Equations

Pythagorean Theorem and Trigonometry

$$r^2 = x^2 + y^2$$

$$\sin\theta = \frac{y}{r} \qquad \cos\theta = \frac{x}{r} \qquad \tan\theta = \frac{y}{x}$$

Quadratic Formula

$$\text{For: } Ax^2 + Bx + C = 0$$

$$x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

Vectors: for any vector $\mathbf{A}$

$$A_x = A\cos\theta \qquad A_y = A\sin\theta$$

$$\tan\theta = \frac{A_y}{A_x} \qquad A^2 = A_x^2 + A_y^2$$

Kinematics – Uniform Acceleration

$$\Delta x = v_{0x}t + \frac{1}{2}a_x t^2 \quad \Delta y = v_{0y}t + \frac{1}{2}a_y t^2$$

$$v_x = v_{0x} + a_x t \quad v_y = v_{0y} + a_y t$$

$$v_x^2 = v_{0x}^2 + 2a_x(\Delta x) \quad v_y^2 = v_{0y}^2 + 2a_y(\Delta y)$$

Newton's Laws

$$\sum \vec{F} = m\vec{a} \qquad \vec{F}_{12} = -\vec{F}_{21}$$

$$\sum F_x = ma_x \qquad \sum F_y = ma_y$$

Universal Gravitation

$$F = G\frac{m_1 m_2}{r^2}$$

Friction

$$f_s \le \mu_s N \qquad f_k = \mu_k N$$

Spring Force

$$F_s = -kx$$

Work and Energy

$$W = F\cos\theta\Delta x$$

$$KE = \tfrac{1}{2}mv^2 \quad PE_g = mgy \quad PE_s = \tfrac{1}{2}kx^2$$

$$E = PE + KE$$

$$W_{nc} = \Delta E$$

Power

$$\bar{P} = \frac{\Delta W}{\Delta t} = \frac{F\Delta x}{\Delta t} = F\bar{v}$$

Impulse and Momentum

$$\vec{I} \equiv \vec{F}\Delta t$$

$$\vec{p} = m\vec{v} \qquad \vec{F}\Delta t = \Delta\vec{p}$$

Conservation of Momentum

$$\sum \vec{p}_i = \sum \vec{p}_f$$

$$\sum p_{ix} = \sum p_{fx} \qquad \sum p_{iy} = \sum p_{fy}$$

Collisions

$$\sum \vec{p}_i = \sum \vec{p}_f$$

$$\underbrace{KE_i = KE_f}_{\text{elastic}} \qquad \underbrace{KE_i \neq KE_f}_{\text{inelastic}}$$

Constants

$$g = G\frac{M_E}{R_E^2} = 9.80\ \text{m/s}^2$$

$$G = 6.67 \times 10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2$$