

Centripetal Force

$$F_c = ma_c = m \frac{v^2}{r} = mr\omega^2$$

Work for a non-constant force

$$\Delta K = W = \int_{s_i}^{s_f} F_s ds$$

Work for a constant force

$$W = F(\Delta r) \cos \theta = \vec{F} \cdot \Delta \vec{r}$$

Force from potential energy

$$F_s = -\frac{\Delta U}{\Delta s} = -\frac{dU}{ds}$$

Kinetic Energy

$$K = \frac{1}{2}mv^2 = \frac{p^2}{2m}$$

Gravitational Potential Energy

$$U_g = mgy$$

Mechanical Energy

$$E_{mech} = K + U$$

Mechanical Energy Conservation

$$\Delta E_{mech} = \Delta K + \Delta U = 0$$

$$K_f + U_f = K_i + U_i$$

Hooke's Law

$$F_{sp} = -k\Delta s$$

Spring Displacement

$$\Delta s = s - s_e = L - L_o$$

$$\text{Average Power} = \frac{\Delta E_{sys}}{\Delta t}$$

Momentum

$$\vec{p} = m \cdot \vec{v}$$

Total Linear Momentum

$$\vec{P} = \vec{p}_{tot} = \sum \vec{p} = \vec{p}_1 + \vec{p}_2 + \vec{p}_3 + \dots$$

$$\text{Power} = \frac{dE_{sys}}{dt}$$

Change in momentum

$$\Delta \vec{p} = \vec{p}_f - \vec{p}_i$$

Momentum Conservation

$$\vec{F}_{net} = \frac{\Delta \vec{P}}{\Delta t} = \text{ZERO}$$

Impulse

$$J_x \equiv \int_{v_i}^{v_f} F_x(t) dt = \Delta p_x$$

$$\vec{P}_f = \vec{P}_i$$

Elastic Collision final velocity equations

$$v_1 = \left( \frac{m_1 - m_2}{m_1 + m_2} \right) v_{1o} + \left( \frac{2m_2}{m_1 + m_2} \right) v_{2o}$$

Newton's 2<sup>nd</sup> Law

$$\vec{F}_{net} = \frac{\Delta \vec{p}}{\Delta t} = \frac{m\Delta \vec{v}}{\Delta t} = m \cdot \vec{a} = \text{average force}$$

$$v_2 = \left( \frac{2m_1}{m_1 + m_2} \right) v_{1o} - \left( \frac{m_1 - m_2}{m_1 + m_2} \right) v_{2o}$$

Critical Speed  $v_{critical} = \sqrt{rg}$

Critical Angular Sped  $\omega_{critical} = \frac{v_{critical}}{r} = \sqrt{\frac{g}{r}}$

System Energy

$$E_{sys} = E_{mech} + E_{thermal} = K + U + E_{th}$$

Work Energy-Theorem/Energy Principle

$$W = \Delta E_{sys} = \Delta K + \Delta U + \Delta E_{th}$$

Work done by Non-conservative force

$$W_{nc} = \Delta E_{mech} = \Delta K + \Delta U$$

Spring/Elastic Potential Energy

$$U_s = \frac{1}{2}k(\Delta s)^2$$