PHY 2048 Formulas

Dot and Cross Product

$\vec{A} \cdot \vec{B} = AB\cos(\varphi)$

$\vec{A} \times \vec{B} = AB\sin(\varphi)$

Translational Kinematics

$x = x_0 + vt$

$v = v_0 + at$

$x = x_0 + v_0 t + \frac{1}{2}at^2$

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

Rotational Kinematics

$\theta_f = \theta_0 + \omega t$

$\omega_f = \omega_0 + \alpha t$

$\theta_f = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$

$\omega_f^2 = \omega_0^2 + 2\alpha(\Delta\theta)$

Projectile Motion

Time of flight: $T = \frac{2v_0\sin(\theta_0)}{g}$

Trajectory:

$y = x\tan(\theta) - \left[\frac{g}{2(v_0\cos(\theta))^2}\right]x^2$

Range: $\frac{v_0^2\sin(2\theta_0)}{g}$

Uniform Circular Motion

$a_c = \frac{v_T^2}{r}$

$\omega = \frac{2\pi}{T}$

$T = \frac{2\pi}{V}$

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

Orbital Motion

$F_c = F_g$

$v = \sqrt{\frac{GM}{r}}$

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

Newton's Laws

1. v = constant when $F_{net} = 0$
2. $F_{net} = ma = \frac{dp}{dt} = \frac{d}{dt}(mv)$
3. $\vec{F}_{AB} = -\vec{F}_{BA}$

Common Forces

$N = mg\cos(\theta)$

$F_{sp} = -k\Delta x$

$f_s \leq \mu_s N$

$f_k = \mu_k N$

$F_c = ma_c = m\frac{v^2}{r} = mr\omega^2$

Terminal Velocity

$v_T = \sqrt{\frac{2mg}{\rho C A}}$

Work

$W_{AB} = \int_A^B \vec{F} \cdot d\vec{r}$

$W = \vec{F} \cdot \vec{d} = Fd\cos(\theta)$

$W_g = -mg\Delta y$

$W_{sp} = \frac{1}{2}k(x_f^2 - x_0^2)$

$W_f = \mu_k N d = \mu_k mgd$

Work-Energy Theorem

$W_{net} = \Delta K = K_f - K_0$

Energy

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

$U_g = mgh$

$U_{sp} = \frac{1}{2}k(x_f^2 - x_0^2)$