Kinematics in One Dimension

Displacement: $\Delta\vec{x} = \vec{x} - \vec{x}_0$

Average speed $= \dfrac{\text{total distance}}{\text{elapsed time}}$

Average velocity: $\vec{v}_{ave} = \dfrac{\Delta\vec{x}}{\Delta t} = \dfrac{\vec{x} - \vec{x}_0}{t - t_0}$

Instantaneous velocity: $\vec{v} = \lim\limits_{\Delta t \to 0} \dfrac{\Delta\vec{x}}{\Delta t}$

Average acceleration: $\vec{a}_{ave} = \dfrac{\Delta\vec{v}}{\Delta t} = \dfrac{\vec{v} - \vec{v}_0}{t - t_0}$

Instantaneous acceleration: $\vec{a} = \lim\limits_{\Delta t \to 0} \dfrac{\Delta\vec{v}}{\Delta t}$

⇒ An object speeds up if the velocity and acceleration point in the same direction; it slows down if the velocity and acceleration point in opposite directions

Equations of Constant Acceleration:

$$v = v_0 + at$$
$$x - x_0 = \frac{1}{2}(v_0 + v)t$$
$$x - x_0 = v_0 t + \frac{1}{2}at^2$$
$$v^2 = v_0^2 + 2a(x - x_0)$$

freefall: gravity is the only force acting on an object (no air resistance)

Equations of Freefall:

$$v = v_0 + at$$
$$y - y_0 = \frac{1}{2}(v_0 + v)t$$
$$y - y_0 = v_0 t + \frac{1}{2}at^2$$
$$v^2 = v_0^2 + 2a(y - y_0)$$

Notes for Freefall:

⇒ a = 9.8 m/s^2 downward or a = –9.8 m/s^2 if up is defined as +

⇒ v = 0 m/s at the highest point

⇒ freefall motion is symmetric