

Equations and Constants

$$\left\{ \begin{array}{l} x = r \cos \theta \\ y = r \sin \theta \end{array} \right\}; \quad \left\{ \begin{array}{l} r = \sqrt{x^2 + y^2} \\ \theta = \tan^{-1} \left(\frac{y}{x} \right) \end{array} \right\};$$

$$\left\{ \begin{array}{l} v_x = v_{0x} + a_x t \\ \Delta x = \frac{1}{2}(v_{0x} + v_x)t \\ \Delta x = v_{0x}t + \frac{1}{2}a_x t^2 \\ v_x^2 = v_{0x}^2 + 2a_x \Delta x \end{array} \right\}; \quad \left\{ \begin{array}{l} v_y = v_{0y} + a_y t \\ \Delta y = \frac{1}{2}(v_{0y} + v_y)t \\ \Delta y = v_{0y}t + \frac{1}{2}a_y t^2 \\ v_y^2 = v_{0y}^2 + 2a_y \Delta y \end{array} \right\};$$

$$\left\{ \begin{array}{l} \Delta x = x_f - x_i \\ \text{speed}_{\text{ave}} = \frac{d}{\Delta t} \end{array} \right\}; \quad \left\{ \begin{array}{l} v_{\text{ave}} = \frac{\Delta x}{\Delta t} \\ a_{\text{ave}} = \frac{\Delta v}{\Delta t} \end{array} \right\}; \quad \left\{ \begin{array}{l} v = \lim_{\Delta t \rightarrow 0} \frac{\Delta x}{\Delta t} \\ a = \lim_{\Delta t \rightarrow 0} \frac{\Delta v}{\Delta t} \end{array} \right\};$$

$$\left\{ \begin{array}{l} a_c = \frac{v^2}{r} \\ T = \frac{2\pi r}{v} \end{array} \right\}; \quad x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A};$$

$$\left\{ \begin{array}{l} \sum \vec{F} = 0 \rightarrow \vec{a} = 0 \\ \sum \vec{F} = m\vec{a} \\ \vec{F}_{2\text{on}1} = -\vec{F}_{1\text{on}2} \end{array} \right\}; \quad \left\{ \begin{array}{l} \sum F_x = ma_x \\ \sum F_y = ma_y \end{array} \right\}; \quad \left\{ \begin{array}{l} 0 \leq f_s \leq \mu_s F_N \\ f_k = \mu_k F_N \\ F_g = mg \\ F_d = bv \end{array} \right\};$$

$$\left\{ \begin{array}{l} F_g = G \frac{Mm}{r^2} \\ G = 6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2 \\ g = 9.80 \text{ m/s}^2 \\ M_{\text{Earth}} = 5.98 \times 10^{24} \text{ kg} \\ R_{\text{Earth}} = 6.27 \times 10^6 \text{ m} \end{array} \right\};$$