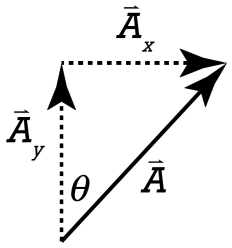
Flipping Physics Lecture Notes:
AP Physics 1 Review of *Kinematics*
http://www.flippingphysics.com/ap1-kinematics-review.html

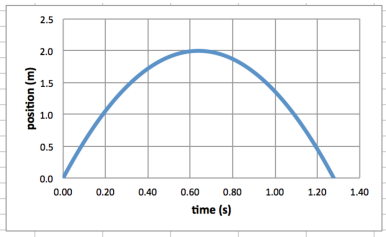
Introductory Concepts:

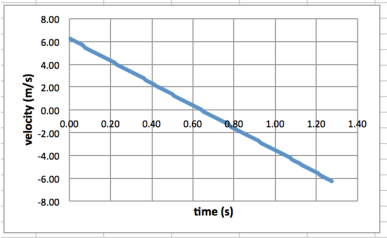
- Vector: Magnitude and Direction
  - Magnitude means the "amount" of the vector or the value of the vector without direction.
- Scalar: Magnitude only, no direction
- Component Vectors
  - Theta won't always be with the horizontal, so the component in the x direction won't always use cosine.
  - $\sin\theta = \frac{O}{H} = \frac{\vec{A}_x}{\vec{A}} \Rightarrow \vec{A}_x = \vec{A}\sin\theta$

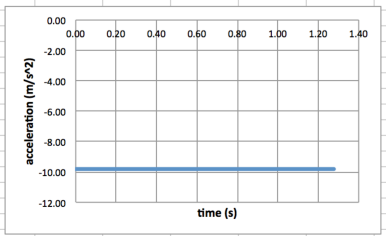


Kinematics:

- Distance vs. Displacement
  - Distance is how far something moves and it includes the path travelled.
    - Distance is a scalar.
  - Displacement is the straight-line distance from where the object started to where it ended.
    - Displacement is a vector.
    - Displacement is the change in position of an object. $\Delta\vec{x} = x_f - x_i$
- $Speed = \frac{Distance}{Time}$, is a scalar.
- Velocity, $\vec{v} = \frac{\Delta\vec{x}}{\Delta t}$, is a vector.
- Acceleration, $\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$, is a vector.
- The slope of a position vs. time graph is velocity.
- The slope of a velocity vs. time graph is acceleration.
- On an acceleration vs. time graph, the area between the curve & the time axis is change in velocity.
- On a velocity vs. time graph, the area between the curve & the time axis is change in position which is also called displacement.
- In Free Fall, $a_y = -g = -9.81\frac{m}{s^2}$.
  - An object is in free fall if the only force acting on it is the force of gravity. In other words: the object is flying through the vacuum you can breathe♥ and not touching any other objects.







♥ Vacuum you can breathe = no air resistance.

- The Uniformly Accelerated Motion Equations (UAM Equations):

AP® Physics 1 Equation Sheet	*Flipping Physics®*
$v_x = v_{x0} + a_x t$	$v_f = v_i + a\Delta t$
$x = x_0 + v_{xo} t + \frac{1}{2} a_x t^2$	$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$
$v_x{}^2 = v_{x0}{}^2 + 2a_x \left(x - x_0 \right)$	$v_f{}^2 = v_i{}^2 + 2a\Delta x$
	$\Delta x = \frac{1}{2} \left(v_f + v_i \right) \Delta t$

- The AP Physics 1 UAM Equations assume $t_i = 0$; $\Delta t = t_f - t_i = t_f - 0 = t$
- Projectile Motion: An object flying through the vacuum you can breathe in at least two dimensions.

x direction	*y direction*
$a_x = 0$	Free-Fall
Constant Velocity	$a_y = -g = -9.81 \frac{m}{s^2}$
$v_x = \frac{\Delta x}{\Delta t}$	Uniformly Accelerated Motion
Δt is the same in both directions because it is a *scalar* and has magnitude only (no direction).	

  - Remember to break your initial velocity into its components if it is not directly in the x direction and if the initial velocity is directly in the x direction, then the initial velocity in the y direction equals zero.
- Relative Motion is Vector Addition.
  - Draw vector diagrams.
  - Break vectors into components using SOH CAH TOA.
  - Make a right triangle.
  - Use SOH CAH TOA and the Pythagorean theorem to determine the magnitude and direction of the resultant vector.
- Center of mass.
  - Only need to know center of mass qualitatively, in other words, without numbers.
  - For the purposes of translational motion, which is essentially non-rotational motion, the whole object or system of objects can be considered to be located at its center of mass. For example, an object or group of objects in projectile motion is described by only analyzing the motion of the center of mass not each individual part of the object or system.