Class Notes – Lecture 3 1 September 2009

CHAPTER 2 Motion in One Dimension

We begin with mechanics b/c of its everyday life applications
IE: kicking the ball into the jumbotron, operating surgical equipment

Dynamics

Branch of physics involving the motion of an object & the relationship between that motion & other physics concepts

Kinematics is a part of dynamics

Interested in the description of motion (in terms of definite quantities)

Not concerned w/ the cause

? you can stop your car in 10ft when going 20mph. What is your stopping distance at 40mph?
Ans: 40ft
2x the speed $(2)^2$ x the distance

Quantities in Motion

Any motion involves 3 concepts: displacement, velocity, acceleration

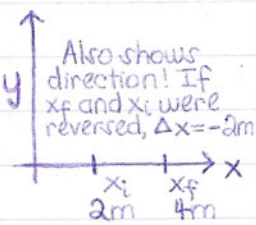
Used to study objects in motion

Displacement

If $x_f = x_i$, the displacement = Ø

Definition: change in position

$\Delta x = x_f - x_i$; where f and i stand for final and initial, respectively



Also shows direction! If x_f and x_i were reversed, $\Delta x = -2m$

$\Delta x = +2m$

May be represented as Δy if vertical

Units are meters (SI), centimeters (cgs), or feet (US)

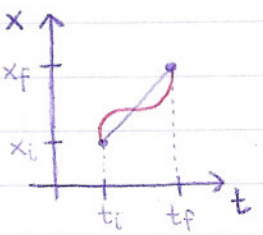
Velocity

It takes time for an object to undergo displacement

The average velocity is the rate at which the displacement occurs

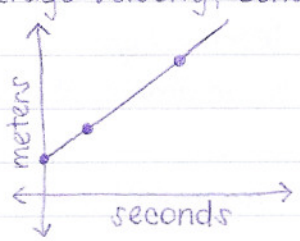
In an x-vs.-time diagram, this is the slope equation

$$v_{avg} = \Delta x / \Delta t = (x_f - x_i)/(t_f - t_i)$$



nonconstant v
constant vel.

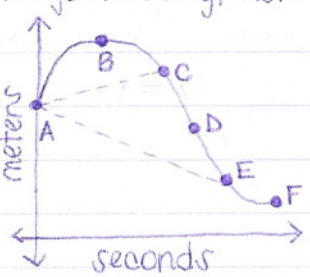
Average Velocity, Constant



The straight line indicates constant velocity

The slope of the line is the value of avg. velocity

Average Velocity, Non-Constant



The motion is non-constant velocity

The average velocity is the slope of the line connecting 2 points (dotted)

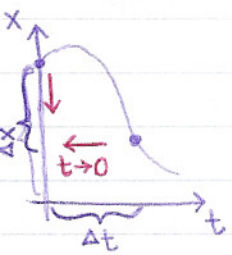
? Average velocity from pt. A to pt. D?

Ans.: Slope of the line from A to D

Instantaneous Velocity

The limit of the avg. velocity as the time interval becomes infinitesimally short (approaches zero)

$V = \lim_{t \to 0} \Delta x / \Delta t$



Indicates what's happening at every point in time

On a graph:

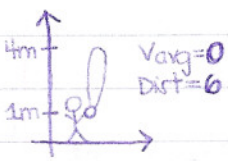
The slope of the line tangent to the position-vs-time graph is defined to be the instantaneous velocity at that time

The instantaneous speed is the magnitude of the instantaneous vel.

Average Speed

The total distance traveled divided by the total time elapsed

$V = d/t$



Speed is a scalar quantity

Acceleration

Changing velocity means acceleration is present

The rate of change of the velocity

Units are m/s^2 (SI), cm/s^2 (cgs), ft/s^2 (US)

Average acceleration:

Vector quantity

Sign of Velocity vs. Sign of Acceleration	Speed
same	increasing
different	decreasing

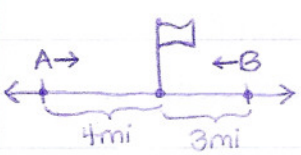
} VERY important!

Instantaneous acceleration: the limit of the average acceleration as the time interval goes to zero

Uniform acceleration: velocity vs. time curve is a straight line

Example (?19): Runners' velocities: A +6mph, B -5mph

beforehand = undetermined



If they start at the same time and meet at point X what is the relationship of t_A and t_B? $t_A = t_B$

$V_A = (x--4)/t_A$ $\quad V_B = (x-3)/t_B$

$6 = (x+4)/t_A$ $\quad -5 = (x-3)/t_B$

$t_A = \frac{x+4}{6}$ $\quad t_B = \frac{x-3}{-5}$

$\frac{x+4}{6} = \frac{x-3}{-5}$ gives us $x = -2/11$ miles as their meeting point