1. Linear Motion; Constant Acceleration:

$v = v_0 + at$
$x = x_0 + v_0 t + {}^1/_2\, at^2$
$x = {}^1/_2\, (v_0 + v)t$
$v^2 = v_0^2 + 2a(x - x_0)$

2. Forces:

$\Sigma\mathbf{F} = m\mathbf{a}$
$f_s^{MAX} = \mu_s n$
$f_k = \mu_k n$

3. Work; Energy; Power:

$W = F_{\|} s = (F\cos\theta)s$
$K_{trans} = {}^1/_2\, mv^2$
$U_{grav} = mgy$
Linear ($F = -kx$) spring:
$U_{spring} = {}^1/_2\, kx^2$
$\bar{P} = W/\Delta t = F\bar{v}$

4. Linear Momentum:

$\mathbf{p} = m\mathbf{v}$
$\sum\mathbf{F} = \Delta\mathbf{p}/\Delta t$

5. Gravitation

$F_G = Gm_1m_2/R^2$
$U_G = -Gm_1m_2/R$
where $G = 6.672 \times 10^{-11}\ N \cdot m^2/kg^2$
At earth's surface:
$F_G = mg$ where $g = 9.8\ m/s^2$.
Satellite Motion: $T^2 = (4\pi^2/MG)R^3$
Sun: $M_S = 2 \times 10^{30}\ kg$
Earth: $M_E = 6 \times 10^{24}\ kg$
$R_E = 6.37 \times 10^6\ m$
from sun $= 1.5 \times 10^{11}\ m$
Moon: $M_M = 7.4 \times 10^{22}\ kg$
$R_M = 1.74 \times 10^6\ m$
from earth $= 3.8 \times 10^8\ m$

6. Rotational Motion:

$\omega = \omega_0 + \alpha t$
$\theta = \omega_0 t + {}^1/_2\, \alpha t^2$
$\theta = {}^1/_2\, (\omega_0 + \omega)t$
$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$
$s = r\theta$
$v_t = r\omega$
$a_T = r\alpha$
$a_C = v_t^2/r = r\omega^2$
$L = I\omega$
$K_{rot} = {}^1/_2\, I\omega^2$
$\tau = R_\perp F = RF_\perp = RF\sin\theta$
$\sum\tau = I\alpha = \Delta L/\Delta t$

7. Rotational Inertia:

$I = \sum_i m_i R_i^2$

solid cylinder:	$I_{CM} = \frac{1}{2}MR^2$
hoop:	$I_{CM} = MR^2$
sphere:	$I_{CM} = \frac{2}{5}MR^2$
rod ($\perp$ to length):	$I_{CM} = \frac{1}{12}ML^2$
rod (through end):	$I_{END} = \frac{1}{3}ML^2$

8. Vibrations:

For Simple Harmonic Motion:
$x = A\cos\omega t$
$v = -\omega A\sin\omega t$
$a = -\omega^2 A\cos\omega t = -\omega^2 x$
where $\omega = 2\pi f$
and $f = 1/T$
$E = {}^1/_2\, kA^2$
For a mass/spring
$\omega = \sqrt{k/m}$
For a Simple Pendulum
$\omega = \sqrt{g/L}$

9. Waves & Sound

Wave velocity:
$v = \lambda f$
Intensity:
$I = P/A$
$I = P/4\pi r^2$
v_{air}= 343 m/s (at 20°C)
$v_{string} = \sqrt{F/\mu}$
$\mu = m/L$
$\beta(dB) = 10\log(I/I_0)$
where $I_0 = 10^{-12}\ W/m^2$
Doppler:

$$f' = (\frac{v \pm u_o}{v \mp u_s})f$$

Organ Pipes:
$f_n = n(v/2L), \quad \lambda_n = 2L/n$
where $n = 1, 2, 3, \ldots$(ends open)

$f_n = n(v/4L), \quad \lambda_n = 4L/n$
where $n = 1, 3, 5, \ldots$(one end closed)

Vibrating strings have a mode structure like open pipes.

Beats: $f_{beat} = |f_1 - f_2|$