$$a_g = 10 m/s^2 \qquad g = 10\ N/kg \qquad G = 6.67\times10^{-11}\ Nm^2/kg^2$$

$$\sin\theta = OPP/HYP \qquad \cos\theta = ADJ/HYP \qquad \tan\theta = OPP/ADJ$$

$$a^2 + b^2 = c^2 \qquad ax^2 + bx + c = 0 \qquad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$Circumference\ of\ C = 2\pi r \qquad Area\ of\ C = \pi r^2$$

$$Area\ of\ Sph = 4\pi r^2 \qquad Volume\ of\ Sph = \frac{4}{3}\pi r^3$$

$$v_{x\,AVE} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} \qquad v_{x\,INST} = \lim_{\Delta t \Rightarrow 0} \frac{\Delta x}{\Delta t}$$

$$a_{x\,AVE} = \frac{\Delta v_x}{\Delta t} = \frac{v_{xf} - v_{xi}}{t_f - t_i} \qquad a_{x\,INST} = \lim_{\Delta t \Rightarrow 0} \frac{\Delta v_x}{\Delta t}$$

$$v_x = v_{xi} + at$$

$$v_{x\,AVE} = \frac{v_{xf} + v_{xi}}{2}$$

$$x = x_i + v_i\,t + \tfrac{1}{2}at^2$$

$$v_x^2 = v_{xi}^2 + 2a_x(x - x_i)$$

$$R = \frac{v_o^2\,\sin(2\theta_o)}{|a_g|}$$

$$A = A_x\,\boldsymbol{i} + A_y\,\boldsymbol{j} + A_z\,\boldsymbol{k}$$

$$\boldsymbol{A}\cdot\boldsymbol{B} = ABcos\theta_{A,B} = A_xB_x + A_yB_y + A_zB_z$$

$$|\boldsymbol{A}\times\boldsymbol{B}| = A\ B\ \sin\theta_{A,B} \quad (RHR)$$

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

$$A = \sqrt{A_x^2 + A_y^2} \qquad \theta_A = \arctan\left(\frac{A_y}{A_x}\right)^*$$

$$\Sigma_n F_n = m\boldsymbol{a} \qquad \boldsymbol{F}_{1,2} = -\boldsymbol{F}_{2,1}$$

$$F_{f\,s} \le \mu_s F_N \qquad F_{f\,k} = \mu_k F_N$$

$$a_c = \frac{v_t^2}{r} = \omega^2 r \qquad v_t = \omega r$$

$$W = \boldsymbol{F}\cdot\boldsymbol{\Delta x} = F\,\Delta x\,\cos\theta_{F,\Delta x} \qquad W_{var} \approx \Sigma_n F_n\,\Delta x_n\,\cos\theta_{F,\Delta s_n}$$

$$W_{net} = \Delta KE \qquad W_{NC} = \Delta KE + \Delta PE \qquad KE = \tfrac{1}{2}mv^2 \qquad P = \frac{\delta W}{\Delta t} = \boldsymbol{F}\cdot\boldsymbol{v} = Fv\cos\theta_{F,v}$$

$$PE_g = mgy \qquad PE_s = \tfrac{1}{2}kx^2 \qquad F_s = (-)kx$$

$$\boldsymbol{p} = m\boldsymbol{v} \qquad \boldsymbol{J} = \Delta\boldsymbol{p} = \boldsymbol{F}\,\Delta t \qquad \boldsymbol{J}_{var} = \Sigma_n F_n\,\Delta t_n$$

$$v_f = \frac{m_1}{m_1+m_2}\,v_i \qquad v_{1f} = \frac{m_1-m_2}{m_1+m_2}\,v_{1i} \qquad v_{2f} = \frac{2m_1}{m_1+m_2}\,v_{1i}$$

$$F_g = \frac{GM_1M_2}{r^2} \qquad \frac{R^3}{P^2} = C$$

$$s = \theta r \qquad v_t = \omega r \qquad a_t = \alpha r$$

$$\overline{\omega} = \frac{\Delta\theta}{\Delta t} = \frac{\theta_f - \theta_i}{t_f - t_i}$$

$$\boldsymbol{\omega} = \lim_{\Delta t \Rightarrow 0} \frac{\Delta\boldsymbol{\theta}}{\Delta t}$$

$$\overline{\alpha} = \frac{\Delta\omega}{\Delta t} = \frac{\omega_f - \omega_i}{t_f - t_i}$$

$$\boldsymbol{\alpha} = \lim_{\Delta t \Rightarrow 0} \frac{\Delta\boldsymbol{\omega}}{\Delta t}$$

$$\omega_{ave} = \frac{\omega_f + \omega_i}{2} \qquad \theta = \theta_i + \omega_i\, t + \frac{1}{2}\alpha t^2 \qquad \omega = \omega_i + \alpha t \qquad \omega^2 = \omega_i^2 + 2\alpha(\theta - \theta_i)$$

$$a_c = \frac{v^2}{r} = \omega^2 r \qquad \Sigma_n F_{Cn} = m\, a_c$$

$$\tau = F_\perp r = Fd = Fr\, \sin\theta_{r,F}\ (RHR)$$

$$x_{CM} = \frac{\Sigma\, m_n\, x_n}{\Sigma\, m_n}$$

$$I_{POINTMASS} = mr^2 \qquad I_{HOOP} = MR^2 \qquad I_{DISK} = ½MR^2 \qquad I_{SOLID\ SPHERE} = \frac{2}{5} MR^2$$

$$I = \Sigma_n\, m_n\, r_n^2$$

$$\Sigma\boldsymbol{\tau}_n = I\boldsymbol{\alpha} \qquad \boldsymbol{\tau} = \frac{\Delta \boldsymbol{L}}{\Delta t}$$

$$KE_{ROT} = ½I\omega^2 \qquad \boldsymbol{L} = I\boldsymbol{\omega}$$

$$P = F/A \qquad PV = nRT \qquad KE_{TRANS} = 3/2\ k_B T$$

$$Q = W + \Delta U \qquad Q = n\, C_P\, \Delta T \qquad Q = n\, C_V\, \Delta T \qquad C_P + R = C_P$$

$$v = \lambda f \qquad f = \frac{1}{P}$$

$$v_{String} = \sqrt{\frac{T}{\mu}} \qquad Z_{String} = \sqrt{T\mu} \qquad v_{Solid} = \sqrt{\frac{Y}{D}} \qquad Z_{Solid} = \sqrt{YD} \qquad v_{Fluid} = \sqrt{\frac{B}{D}}$$

$$y\,(x,\, t) = A\, \sin(\frac{2\pi}{\lambda} x \mp 2\pi f t + \varphi)$$

$$v(T) = (331 m/s)\sqrt{1 + \frac{T}{273}}$$

$$I = \frac{P}{A} = \frac{P}{4\pi r^2} \qquad dB = 10\, \log\frac{I}{I_0} \qquad I_0 = 10^{-12} W/m^2$$

$$f_n = \frac{nv}{2L}\ ;\ n = 1,\ 2,\ 3,... \qquad f_n = \frac{nv}{4L}\ ;\ n = 1,\ 3,\ 5,...$$

$$P = 2\pi\sqrt{\frac{M}{k}} \qquad P = 2\pi\sqrt{\frac{L}{g}}$$

$$\sin\theta \cong \theta_{radians}$$

$$f_{heard} = f_{emitted}\, \frac{v_{sound} \pm v_{observer}}{v_{sound} \mp v_{source}}$$

$$f_{heard} = \frac{f_1 + f_2}{2} \qquad f_{beat} = |\, f_1 - f_2\, |$$