Chapter 2: Kinematics (St. Line Motion) Key Ideas

Displacement and Velocity:

- Displacement is a change of position in a certain direction, not the total distance traveled.
- The average velocity of an object during some time interval is equal to the displacement of the object divided by the time interval.
- The average velocity is equal to the slope of the straight line connecting the initial and final points on a graph of the position of the object versus the time.

Acceleration:

- The average acceleration of an object during a certain time interval is equal to the change in the object's velocity divided by the time interval.
- The direction of the acceleration is not always the same as the direction of the velocity. The direction of the acceleration depends on the direction of the motion and on whether the velocity is increasing or decreasing.
- The average acceleration is equal to the slope of the straight line connecting the initial and final points on the graph of the velocity of the object versus the time.

Falling Objects:

- An object thrown or dropped in the presence of Earth's gravity experiences a constant acceleration directed toward the center of the Earth. This acceleration is called free-fall acceleration, or the acceleration due to gravity.
- Free-fall acceleration is the same for all object, regardless of mass.
- The value for free-fall acceleration on Earth's surface used in our studies is $a_g = -g = -9.81\ m/s^2$. The direction of the free-fall acceleration is considered to be negative because the object accelerates toward Earth.

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Equations:

$$v_{avg} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t}$$

$$a_{avg} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t}$$

$$v_f = v_i + at$$

$$\Delta x = \tfrac{1}{2}\left(v_i + v_f\right)t$$

$$\Delta x = v_i t + \tfrac{1}{2} a t^2$$

$$v_f{}^2 = v_i{}^2 + 2a\Delta x$$

Free-fall:

$$v_f = v_i - gt$$

$$\Delta y = v_i t - \tfrac{1}{2} g t^2$$

$$v_f{}^2 = v_i{}^2 - 2g\Delta y$$