Equations:

$v = \frac{dx}{dt}$ $\omega = \frac{d\theta}{dt}$ $s = r\Delta\theta$

$\bar{v} = \frac{\Delta x}{\Delta t}$ $\bar{\omega} = \frac{\Delta\theta}{\Delta t}$ $v = r\omega$

$a_t = \frac{dv}{dt}$ $\alpha = \frac{d\omega}{dt}$ $a_t = r\alpha$

$\bar{a_t} = \frac{\Delta v}{\Delta t}$ $\bar{\alpha} = \frac{\Delta\omega}{\Delta t}$ $a_c = \frac{v^2}{r} = r\omega^2$

$\tau = \vec{r} \times \vec{F}$

$\tau = rF_\perp = \pm rF \sin\theta$

$\sum \tau = I\alpha$

Point particle: $I = mr^2$

Parallel axis thm: $I = I_{cm} + MD^2$

$K_T = \frac{1}{2} mv^2$ $K_R = \frac{1}{2} I \omega^2$ $U_g = mgy$ $U_s = \frac{1}{2} kx^2$

$\vec{L} = \vec{r} \times \vec{p}$ $L = I\omega$

$E_{mech} = K_T + K_R + U$

$F_s = -kx$

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

$\omega_p = \sqrt{\frac{g}{l}}$

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

$v(t) = -A\omega \sin(\omega t + \phi)$

$a(t) = -A\omega^2 \cos(\omega t + \phi)$

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

$y(x,t) = A\sin(kx - \omega t + \phi)$

$k = \frac{2\pi}{\lambda}, \quad v = f\lambda$

$v = \sqrt{\frac{F_T}{\mu}}$ where μ is m/L

$v = \sqrt{\frac{B}{\rho}}$ sound in air: $v = 331\sqrt{1 + \frac{T_c}{273}}$ or v = 343 m/s at room temperature

$I = \frac{P}{A} \quad P = \frac{E}{t} \quad I = \frac{P_{source}}{4\pi r^2}$

$\beta = 10\log\left(\frac{I}{I_0}\right)$ Doppler effect: $f_o = f_s\left(\frac{v + v_o}{v - v_s}\right)$

$I_0 = 10^{-12}$ W/m^2

standing wave:

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

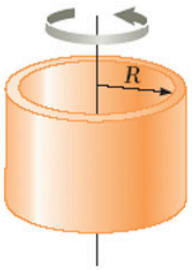
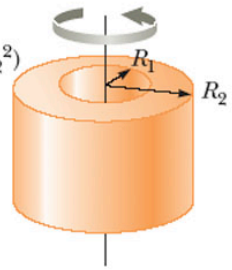
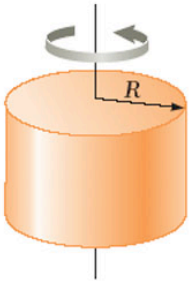
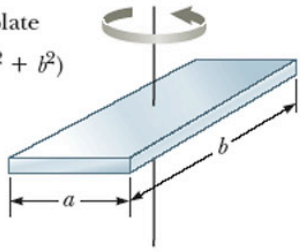
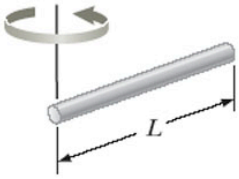
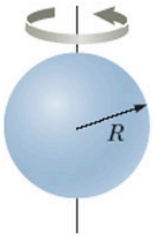
$f_m = \frac{mv}{2L}$, m = 1, 2, 3, … (for strings, rods, and open tubes)

$f_m = \frac{mv}{4L}$, m = 1, 3, 5,… (for closed tubes)

Constructive interference: $|r_1 - r_2| = m\lambda$, m = 0, 1, 2, 3, …

Destructive interference: $|r_1 - r_2| = (m + \frac{1}{2})\lambda$, m = 0, 1, 2, 3, …

TABLE 10.2 *Moments of Inertia of Homogeneous Rigid Objects with Different Geometries*

Hoop or thin cylindrical shell $I_{CM} = MR^2$		Hollow cylinder $I_{CM} = \frac{1}{2}M(R_1^2 + R_2^2)$	
Solid cylinder or disk $I_{CM} = \frac{1}{2}MR^2$		Rectangular plate $I_{CM} = \frac{1}{12}M(a^2 + b^2)$	
Long, thin rod with rotation axis through center $I_{CM} = \frac{1}{12}ML^2$		Long, thin rod with rotation axis through end $I = \frac{1}{3}ML^2$	
Solid sphere $I_{CM} = \frac{2}{5}MR^2$		Thin spherical shell $I_{CM} = \frac{2}{3}MR^2$