Velocity (Notes)

Translational Motion
the motion of objects that move without rotating

Mechanics
the study of why and how objects move

Kinematics
how objects move

Dynamics
why objects move

Vector
has magnitude (a number representing how big it is) and direction

Scalar
has magnitude only

Position
separation between an object and a reference point; "where you are"

Distance
how far you have traveled; "odometer reading;" the magnitude of the change in position; scalar quantity; symbol is d and SI unit is m (for meters)

Displacement
how far you have gone in a certain direction; distance with direction; how far you are from your starting point; "as the crow flies;" vector quantity; symbol is **d** or **x** and SI unit is m (for meters); the change in position of an object
Displacement = change in position = original position minus initial position
$\Delta x = x_f - x_i$

Displacement does not always equal the distance traveled! Displacement describes the direction of motion of the object. We will call the displacement of an object moving to the right positive and that of an object moving to the left negative.

Directions in physics can be assigned positive and negative signs. For now, let right and up be positive and left and down be negative.

Speed
distance (how far you have gone) traveled in a given amount of time; scalar quantity; symbol is *v*and SI unit is *m/s* (for meters per second)

Velocity
displacement (how far you have gone in a certain direction) per time interval; vector quantity; symbol is *v* and SI unit is *m/s* (for meters per second)

In physics, definitions can be expressed mathematically. The definition for speed (and velocity) can be expressed as:

$$v = \frac{d}{t} \quad \text{or} \quad d = v\,t$$

Instantaneous velocity (or speed)
velocity (or speed) at that instant of time, or, it can be defined as the average velocity (or speed) over an infinitesimally short time interval (average speed and velocity are always the same value)

Frame of reference

gives location of an object relative to a reference point. Any measurement of position, distance, or speed must be made with respect to a frame of reference.

Average velocity

total displacement divided by total time

v_{av}=(displacement)/(elapsed time)

v_{av} = (change in position)/(change in time) = displacement/time = **x** / t

The average velocity of an object is positive if the sign of the displacement is positive and negative if the sign of the displacement is negative.

Average speed

total distance divided by total time, or, the distance traveled along a path divided by the time it takes to travel this distance

v_{av}=(distance traveled)/(elapsed time)

Riverboat problem (http://mysite.verizon.net/vzeoacw1/velocity_composition.html)

In physics, the relationship between variables is examined graphically. If you wanted to experimentally determine the speed (velocity) of an object, you would collect position (displacement) and time data. Since your distance traveled (or your displacement) depends upon the elapsed time, position (displacement) is the dependent variable (graphed on the y-axis) and time is the independent variable (graphed on the x-axis). The slope of the line gives the speed (velocity) of the object. On a position vs time graph, a line of constant slope indicates that the object is moving at constant speed (velocity). A horizontal line (a slope of zero) means that the object is motionless. A curved line (variable slope) means that the speed of the object is changing. On a graph, if a line has positive slope, we say that the object has positive speed (or velocity); if a line has negative slope, we say that the object has negative speed (or velocity).

On a *d* vs *t* graph, you can mathematically write the equation for the motion of the object knowing the slope and the y-intercept. Remember, the equation of a line is given as $y = mx + b$, where m is slope and b is the y-intercept.