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

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

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 or hoop: $I = mr^2$ *Solid cylinder or disk:* $I = \frac{1}{2} mr^2$

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

Kinematics:

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

Newton's Laws:

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

Forces:

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

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

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:

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

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

Rotational Motion:

$\theta = s/r$ $\langle \omega \rangle = \frac{\langle v_t \rangle}{r} = \frac{\Delta \theta}{\Delta t}$ $\langle \alpha \rangle = \frac{\langle a_t \rangle}{r} = \frac{\Delta \omega}{\Delta t}$ $a_c = v^2/r$

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

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

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

Harmonic Motion:

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

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

Fluids:

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

$\rho_1 A_1 v_1 = \rho_2 A_2 v_2$ $A_1 v_1 = A_2 v_2$ $(if\ \rho_1 = \rho_2)$

Heat:

$T_c = \frac{5}{9}(T_F - 32)$ $T_K = T_C + 273.15$ $\frac{\Delta L}{L} = \alpha \Delta T$ $\frac{\Delta V}{V} = 3\alpha \Delta T = \beta \Delta T$

$Q_{specific} = mc\Delta T$ $Q_{latent} = mL$ $\frac{Q_{conduction}}{t} = \frac{kA\,\Delta T}{L}$ $\frac{Q_{radiation}}{t} = e\sigma A T^4$

Ideal Gas:

$n = \frac{N}{N_A} = \frac{m}{M_{molar}}$ $PV = nRT = NkT$ $\langle KE \rangle = \frac{3}{2}kT$ $U_{monatomic} = \frac{3}{2}NkT = \frac{3}{2}nRT$

Thermodynamics:

$\Delta U = Q - W$

$W = P\Delta V = nR\Delta T$ *(isobaric, const. P)* $W = nRT\ ln(\frac{V_f}{V_i})$ *(isothermal, const. T)*

$W = -\frac{3}{2}nR(T_f - T_i)$ *(adiabatic, monatomic)* $P_1 {V_1}^{\gamma} = P_2 {V_2}^{\gamma}$ *(adiabatic)*

$Q = Cn\Delta T$ $C_{P\_monatomic} = \frac{5}{2}R$ $C_{V\_monatomic} = \frac{3}{2}R$ $\gamma = C_P/C_V$ *(= 5/3 for monatomic)*

$e = \frac{|W|}{|Q_H|} = 1 - \frac{|Q_C|}{|Q_H|}$ $|Q_H| = |W| + |Q_C|$ $\frac{|Q_C|}{|Q_H|} = \frac{T_C}{T_H}$ *(Carnot engine)*

$\Delta S = Q/T$ *(Reversible processes)*

Waves

$f = 1/T$ $v = f\lambda$ $v_{string\_wave} = \sqrt{\frac{Tension}{m/L}}$ $v_{sound\_wave} = \sqrt{\frac{\gamma k T}{m}}$