Trigonometry

(1) $\cos(\theta) = \frac{adj}{hyp}, \sin(\theta) = \frac{opp}{hyp}, \tan(\theta) = \frac{opp}{adj}$

(2) $hyp^2 = adj^2 + opp^2$

Quadratic Formula:

$$Ax^2 + Bx + C = 0 \Rightarrow x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

Displacement, Velocity, Acceleration:

(1) $\Delta\vec{r} = \vec{r}_f - \vec{r}_0$

(2) $\vec{v}_{avg} = \frac{\Delta\vec{r}}{\Delta t}$

(3) $\vec{a}_{avg} = \frac{\Delta\vec{v}}{\Delta t}$

Kinematic Equations for constant acceleration:

(1) $x_f = x_0 + v_0 t + \frac{1}{2}at^2$

(2) $v_f = v_0 + at$

(3) $v_f^2 = v_0^2 + 2a(x_f - x_0)$

(4) $x_f - x_0 = \frac{1}{2}(v_f + v_0)t$

Work & Energy:

(1) $W_{net} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_0^2 = \Delta K.E.$

(2) $W = \vec{F} \cdot \vec{s} \ \ (Const.\ \ Force)$

(3) $W = \int_a^b \vec{F} \cdot d\vec{s} \ \ (Varying\ \ Force)$

(4) $\Delta K.E. + \Delta U - W_{nc} = 0 \ \ (No\ \ Ext.\ \ Forces)$

(5) $U_{Grav} = mgy \ \ U_{Spring} = \frac{1}{2}kx^2$

(6) $\Delta U_{ab} = -W_{ab} = -\int_a^b \vec{F} \cdot d\vec{s}$

(7) $\vec{F} = -\nabla U = -\frac{\partial U}{\partial x}\hat{i} - \frac{\partial U}{\partial y}\hat{j} - \frac{\partial U}{\partial z}\hat{k}$

Vector Products

(1) $\vec{A} \cdot \vec{B} = \left|\vec{A}\right|\left|\vec{B}\right|\cos\phi_{AB} = A_x B_x + A_y B_y + A_z B_z$

(2) $\left|\vec{A} \times \vec{B}\right| = \left|\vec{A}\right|\left|\vec{B}\right|\sin\phi_{AB}$

(3) $\vec{A} \times \vec{B} = \det\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$

(4) $\vec{v}_{inst} = \frac{d\vec{r}}{dt}, \vec{\omega}_{inst} = \frac{d\theta}{dt}$

(5) $\vec{a}_{inst} = \frac{d\vec{v}}{dt}, \alpha_{inst} = \frac{d\omega}{dt}$

(6) $\left|\vec{a}_{circular}\right| = \frac{v^2}{r}$

Newton's Laws:

(1) $\vec{F}_{net} = 0 \Rightarrow \vec{a} = 0$

(2) $\vec{F}_{net} = m\vec{a}$

$\vec{F}_{AB} = -\vec{F}_{BA}$

Force Laws:

(1) $\vec{F}_{fricetion}: \begin{matrix} = \mu_k N \\ \le \mu_s N \end{matrix}$

(2) $\vec{F}_{Spring} = -k\vec{x}$

(3) $\vec{F}_{Grav} = \begin{matrix} mg \ \ (Earth's\ \ Surface) \\ \frac{Gm_1 m_2}{r^2} \ \ (Otherwise) \end{matrix}$

Impulse & Momentum:

(1) $\vec{F}_{net} = \dfrac{d\vec{p}}{dt}$

(2) $\vec{J}_{net} = F_{AVG}\Delta t = \int_0^t \vec{F}_{net}\,dt = m\vec{v}_f - m\vec{v}_i = \Delta\vec{p}$

(3) $\dfrac{d\vec{p}_{Total}}{dt} = 0 \;\; (No \;\; Ext. \;\; Forces)$

Center of Mass:

(1) $\vec{F}_{net\,EXT} = M_{Total}\vec{a}_{CM}$

(2) $\vec{r}_{CM} = \dfrac{m_1\vec{r}_1 + m_2\vec{r}_2 + \ldots}{m_1 + m_2 + \ldots} = \dfrac{1}{M_{Total}}\int \vec{r}\,dm$

(3) $\rho = \dfrac{M}{V} = \dfrac{dm}{dV}$

Moment of Inertia:

(1) $I_z = \int r^2\,dm$

(2) $I_{Parallel} = I_{CM} + Md^2$

Kinematic Equations for constant acceleration:

(1) $\theta_f = \theta_0 + \omega_0 t + \dfrac{1}{2}\alpha t^2$

(2) $\omega_f = \omega_0 + \alpha t$

(3) $\omega_f^2 = \omega_0^2 + 2\alpha(\theta_f - \theta_0)$

(4) $\theta_f - \theta_0 = \dfrac{1}{2}(\omega_f + \omega_0)t$

(5) $s = r\theta, (\theta \; in \; radians)$

(6) $\vec{v}_T = \vec{\omega} \times \vec{r}$

(7) $\vec{a}_T = \vec{\alpha} \times \vec{r}$

(8) $a_R = \dfrac{v^2}{r}$

Rotational Work & Energy:

(1) $W_{net} = \int \tau_{net}\,d\theta = \dfrac{1}{2}I\omega_f^2 - \dfrac{1}{2}I\omega_0^2 = \Delta K.E._{Rotational}$

Rotational Dynamics:

(1) $\vec{\tau} = \vec{r} \times \vec{F}, \;\; |\vec{\tau}| = |\vec{r}||\vec{F}|\sin\theta_{rF}$

(2) $\vec{\tau}_{net} = 0 \Rightarrow \vec{\alpha} = 0$

(3) $\vec{\tau}_{net} = I\vec{\alpha}$

(4) $\vec{\tau}_{AB} = -\vec{\tau}_{BA}$

(5) $\vec{L}_{Totf} = \sum I_f\vec{\omega}_f = \vec{L}_{Tot0} = \sum I_0\vec{\omega}_0 \quad (No \;\; Ext. \;\; Torques)$

Pressure & Fluids:

(1) $\rho = \dfrac{dM}{dV}$

(2) $P = \dfrac{dF_\perp}{dA}$

(3) $F_B = \rho_{Fluid}gV_{Object}$

(4) $P_1 + \rho g h_1 + \dfrac{1}{2}\rho v_1^2 = P_2 + \rho g h_2 + \dfrac{1}{2}\rho v_2^2$

Oscillations & S.H.M

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

(2) $T = \dfrac{1}{f} = \dfrac{2\pi}{\omega}$

(3) $T_{mass-spring} = 2\pi\sqrt{\dfrac{m}{k}}$

(4) $T_{pendulum} = 2\pi\sqrt{\dfrac{mgr_{cm}}{I}}$

Temperature & Heat:

(1) $Q = mc\Delta T$

(2) $\Delta L = \alpha L_0 \Delta T$

(3) $PV = nkT$

(4) $\Delta E_{Int} = W + Q$