

Linear Kinematics

$$d = p_2 - p_1 \qquad v = \frac{p_2 - p_1}{t_2 - t_1} \qquad a = \frac{v_2 - v_1}{t_2 - t_1} \qquad \text{speed} = \frac{\Delta \text{distance}}{\Delta \text{time}}$$

Projectile Equations

$$v_2 = v_1 + at \qquad d = v_1 t + \frac{1}{2} at^2 \qquad v_2^2 = v_1^2 + 2ad$$

$$\text{Time of Flight} = \frac{(2v_1)}{-g} \qquad \text{Time of Flight} = \frac{-v_1 - \sqrt{v_1^2 - 2gh}}{g} \qquad \text{Maximal Height} = \frac{(v_1)^2}{-2g}$$

Linear Kinetics

$$W = mg \qquad F_f = \mu F_N \qquad \text{Linear Momentum: } L = mv \qquad F_{\text{slope}} = mg \sin \theta$$

Perfectly elastic collision: $m_A v_A = m_B v_B$; Static Equilibrium: $\sum F = 0$;

Coefficient of restitution: $e = \sqrt{\frac{\text{bounce height}}{\text{drop height}}}$ or $e = \frac{v_2 - v_1}{u_1 - u_2}$

Law of Gravity

$$F = G \frac{m_1 m_2}{d^2}$$

Impulse/Momentum: $F \Delta t = m \Delta v$ A version of the conservation of L: $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$

Work, Power, & Energy

$$U = Fd \qquad KE = \frac{1}{2} mv^2 \qquad GPE = m|g|h \qquad SE = \frac{1}{2} k \Delta x^2$$

$$U = \Delta KE + \Delta GPE + \Delta SE \qquad P = \frac{U}{t} = Fv$$

Angular Kinematics

$$\omega = \frac{\Delta \theta}{\Delta t}; \quad \alpha = \frac{\Delta \omega}{\Delta t}; \quad l = \theta r; \quad v = \omega r; \quad a_t = \alpha r; \quad a_r = \omega^2 r; \quad a_r = \frac{v^2}{r}$$

Locating the Center of Mass

$$\Sigma(W \times r) = \Sigma(W) \times r_{\text{com}}; \quad \text{com}_x = X_{\text{prox}} + L\%(X_{\text{dist}} - X_{\text{prox}}); \quad \text{com}_y = Y_{\text{prox}} + L\%(Y_{\text{dist}} - Y_{\text{prox}})$$

Angular Kinetics

Static Equilibrium: $\sum T = 0$

$$T = F \times r; \quad I = mk^2; \quad H = I\omega; \quad T \Delta t = I \Delta \omega = \Delta H; \quad F_c = \frac{mv^2}{r} = mr\omega^2; \quad T = I\alpha$$

Fluid Mechanics

$$P = \frac{F}{A} \qquad \rho = \frac{m}{V} \qquad F_{\text{Drag}} = \frac{1}{2} C_D \rho A v^2 \qquad F_{\text{Lift}} = \frac{1}{2} C_L \rho A v^2 \qquad v = \sqrt{\frac{-2mg \sin(\theta)}{C_D \rho A}}$$

Conversions

1 lb = 4.45 N	1 mile = 1609 m	1 m = 3.28 ft	1 kg = 2.214 lb	1 radian = 57.3°
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