Physics 120 Formula Sheet

$$\overline{v}_x = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} \qquad v_x = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt} \qquad \overline{a}_x = \frac{v_{xf} - v_{xi}}{t_f - t_i} = \frac{\Delta v_x}{\Delta t} \qquad a_x = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt}$$

$$v_{xf} = v_{xi} + a_x t \qquad x_f = x_i + \frac{1}{2}\left(v_{xi} + v_{xf}\right) t \qquad x_f = x_i + v_{xi} t + \frac{1}{2} a_x t^2 \qquad v_{xf}^2 = v_{xi}^2 + 2a_x\left(x_f - x_i\right)$$

$$\Sigma \overrightarrow{F} = m\overrightarrow{a} \qquad F_g = mg \qquad \overrightarrow{F}_{12} = -\overrightarrow{F}_{21} \qquad f_s \le \mu_s n \qquad f_k = \mu_k n \qquad \overrightarrow{A} = A_x \widehat{i} + A_y \widehat{j}$$

$$A = \sqrt{A_x^2 + A_y^2} \qquad \tan\theta = \frac{A_y}{A_x} \qquad a_c = \frac{v^2}{r} \qquad \overrightarrow{A} \bullet \overrightarrow{B} = AB\cos\theta = A_x B_x + A_y B_y + A_z B_z$$

$$W_{net} = \int_{r_1}^{r_2} \left(\Sigma \overrightarrow{F}\right) \bullet d\overrightarrow{r} \qquad F_s = -kx \qquad K = \frac{1}{2}mv^2 \qquad W_{net} = K_f - K_i = \Delta K \qquad g = 9.8\, m/s^2$$

$$\Delta E_{system} = \Sigma H \qquad \Delta K = -f_k \Delta x + \Sigma W_{other\, forces} \qquad \Delta E_{int} = f_k \Delta x \qquad P = \frac{dE}{dt} \qquad U_g \equiv mgy$$

$$K_i + U_i = K_f + U_f \qquad E_{mech} \equiv K + U \qquad U_s \equiv \frac{1}{2}kx^2 \qquad K + U + E_{int} = constant \qquad U_f = -\int_{x_i}^{x_f} F_x dx + U_i$$

$$F_x = -\frac{dU}{dx} \qquad \overrightarrow{p} = m\overrightarrow{v} \qquad \Sigma \overrightarrow{F} = \frac{d\overrightarrow{p}}{dt} \qquad \overrightarrow{I} \equiv \int_{t_i}^{t_f} \Sigma \overrightarrow{F} dt = \Delta \overrightarrow{p} \qquad \overrightarrow{r}_{cm} = \frac{\Sigma_i m_i \overrightarrow{r}_i}{M}$$

$$\Delta t = \frac{\Delta t_p}{\sqrt{1 - \frac{v^2}{c^2}}} = \gamma \Delta t_p \qquad L = \frac{L_p}{\gamma} = L_p \left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}} \qquad \overrightarrow{p} \equiv \frac{m\overrightarrow{u}}{\sqrt{1 - \frac{u^2}{c^2}}} \qquad E_R = mc^2 \qquad E = \frac{mc^2}{\sqrt{1 - \frac{u^2}{c^2}}}$$

$$K = \frac{mc^2}{\sqrt{1 - \frac{u^2}{c^2}}} - mc^2 = \gamma mc^2 - mc^2 = (\gamma - 1)mc^2 \qquad E^2 = p^2c^2 + (mc^2)^2 \qquad \theta = \frac{s}{r} \qquad \overline{\omega} = \frac{\theta_f - \theta_i}{t_f - t_i} = \frac{\Delta\theta}{\Delta t}$$

$$\omega = \lim_{\Delta t \to 0} \frac{\Delta\theta}{\Delta t} = \frac{d\theta}{dt} \qquad \overline{\alpha} = \frac{\omega_f - \omega_i}{t_f - t_i} = \frac{\Delta\omega}{\Delta t} \qquad \alpha = \lim_{\Delta t \to 0} \frac{\Delta\omega}{\Delta t} = \frac{d\omega}{dt} \qquad \omega_f = \omega_i + \alpha t \qquad v = r\omega \qquad a_t = r\alpha$$

$$\theta_f = \theta_i + \omega_i t + \frac{1}{2}\alpha t^2 \qquad \theta_f = \theta_i + \frac{1}{2}\left(\omega_i + \omega_f\right) t \qquad \omega_f^2 = \omega_i^2 + 2\alpha\left(\theta_f - \theta_i\right) \qquad a_c = \frac{v^2}{r} = r\omega^2$$

$$I = \Sigma_i m_i r_i^2 \qquad K_R = \frac{1}{2} I\omega^2 \qquad \overrightarrow{\tau} = \overrightarrow{r} \times \overrightarrow{F} \qquad \left|\overrightarrow{A} \times \overrightarrow{B}\right| = AB\sin\theta \qquad \Sigma\tau = I\alpha$$

$$\overrightarrow{L} = \overrightarrow{r} \times \overrightarrow{p} \qquad L = mvr\sin\phi \qquad \Sigma\overrightarrow{\tau}_{ext} = \frac{d\overrightarrow{L}}{dt} \qquad \overrightarrow{L}_{tot,i} = \overrightarrow{L}_{tot,f}$$

$$x = A\cos\left(\omega t + \phi\right) \qquad T = \frac{1}{f} = \frac{2\pi}{\omega} \qquad \omega = \sqrt{\frac{k}{m}} \qquad E = \frac{1}{2}kA^2 \qquad T = 2\pi\sqrt{\frac{L}{g}}$$

$$y = A\sin\left[\frac{2\pi}{\lambda}\left(x - vt\right)\right] = A\sin\left(kx - \omega t\right) \qquad v = \frac{\lambda}{T} = \lambda f \qquad k \equiv \frac{2\pi}{\lambda} \qquad \omega \equiv \frac{2\pi}{T} = 2\pi f$$

$$v = \sqrt{\frac{T}{\mu}} \qquad y = \left(2Asinkx\right) cos\omega t \qquad f_n = \frac{n}{2L}\sqrt{\frac{T}{\mu}} \quad \left(n = 1, 2, 3, ...\right)$$