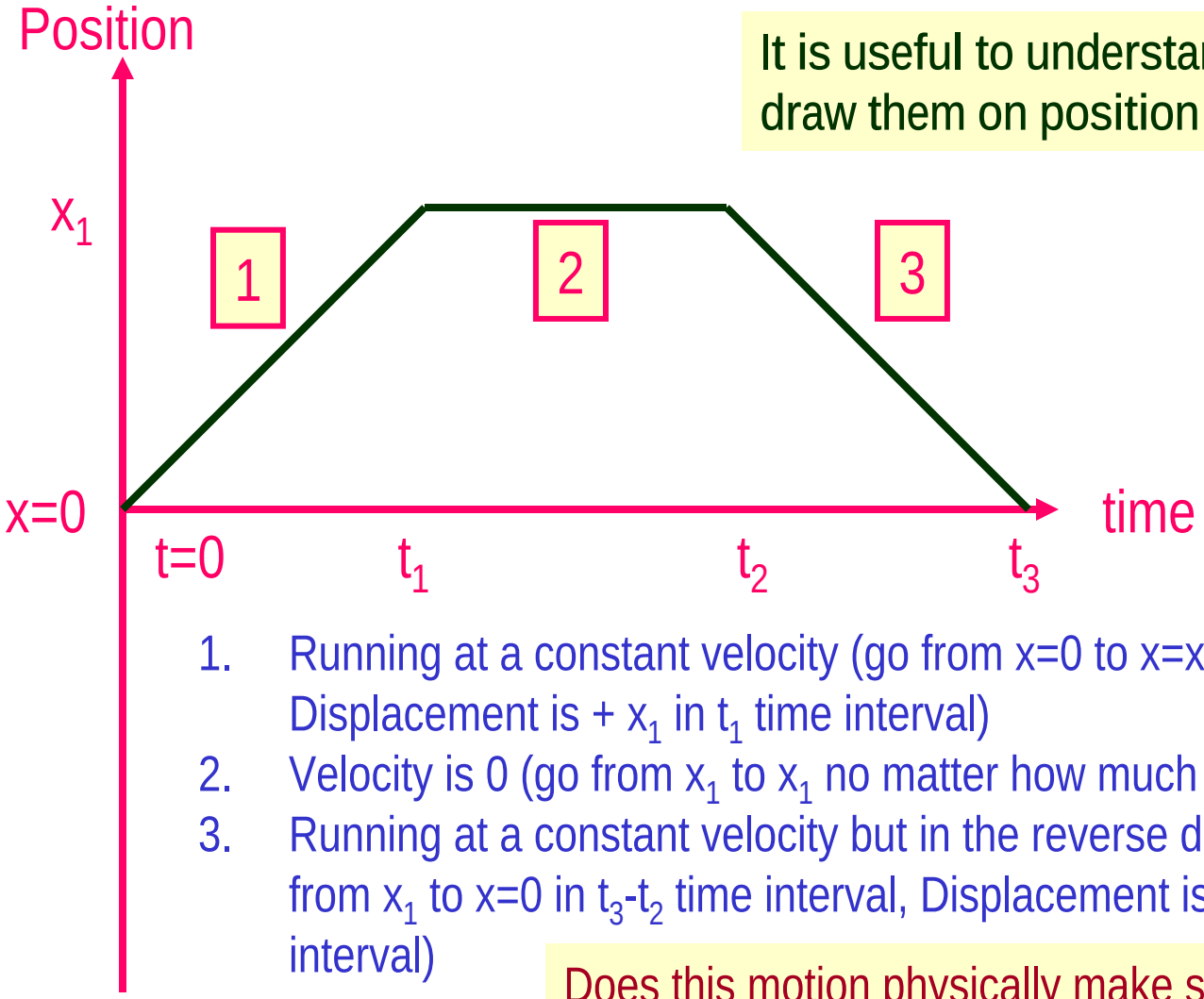
$$v_x = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

- Instantaneous speed is the size (magnitude) of the velocity vector:

$$|v_x| = \left| \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} \right| = \left| \frac{dx}{dt} \right|$$

*Magnitude of Vectors are Expressed in absolute values

Position vs Time Plot



It is useful to understand motions to draw them on position vs time plots.

1. Running at a constant velocity (go from x=0 to $x=x_1$ in t_1, Displacement is + x_1 in t_1 time interval)
2. Velocity is 0 (go from x_1 to x_1 no matter how much time changes)
3. Running at a constant velocity but in the reverse direction as 1. (go from x_1 to x=0 in t_3-t_2 time interval, Displacement is - x_1 in t_3-t_2 time interval)

Does this motion physically make sense?