CHAPTER 2 SUMMARY. **Motion in One Dimension**

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Kinematics Description of motion

Displacement, Velocity, and Speed

An object moving from intial position x_i to final position x_f has **displacement**

$$\Delta x = x_f - x_i.$$

The **average velocity** of the object is the ratio of the displacement to the time it takes for the displacement $\Delta t = t_f - t_i$,

$$v_{av} = \frac{\Delta x}{\Delta t}.$$

The **average speed** of the object is the ratio of the distance traveled to the time it takes,

$$\bar{v} = \frac{\Delta s}{\Delta t}.$$

The average velocity and the average speed of an object are very different.
Geometric Interpretation: The average velocity is the slope of the straight line connecting the points (t_1, x_1) and (t_2, x_2) in the x-versus-t plot.
Instantaneous velocity is defined as

$$v(t) = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}.$$

The **instantaneous speed** is the magnitude of the instantaneous velocity.

Acceleration

The rate of change of the instantaneous velocity with respect to time.

The **average acceleration** of an object is the ratio of the *change* in velocity to the time it takes for the change $\Delta t = t_f - t_i$,

$$a_{av} = \frac{\Delta v}{\Delta t}.$$

The **instantaneous acceleration** is the slope of the line tangent to the v-versus-t curve.

$$a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t}.$$

Motion with Constant Acceleration

The motion of a particle that has constant acceleration is common in nature. When air resistance is negligeble, the free fall of an object near Earth's surface has acceleration $g = 9.81 m/s^2$, which Galileo was the first to conclude.
We can use the "Big Five" under constant acceleration:

$$v = v_0 + at$$

$$\Delta x = v_0 t + \frac{1}{2} a t^2$$

$$v^2 - v_0^2 = 2a\Delta x$$

$$\Delta x = \frac{1}{2}(v_0 + v)\, t$$

$$\Delta x = vt - \frac{1}{2} a t^2$$