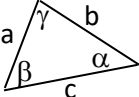


Math Stuff		Constants	
Scalar Product	$\vec{A} \cdot \vec{B} = \vec{A} \vec{B} \cos \theta$	Acceleration of gravity	$g = 9.80 \text{ m/s}^2$
Vector Product	$\vec{A} \times \vec{B} = \vec{A} \vec{B} \sin \theta$	Universal gravitation	$G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$
Quadratic formula ($ax^2+bx+c=0$)	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	Mass of Earth	$M_E = 5.97 \times 10^{24} \text{ kg}$
		Radius of Earth	$R_E = 6.38 \times 10^6 \text{ m}$

Kinematics	Trig Identities	Newton's Laws / Friction / Circular motion	
$v_x = v_{ox} + a_x t$	Law of cosines:	2 nd Law	$\sum \vec{F} = m\vec{a} = \frac{\Delta \vec{p}}{\Delta t}$
$x = x_o + v_{ox}t + \frac{1}{2}a_x t^2$	$a^2 = b^2 + c^2 - 2bc \cos \alpha$	Gravitation	$F = \frac{Gm_1 m_2}{r^2}$
$v_x^2 = v_{ox}^2 + 2a_x(x - x_o)$	Law of sines:	Static friction	$f_s \leq \mu_s N$
$x - x_o = \left(\frac{v_{ox} + v_x}{2}\right)t$	$\frac{a}{\sin \alpha} = \frac{b}{\sin \beta} = \frac{c}{\sin \gamma}$	Kinetic friction	$f_k = \mu_k N$
Velocity Addition		Centripetal acceleration	$a_{cp} = \frac{v^2}{r}$
$\vec{v}_{AB} = \vec{v}_{AC} + \vec{v}_{CB}$			

Work & Power		Energy	
Work by constant force	$W = Fd \cos \theta$	Kinetic energy	$K = \frac{1}{2}mv^2$
Work done by a spring	$W_{sp} = \frac{1}{2}kx^2$	Gravitational potential energy	$U_g = mgy = -\frac{GmM_E}{r}$
Conservative forces	$W_c = -\Delta U$	Spring potential energy	$U_{sp} = \frac{1}{2}kx^2$
Non-conservative forces	$W_{nc} = \Delta E$	Hooke's Law (spring force)	$F = kx$
Power	$P = \frac{\text{Work}}{\text{time}}$	Work-Energy Theorem	$W_{total} = \Delta K$

Impulse and Momentum		Center of Mass	
Linear momentum	$\vec{p} = m\vec{v}$	Center of mass (point objects)	$x_{CM} = \frac{\sum m_n x_n}{\sum m_n}$
Impulse	$\vec{I} = \vec{F}_{ave} \Delta t$		
Impulse - momentum	$\vec{I} = \Delta \vec{p}$	Total momentum	$\vec{p}_{total} = M_{total} \vec{v}_{CM}$
			$\sum \vec{F}_{ext} = M_{total} \vec{a}_{CM}$

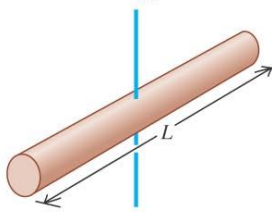
Rotational Kinematics	Linear / Angular	Rotational Inertia and Energy	
$\omega = \omega_o + \alpha t$	$s = r\theta$ (θ in radians)	Rotational inertia (point objects)	$I = \sum_i m_i r_i^2$
$\theta = \theta_o + \omega_o t + \frac{1}{2}\alpha t^2$	$v_t = r\omega$		
$\omega^2 = \omega_o^2 + 2\alpha(\theta - \theta_o)$	$a_t = r\alpha$	Parallel axis theorem	$I_P = I_{CM} + Md^2$
$\theta - \theta_o = \left(\frac{\omega_o + \omega}{2}\right)t$	$a_{cp} = \frac{v^2}{r} = r\omega^2$	Rotational kinetic energy	$K = \frac{1}{2}I\omega^2$

Torque and Angular Momentum		Rotational Motion	
Torque	$\vec{\tau} = \vec{r} \times \vec{F} = rF \sin \phi = r_{\perp} F$	Newton's 2 nd law	$\sum \vec{\tau} = I\vec{\alpha} = \frac{d\vec{L}}{dt}$
Angular momentum	$\vec{L} = \vec{r} \times \vec{p} = mvr_{\perp} = I\vec{\omega}$	Work	$W = \tau \Delta \theta = \Delta K_{rot}$
		Power	$P = \tau \omega$

Simple Harmonic Motion		Angular Frequency	
Displacement	$x(t) = A\cos(\omega t + \phi)$	Mass on a spring	$\omega = \sqrt{\frac{k}{m}}$
Velocity	$v(t) = -\omega A\sin(\omega t + \phi)$	Simple pendulum	$\omega = \sqrt{\frac{g}{l}}$
Period	$T = \frac{2\pi}{\omega}$	Frequency	$f = \frac{1}{T} = \frac{\omega}{2\pi}$

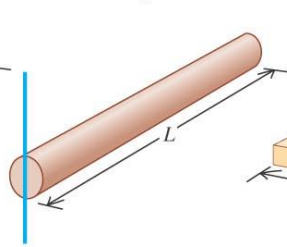
(a) Slender rod, axis through center

$$I = \frac{1}{12}ML^2$$



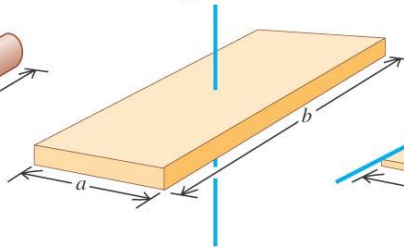
(b) Slender rod, axis through one end

$$I = \frac{1}{3}ML^2$$



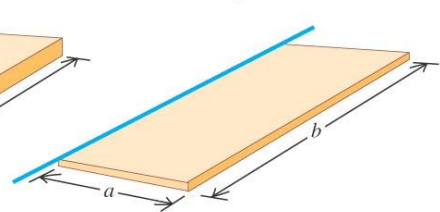
(c) Rectangular plate, axis through center

$$I = \frac{1}{12}M(a^2 + b^2)$$



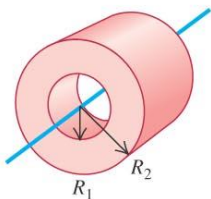
(d) Thin rectangular plate, axis along edge

$$I = \frac{1}{3}Ma^2$$



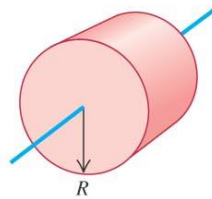
(e) Hollow cylinder

$$I = \frac{1}{2}M(R_1^2 + R_2^2)$$



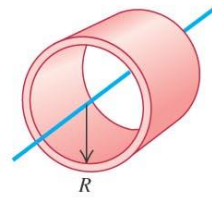
(f) Solid cylinder

$$I = \frac{1}{2}MR^2$$



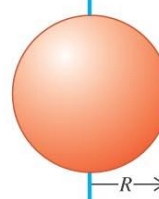
(g) Thin-walled hollow cylinder

$$I = MR^2$$



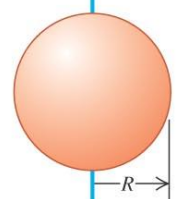
(h) Solid sphere

$$I = \frac{2}{5}MR^2$$



(i) Thin-walled hollow sphere

$$I = \frac{2}{3}MR^2$$



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(j) Thin hoop rotating on axis through any diameter of the hoop:

$$I = \frac{1}{2}MR^2$$

