# Formulas and Constants

---

$$g = 9.81\ \text{m/s}^2\ , \qquad G = 6.67 \cdot 10^{11}\ \text{Nm}^2/\text{kg}^2$$

$$R_{\text{Earth}} = 6.38 \cdot 10^6\ \text{m}\ , \qquad M_{\text{Earth}} = 5.98 \cdot 10^{24}\ \text{kg}$$

$$M_{\text{Sun}} = 1.99 \cdot 10^{30}\ \text{kg}\ , \qquad d_{\text{Earth-Sun}} = 1.5 \cdot 10^{11}\ \text{m}$$

---

$$\vec{A} + \vec{B} = \vec{C} \quad \Rightarrow \quad A_x + B_x = C_x\ , \qquad A_y + B_y = C_y$$

$$C_x = C\cos\theta\ , \qquad C_y = C\sin\theta\ , \qquad C = \sqrt{C_x^2 + C_y^2}\ , \qquad \theta = \arctan\left(\frac{C_y}{C_x}\right)$$

$$\Delta(\text{thing}) = \text{thing}_f - \text{thing}_i$$

$$\bar{v} = \frac{\Delta x}{\Delta t}\ , \qquad v = v_0 + at\ , \qquad \Delta x = v_0 t + \frac{1}{2}at^2\ , \qquad v^2 = v_0^2 + 2a\Delta x$$

$$\omega = \frac{\Delta\theta}{\Delta t}\ , \qquad \alpha = \frac{\Delta\omega}{\Delta t}$$

$$v_{banked\ curve} = \sqrt{gr\tan\theta}\ , \qquad v_{unbanked} = \sqrt{\mu_s gr}\ , \qquad v_{orbit} = \sqrt{\frac{GM_E}{r}}$$

$$\vec{F}_{net} = m\vec{a}\ , \qquad F_{grav} = \frac{Gm_1m_2}{r^2}\ , \qquad f_k = \mu_k F_N\ , \qquad f_s \le \mu_s F_N$$

$$\text{Weight} = mg\ , \qquad \vec{F}_{cent} = m\vec{a}_{cent}\ , \qquad a_{cent} = \frac{v^2}{r} = \omega^2 r\ , \qquad v = \frac{2\pi r}{T} = \omega r$$

$$W = F\Delta x\cos\theta\ , \qquad \text{KE} = \frac{1}{2}mv^2\ , \qquad \text{PE} = mgh\ , \qquad \text{E} = \text{KE} + \text{PE}$$

$$\text{KE}_i + \text{PE}_i = \text{KE}_f + \text{PE}_f\ , \qquad \Delta\text{KE} + \Delta\text{PE} = 0\ , \qquad \text{W} = \Delta\text{KE}$$

$$W_{non-cons.} = \Delta E = E_f - E_i\ , \qquad \text{Average Power} = \frac{\Delta E}{\Delta t}$$

$$\vec{p} = m\vec{v}\ , \qquad impulse = \vec{I} = \Delta\vec{p} = m\Delta\vec{v} = \vec{F}_{ext}\Delta t$$

$$\vec{p}_{1i} + \vec{p}_{2i} = \vec{p}_{1f} + \vec{p}_{2f}\ , \qquad \Delta\vec{p}_1 + \Delta\vec{p}_2 = 0$$