Trigonometry (*For right triangle with sides Adjacent, Opposite, and Hypoteneuse*):

Sin(θ) = O/H *Cos(θ) = A/H* *Tan(θ) = O/A* $H^2 = O^2 + A^2$ $A_{circle} = \pi r^2$

Sin(30°) = Cos(60°) = ½ *Sin(60°) = Cos(30°) =* $\sqrt{3}/2$ *~=0.866* *Sin(45°) = Cos(45°) =* $\sqrt{2}/2$ *~0.707*

Sin(0°) = Cos(90°) = 0 *Sin(90°) = Cos(0°) = 1*

Moment of Inertia

Point mass or thin-walled wheel: $I = mr^2$ *Solid cylinder:* $I = \frac{1}{2} mr^2$

Thin rod pivoting around end: $I = 1/3\ mr^2$ *Solid sphere:* $I = 2/5\ mr^2$

Kinematics:

$\langle \vec{v} \rangle = \frac{\Delta \vec{r}}{\Delta t}$ $\langle \vec{a} \rangle = \frac{\Delta \vec{v}}{\Delta t}$ $\vec{r}(t) = \vec{r_0} + \vec{v_o}t + \frac{1}{2}\vec{a}t^2$ $v(t)^2 = {v_o}^2 + 2\vec{a} \cdot \Delta\vec{r}(t)$

Newton's Laws:

$\sum \vec{F} = m\vec{a}$ $\overrightarrow{F_{AB}} = -\overrightarrow{F_{BA}}$

Forces:

$F_G = mg$ (@ surface) ${f_s}^{MAX} = \mu_s F_N$ $f_k = \mu_k F_N$

$F_C = ma_c = \frac{mv^2}{r}$ $F_{spring} = -kx$ $F_{Buoyant} = m_{fluid\_displaced}\ g$

Work & Energy:

$KE_{trans} = \frac{1}{2}mv^2$ $\Delta KE = W_{net}$ $PE_G = mgh$ $PE_{spring} = \frac{1}{2}kx^2$

$E = KE + PE$ $\Delta E = W_{nc}$ $W = \vec{F} \cdot \Delta\vec{r} = |\vec{F}||\Delta \vec{r}| \cos\theta_{Fdr}$

Impulse & Momentum:

$\vec{J} = \vec{F}\Delta t$ $\vec{p} = m\vec{v}$ $\sum \vec{J} = \Delta \vec{p}$ $\sum \overrightarrow{p_f} = \sum \overrightarrow{p_i}$ *(if F_{ext}=0)*

$\overrightarrow{v_{cm}} = \frac{\sum m_i \vec{v_i}}{\sum m_i} = \sum \vec{p}/M$

Rotational Motion:

$\theta = s/r$ $\langle \omega \rangle = \frac{\langle v_t \rangle}{r} = \frac{\Delta\theta}{\Delta t}$ $\langle \alpha \rangle = \frac{\langle a_t \rangle}{r} = \frac{\Delta\omega}{\Delta t}$

$\theta(t) = \theta_o + \omega_o t + \frac{1}{2}\alpha t^2$ $\omega(t)^2 = {\omega_o}^2 + 2\alpha\Delta\theta(t)$

$\tau = rF\sin\theta_{rF} = F * lever\ arm$ $\sum \tau = I\alpha$ $L = mvr = I\omega$

$W_{rot} = \tau\Delta\theta$ $KE_{rot} = \frac{1}{2}I\omega^2$ $r_{CM} = \frac{\sum m_i r_i}{\sum m_i}$

Harmonic Motion:

$\omega_h = 2\pi f_h = \frac{2\pi}{T} = \sqrt{\frac{k}{m}}$ $x_{max} = A$ $v_{max} = A\omega_h$ $a_{max} = A{\omega_h}^2$

$\omega_{h\_pendulum} = \sqrt{\frac{mgr_{CM}}{I}} = \sqrt{\frac{g}{L}}$ *for simple pendulum of length L*

Fluids:

$\rho = mass/Volume$ $P = F/A$ $P_2 = P_1 + \rho g d$ $F_B = W_{fluid\_displaced}$

$\rho_1 A_1 v_1 = \rho_2 A_2 v_2$ $A_1 v_1 = A_2 v_2\ (if\ \rho_1 = \rho_2)$ $P_1 + \frac{1}{2}\rho {v_1}^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho {v_2}^2 + \rho g y_2$