8.012 Physics I: Classical Mechanics
Fall 2008

USEFUL EQUATIONS

Velocity in polar coordinates	$\frac{d\vec{r}}{dt} = \dot{\vec{r}} = \dot{r}\hat{r} + r\dot{\theta}\hat{\theta}$
Acceleration in polar coordinates	$\frac{d^2\vec{r}}{dt^2} = \ddot{\vec{r}} = (\ddot{r} - r\dot{\theta}^2)\hat{r} + (r\ddot{\theta} + 2\dot{r}\dot{\theta})\hat{\theta}$
Universal Law of Gravitational	$\vec{F}_{12} = -G\frac{m_1 m_2}{r_{12}^2}\hat{r}_{12}$
Center of mass of a rigid body	$\vec{R} = \frac{\sum m_i \vec{r}_i}{\sum m_i} = \frac{1}{M}\int \rho\vec{r}dV$
Volume element in rectangular coordinates	$dV = dxdydz$
Volume element in cylindrical coordinates	$dV = rdrd\theta dz$
Kinetic energy	$K = \frac{1}{2}M(\vec{v}\cdot\vec{v})$
Work-Energy Theorem	$W = \Delta E = \Delta(K+U) = \int \vec{F}\cdot d\vec{r}$
Potential Energy (conservative forces)	$U = -\int \vec{F}_c \cdot d\vec{r}$ $\vec{F}_c = -\vec{\nabla}U$
Taylor Expansion of f(x)	$f(x) = f(a) + \frac{1}{1!}\frac{df}{dx}\|_a(x-a) + \frac{1}{2!}\frac{d^2f}{dx^2}\|_a(x-a)^2 + ...$