Useful Physics Formulas

BCCC Tutoring Center

This handout highlights some of frequently encountered formulas found in Physics I and Physics A.

Please note that most of the formulas assume that a quantity, such as acceleration, is constant. To deal with changing quantities the Calculus must be employed.

Kinematics Equations

$$v_{\text{avg}} = \frac{x - x_0}{t} \qquad a_{\text{avg}} = \frac{v - v_0}{t} \qquad v = v_0 + at$$

$$x = x_0 + v_0 t + \tfrac{1}{2}at^2 \qquad v^2 = v_0^2 + 2a(x - x_0) \qquad \text{Uniform Circular Motion: } a_R = \frac{v^2}{r}$$

Force and Work

$$F_{\text{net}} = \Sigma F_i = ma \qquad F_{\text{fr}} = \mu F_N \qquad G = 6.67 \text{ x } 10^{-11} \tfrac{\text{Nm}^2}{\text{kg}^2}$$

$$F_G = G\frac{m_1 m_2}{r^2} \qquad W = Fd \qquad F_{\text{spring}} = -kx$$

Energy and Power

$$KE = \tfrac{1}{2}mv^2 \qquad U_{\text{grav}} = mgy \qquad U_{\text{spring}} = \tfrac{1}{2}kx^2$$

$$W_{\text{net}} = \Delta KE \qquad \Delta KE = -\Delta U \qquad \Sigma\text{Energy}_{\text{Initial}} = \Sigma\text{Energy}_{\text{Final}}$$

$$U(r) = -\frac{GmM}{r} \text{ for } r > r_M \qquad P_{\text{avg}} = \frac{W}{t} \qquad e = \frac{P_{\text{out}}}{P_{\text{in}}}$$

$$v_{\text{esc}} = \sqrt{\frac{2GM}{r}} \qquad KE_{\text{rotation}} = \tfrac{1}{2}I\omega^2$$

Momentum

$$p = mv \qquad F_{\text{net}} = \frac{dp}{dt} \qquad p_1 + p_2 = p_1' + p_2'$$

Angular Quantities

$$\omega_{\text{avg}} = \frac{\Delta\theta}{\Delta t} \qquad \alpha_{\text{avg}} = \frac{\Delta\omega}{\Delta t} \qquad v = R\omega$$

$$a_{\text{tan}} = R\alpha \qquad \omega = \omega_0 + \alpha t \qquad \theta = \theta_0 + \omega_0 t + \tfrac{1}{2}\alpha t^2$$

$$\omega^2 = \omega_0^2 + 2\alpha\theta \qquad \tau = mR^2\alpha \qquad \tau_{\text{net}} = \Sigma\tau = I\alpha$$

$$I = I_{\text{cm}} + Mh^2 \qquad L_{\text{intitial}} = L_{\text{final}} \qquad L = I\omega$$

Harmonic Motion

$$T = \frac{1}{f} \qquad x = A\cos(\omega t + \phi) \qquad \omega^2 = \frac{k}{m}$$

$$\omega = 2\pi f \qquad f = \tfrac{1}{2\pi}\sqrt{\frac{m}{k}} \qquad F_{\text{damping}} = -bv$$

$$x = Ae^{-\alpha t}\cos(\omega' t) \qquad \alpha = \frac{b}{2m} \qquad \omega' = \sqrt{\frac{k}{m} - \frac{b^2}{4m^2}}$$

Thermodynamics

$$\Delta L = \alpha L_0 \Delta T \qquad \Delta V = \beta V_0 \Delta T \qquad PV = nRT$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad PV = NkT \qquad Q = mc\Delta T$$

$$\Delta U = Q - W \qquad K_{\text{avg}} = \tfrac{3}{2}kT \qquad Q = mL$$