

The Equations

1-D Kinematics → Conservation of Momentum

$$\bar{v} = \frac{x - x_0}{t}$$

$$a = \frac{v - v_0}{t}$$

$$\bar{v} = \frac{v_0 + v}{2}$$

$$\Sigma F = ma$$

$$G = mg$$

$$f = \mu_{s,k} N$$

$$F = k \frac{q_1 q_2}{r^2}$$

$$P = \frac{F}{A}$$

$$\Sigma E_0 = \Sigma E_1$$

$$K_0 + U_{S0} + U_{G0} = K_1 + U_{S1} + U_{G1}$$

$$W_{NC} = \Delta K + \Delta U$$

$$v = v_0 + at$$

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

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

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

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

$$\Delta x = v_{0x} t$$

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

$$a_R = \frac{v^2}{r}$$

$$ma_R = m \frac{v^2}{r}$$

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

$$F_s = -kx$$

$$P_{avg} = \frac{W}{\Delta t}$$

$$P_{avg} = F \bar{v} \cos \theta$$

$$\bar{\mathbf{p}} = m \bar{\mathbf{v}}$$

$$\Sigma \bar{\mathbf{F}} = \frac{\Delta \bar{\mathbf{p}}}{\Delta t}$$

$$\bar{\mathbf{F}} \Delta t = \Delta \bar{\mathbf{p}}$$

$$e = \frac{v'_B - v'_A}{v_A - v_B} = \sqrt{\frac{h'}{h}}$$

$$v_y = v_{0y} - gt$$

$$\Delta y = v_{0y} t - \frac{1}{2} gt^2$$

$$v_y^2 = v_{0y}^2 - 2g\Delta y$$

$$\Delta y = v_y t + \frac{1}{2} gt^2$$

$$y = \tan \theta x - \frac{g}{2v_0^2 \cos^2 \theta} x^2$$

$$f = \frac{1}{\tau}$$

$$v = \frac{2\pi r}{\tau}$$

$$v = 2\pi r f$$

$$K = \frac{1}{2} mv^2$$

$$U_G = mgh$$

$$U_S = \frac{1}{2} kx^2$$

$$m_A \bar{\mathbf{v}}_A + m_B \bar{\mathbf{v}}_B = m_A \bar{\mathbf{v}}'_A + m_B \bar{\mathbf{v}}'_B$$

$$\frac{1}{2} m_A v_A^2 + \frac{1}{2} m_B v_B^2 = \frac{1}{2} m_A v_A'^2 + \frac{1}{2} m_B v_B'^2$$

$$\bar{\mathbf{v}}'_A = \frac{m_A - m_B}{m_A + m_B} \bar{\mathbf{v}}_A + \frac{2m_B}{m_A + m_B} \bar{\mathbf{v}}_B$$

$$\bar{\mathbf{v}}'_B = \frac{2m_A}{m_A + m_B} \bar{\mathbf{v}}_A + \frac{m_B - m_A}{m_A + m_B} \bar{\mathbf{v}}_B$$

$$x_{CM} = \frac{m_A x_A + m_B x_B + \dots}{m_A + m_B + \dots}$$

The Constants

1-D Kinematics → Conservation of Momentum

$$g_{Earth's\ Surface} = 9.802 \text{ m/s}^2$$

$$m_{Earth} = 5.98 \times 10^{24} \text{ kg}$$

$$r_{Earth} = 6.38 \times 10^6 \text{ m}$$

$$d_{Earth-Moon} = 3.84 \times 10^8 \text{ m}$$

$$m_{Moon} = 7.35 \times 10^{22} \text{ kg}$$

$$r_{Moon} = 1.74 \times 10^6 \text{ m}$$

$$d_{Earth-Sun} = 1.496 \times 10^{11} \text{ m}$$

$$m_{Sun} = 1.99 \times 10^{30} \text{ kg}$$

$$r_{Sun} = 6.96 \times 10^8 \text{ m}$$

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

$$k = 8.988 \times 10^9 \frac{N \cdot m^2}{C^2}$$