Acceleration

$$A = (V_f - V_i)/(t_f - t_i)$$

Acceleration is a Vector $(Vf – Vi)/tf - ti$

- If Acceleration and Velocity have the same sign, the motion is speeding UP.

- If Acceleration and Velocity have opposite signs, the motion is slowing DOWN.

- If Acceleration and Velocity are at 90 degrees with respect to each other, the motion is circular motion.

Given constant acceleration and motion in a straight line ("uniformly accelerated motion")

- 1. $V_{avg} = (V_i + V_f)/2$

- 2. $V_f = V_i + A \times t$

- 3. $D = V_i \times t + \frac{1}{2} A t^2$

- 4. $V_f^2 = V_i^2 + 2 \times A \times D$

- (N.B.: #4 has no time; #3 has time; #4 has Vf. #2 has Vf but no D)

Example

- An object is dropped rest from a height of 49 meters. How long does the object take to hit the ground? What is its speed as it hits the ground?

- Vi = 0 and we need t, so use #3.

- D = Vi x t + ½ a t^2

- -49 = ½ (-9.8)t^2   t = 3.2 s

- Vf = -9.8 x 3.2 s = - 31 m/s

Example

- A softball is thrown straight up, reaching a maximum height of 20 meters. Neglecting air resistance what is the softball's vertical velocity when it hits the ground?

- (N.B. no time, D, Vi, A........so use #4)

- $Vf^2 = Vi^2 + 2 \times A \times D = 0 + 2 \times -9.8 \times -20$

-         $= 392$

- $Vf = 20$ m/s

Group Activity

- 1. An object is allowed to fall freely near the surface of a planet. The object has an acceleration due to gravity of 24 m/s^2. How far will the object fall during the first second?

- 2.   Object A with a mass of 2 kg and object B with a mass of 4 kg are dropped simultaneously from rest near the surface of the earth. At the end of 3 s what is the ratio of the speed of object A to the speed of object B.

Group Activity

- 3. Starting from rest, an object rolls freely down an incline that is 10 meters long in 2 s. The acceleration of the object is how much?

- 4. An object starting from rest moves down an incline with an acceleration of 2 m/s^2 for 2 s. How far does the object move during the 2 s? What is the final speed of the object after 2 s?

Group Activity

- 5.   An object initially traveling in a straight line with a speed of 5 m/s is accelerated at 2 m/s^2 for 4 s. What is the total distance traveled by the object in the 4 s?

- 6.   An object is allowed to fall freely near the surface of a planet. The object falls 54 m in the first 3 s after it is released. The acceleration due to gravity on that planet is what?