Useful equations for Physics 152

Translation	Rotation
m	$I = \sum m_i r_i^2$
x	θ
$v = \frac{dx}{dt}$	$\omega = \frac{d\theta}{dt}$
$a = \frac{dv}{dt}$	$\alpha = \frac{d\omega}{dt}$
$v = v_0 + at$ $x - x_0 = \frac{1}{2}(v + v_0)t$ $x - x_0 = v_0 t + \frac{1}{2}at^2$ $v^2 = v_0^2 + 2a(x - x_0)$	$\omega = \omega_0 + \alpha t$ $\theta - \theta_0 = \frac{1}{2}(\omega + \omega_0)t$ $\theta - \theta_0 = \omega_0 t + \frac{1}{2}\alpha t^2$ $\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$
$\sum \vec{F} = m\vec{a}$	$\sum \vec{\tau} = I\vec{\alpha}$
$\vec{p} = m\vec{v}$	$\vec{L} = I\vec{\omega}$
$\sum \vec{F}_{\text{ext}} = \frac{d\vec{p}}{dt}$	$\sum \vec{\tau}_{\text{ext}} = \frac{d\vec{L}}{dt}$
$W = \int \vec{F} \cdot d\vec{s}$	$W = \int \tau d\theta$
$K = \frac{1}{2}mv^2$	$K = \frac{1}{2}I\omega^2$
$U = \frac{1}{2}kx^2$	
$P = \vec{F} \cdot \vec{v}$	$P = \tau\omega$ $I_{\parallel} = I_{cm} + Mh^2$
$F = -kx$	

Translation ↔ Rotation Conversion

$v = r\omega$	$\vec{\ell} = \vec{r} \times \vec{p}$
$a_t = r\alpha$	$a_r = \frac{v^2}{r} = \omega^2 r$
$\vec{\tau} = \vec{r} \times \vec{F}$	$\tau = r_\perp F = rF_\perp = rF\sin\theta$

Simple Harmonic Motion

$x = A\cos(\omega t + \delta)$

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

$\omega = \sqrt{\frac{k}{m}}$

$\omega = \sqrt{\frac{g}{L}}$

$\omega = \sqrt{\frac{\kappa}{I}}$

Gravitational Force

$F = \frac{Gm_1m_2}{r^2}$

Fluids

$\rho = \frac{m}{V}$

$P = \frac{F}{A}$

$P = P_0 + \rho g h$

$Av = \text{constant}$

$P + \frac{1}{2}\rho v^2 + \rho g y = \text{constant}$

Traveling Wave

$v = \sqrt{\frac{\tau}{\mu}}$

$T = \frac{1}{f}$

$v = \lambda f$

$k = \frac{2\pi}{\lambda}$

$y = A\sin(kx - \omega t)$

Standing Wave

$\omega = 2\pi f$

$y = 2A_0 \sin kx \cos\omega t$

$f_n = \frac{n}{2L}\sqrt{\frac{\tau}{\mu}}$

Constants

$g = 9.8\ \text{m/s}^2$

$G = 6.67 \times 10^{-11}\ \text{N-m}^2/\text{kg}^2$

$M_E = 5.98 \times 10^{24}\ \text{kg}$

$R_E = 6.37 \times 10^6\ \text{m}$

$\rho_{\text{water}} = 1000\ \text{kg}/m^3$

$P_0 = 1.01 \times 10^5\ \text{Pa}$