

Displacement, Speed, Velocity, and Acceleration

$$\Delta x = x_2 - x_1 \text{ (similarly for } \Delta y, \text{ etc.)}$$

$$\bar{v}_x = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1} \text{ (similarly for } \bar{v}_y, \text{ etc.)}$$

$$\bar{s} = \frac{\text{total distance}}{\Delta t}$$

$$s = \sqrt{v_x^2 + v_y^2}$$

$$v_x = \text{slope of } x \text{ vs } t \text{ plot}$$

$$\bar{a} = \frac{\Delta v}{\Delta t}$$

$$a = \text{slope of } v \text{ vs } t \text{ plot}$$

Gravity

$$g = +9.8 \text{ m/s}^2 = +32.2 \text{ ft/s}^2$$

Constant Acceleration

$$x_f = x_i + v_{ix}\Delta t + \frac{1}{2}a_x\Delta t^2$$

$$v_{fx} = v_{ix} + a_x\Delta t$$

$$v_{fx}^2 = v_{ix}^2 + 2a_x(x_f - x_i)$$

$$x_f = x_i + \frac{1}{2}(v_{ix} + v_{fx})\Delta t$$

Projectile Motion

(assumes + y is upwards)

$$a_x = 0$$

$$a_y = -g$$

$$\tan \mathbf{q}_0 = \frac{v_{0y}}{v_{0x}}$$

$$v_{0x} = |v_0| \cos \mathbf{q}_0$$

$$v_{0y} = |v_0| \sin \mathbf{q}_0$$

$$y = y_0 + (x - x_0) \left(\frac{v_{0y}}{v_{0x}} \right) - \frac{g(x - x_0)^2}{2v_{0x}^2}$$

or

$$y = y_0 + (x - x_0) \tan \mathbf{q}_0 - \frac{g(x - x_0)^2}{2(v_0 \cos \mathbf{q}_0)^2}$$

$$R = \frac{v_0^2}{g} \sin(2\mathbf{q}_0)$$

(destination and source at same height)

Vectors

$$\vec{A} = A_x \hat{x} + A_y \hat{y} + A_z \hat{z}$$

$$A = |\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$$

$$\mathbf{q} = \arctan \left(\frac{A_y}{A_x} \right)$$

$$A_x = A \cos \mathbf{q}$$

$$A_y = A \sin \mathbf{q}$$

Forces

Name an object or group of objects!!!

$$\Sigma F_x = ma_x, \quad \Sigma F_y = ma_y$$

$$W = mg \text{ (down)}$$

$$f_{s,\max} = \mathbf{m}_s N$$

$$f_k = \mathbf{m}_k N$$