

Physics 101 Formula Sheet (for Midterm #2)

Constant acceleration (2-11): $x = x_0 + v_0 t + \frac{1}{2} a t^2$, $v = v_0 + a t$, $v^2 = v_0^2 + 2a(x - x_0)$

Vector components (3-3, 3-4): $V_x = V \cos \theta$; $V_y = V \sin \theta$

$$V = \sqrt{V_x^2 + V_y^2}; \quad \tan \theta = \frac{V_y}{V_x}$$

Relative velocity (3-6): $\vec{v}_{BS} = \vec{v}_{BW} + \vec{v}_{WS}$

Circular motion (5-1): $a_R = \frac{v^2}{r}$, $v = \frac{2\pi r}{T}$, $T = \frac{1}{f}$

Newton's law of gravitation (5-4): $F = G \frac{m_1 m_2}{r^2}$; where $G = 6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2 / \text{kg}^2$

Work (6-1): $W = \vec{F} \cdot \vec{d} = Fd \cos(\theta)$

Work energy principle (6-2, 6-4): $W_{net} = \Delta K = \frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2$

Potential Energy of a spring (6-9): $U = \frac{1}{2} k x^2$

Power (6-17): $P = \frac{W}{\Delta t} = \vec{F} \cdot \vec{v}$

Momentum (7-1): $\vec{p} = m\vec{v}$

Centre of mass (7-9): $\vec{r}_{CM} = \frac{\sum m_i \vec{r}_i}{M}$

Sine and Cosine Laws: $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$
 $c^2 = a^2 + b^2 - 2ab \cos C$

$$v = R\omega$$

Linear and angular quantities for rotation (8-4,5,6): $a_{\tan} = R\alpha$

$$a_R = \omega^2 R$$

Torque due to a force (8-10): $\tau = R_{\perp} F = R F_{\perp} = R F \sin \theta$

Moments of inertia (8-13): $I = \sum m_i R_i^2$

Newton's 2nd law for rotation (8-14): $\Sigma \tau = I\alpha$

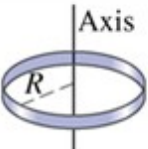
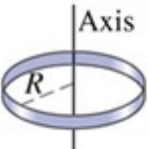
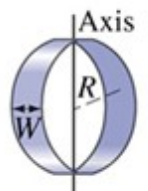
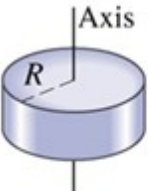
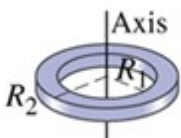
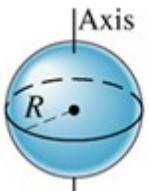
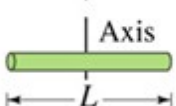
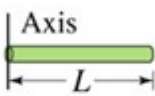
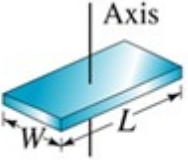
Total kinetics energy (8-16): $KE = \frac{1}{2} M v_{MC}^2 + \frac{1}{2} I_{CM} \omega^2$

Angular momentum of a rigid body (8-18): $L = I\omega$

Angular momentum of a moving particle: $L = r_{\perp} p = r p_{\perp} = r p \sin \theta$, where $p = mv$.

Static equilibrium (9-1,2): $\Sigma \vec{F} = 0$, $\Sigma \tau = 0$.

Young's Modulus (9-4): $\Delta L = \frac{1}{E} \frac{F}{A} L_0$.

	Object	Location of axis		Moment of inertia
(a)	Thin hoop, radius R	Through center		MR^2
(b)	Thin hoop, radius R width W	Through central diameter		$\frac{1}{2}MR^2 + \frac{1}{12}MW^2$
(c)	Solid cylinder, radius R	Through center		$\frac{1}{2}MR^2$
(d)	Hollow cylinder, inner radius R_1 outer radius R_2	Through center		$\frac{1}{2}M(R_1^2 + R_2^2)$
(e)	Uniform sphere, radius R	Through center		$\frac{2}{5}MR^2$
(f)	Long uniform rod, length L	Through center		$\frac{1}{12}ML^2$
(g)	Long uniform rod, length L	Through end		$\frac{1}{3}ML^2$
(h)	Rectangular thin plate, length L , width W	Through center		$\frac{1}{12}M(L^2 + W^2)$