

Formulae for Final Exam (use also sheets for exams 1 & 2)

Phys 171
AQ 2008

Conservation of momentum: $\sum_{i=1}^N \vec{p}_{\text{initial},i} = \sum_{i=1}^N \vec{p}_{\text{final},i}$; N bodies (if net ext. force zero)

of kinetic energy: $\sum_{i=1}^N K_{\text{initial},i} = \sum_{i=1}^N K_{\text{final},i}$ (if collision elastic)

of mechanical energy: $\sum_{i=1}^N (K+U)_{\text{initial},i} = \sum_{i=1}^N (K+U)_{\text{final},i}$ (if non-conservative forces don't do work)

Momentum $\vec{p} = m\vec{v}$; Kinetic energy: $K = \frac{1}{2}mv^2$; Rotational K: $K_{\text{rot}} = \frac{1}{2}I\omega^2$

Rotation: $2\pi \text{ rad} = 360^\circ$

$\omega = \frac{d\theta}{dt}$; θ measured in radians

$\alpha = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$

$v = R\omega$; $a_{\text{tangential}} = R\alpha$; $a_{\text{radial}} = \omega^2 R$

$f = \frac{1}{T} = \frac{\omega}{2\pi}$

linear		rotational
l	\leftrightarrow	θ
\vec{v}	\leftrightarrow	$\vec{\omega}$
\vec{a}_t	\leftrightarrow	$\vec{\alpha}$
\vec{F}	\leftrightarrow	$\vec{\tau}$
m	\leftrightarrow	I
\vec{p}	\leftrightarrow	\vec{L}

Torque: $\vec{\tau} = \vec{r} \times \vec{F}$; angular momentum: $\vec{L} = \vec{r} \times \vec{p} = I\vec{\omega}$

Moment of inertia: $I = \sum_{i=1}^N m_i R_i^2$; N bodies ; R_i distance to axis

Cross-product: $\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix} \equiv \vec{D}$; $|\vec{D}| = |\vec{A}||\vec{B}|\sin\theta_{\vec{A},\vec{B}}$
 $\vec{D} \perp \vec{A}$, $\vec{D} \perp \vec{B}$, use RHR

$= \begin{pmatrix} A_y B_z - A_z B_y \\ A_z B_x - A_x B_z \\ A_x B_y - A_y B_x \end{pmatrix}$