

Some Useful/Useless Equations and Constants

Kinematic Equations

$$\begin{aligned} x_f &= x_i + v_{ix}t + \frac{1}{2}a_x t^2 & y_f &= y_i + v_{iy}t + \frac{1}{2}a_y t^2 \\ v_{fx} &= v_{ix} + a_x t & v_{fy} &= v_{iy} + a_y t \\ v_{fx}^2 &= v_{ix}^2 + 2a_x \Delta x & v_{fy}^2 &= v_{iy}^2 + 2a_y \Delta y \end{aligned}$$

Rotational/Circular Motion Equations

$$\begin{aligned} \theta_f &= \theta_i + \omega_i t + \frac{1}{2}\alpha t^2 & \omega_f &= \omega_i + \alpha t \\ \omega_f^2 &= \omega_i^2 + 2\alpha(\theta_f - \theta_i) & v_t &= \omega r \\ a_t &= \alpha r & a_c &= \frac{v_t^2}{r} = \omega^2 r & \sum \tau &= I\alpha \\ \boldsymbol{\tau} &= \mathbf{F} \times \mathbf{r} & \tau &= F_{\perp} r & \tau &= |\mathbf{F}| \cdot |\mathbf{r}| \sin \theta \\ I &= \sum_i m_i r_i^2 & I &= \int r^2 dm \end{aligned}$$

Thermal Equations

$$\begin{aligned} \Delta Q &= mc\Delta T & Q &= mL_f & Q &= mL_v \\ W &= P\Delta V & W &= \int P dV & K &= \frac{3}{2}k_B T \\ T_F &= \frac{9}{5}T_C + 32 & T_C &= \frac{5}{9}(T_F - 32) & T_K &= T_C + 273 \\ PV &= nRT & PV &= Nk_B T & \Delta L &= L_o \alpha \Delta T \\ \Delta A &= A_o \gamma \Delta T & \Delta V &= V_o \beta \Delta T & \Delta U &= Q - W \\ \Delta U &= \frac{3}{2}nR\Delta T \end{aligned}$$

Circuits Equations

$$\begin{aligned} V &= IR & R_T &= \sum R_i & \frac{1}{R_T} &= \sum \frac{1}{R_i} \\ C &= \frac{Q}{V} & C_T &= \sum C_i & \frac{1}{C_T} &= \sum \frac{1}{C_i} \\ C &= \kappa \frac{\epsilon_o \cdot A}{d} & P &= IV & E &= \frac{Q}{\epsilon_o \cdot A} \end{aligned}$$

Force Equations

$$\begin{aligned} \Sigma \mathbf{F} &= m\mathbf{a} & w &= mg \\ F_f &= \mu F_N & F_s &= -kx \\ F_G &= G \frac{m_1 m_2}{r^2} & F_C &= k_e \frac{|q_1||q_2|}{r^2} \\ F_B &= q\mathbf{v} \times \mathbf{B} & F_B &= qvB \sin \phi \end{aligned}$$

Work and Energy Equations

$$\begin{aligned} W &= \mathbf{F} \cdot \Delta \mathbf{r} & W &= \int \mathbf{F} \cdot d\mathbf{r} \\ W &= |\mathbf{F}| \cdot |\mathbf{r}| \cos \theta & K_t &= \frac{1}{2}mv^2 \\ K_r &= \frac{1}{2}I\omega^2 & W &= \Delta K \\ U_g &= mgh & U_s &= \frac{1}{2}kx^2 \\ \Delta K &= -\Delta U & K_i + U_i &= K_f + U_f \end{aligned}$$

Momentum and Impulse Equations

$$\begin{aligned} \text{Impulse} &= \mathbf{F} \cdot \Delta t & \mathbf{p} &= m\mathbf{v} \\ \text{Impulse} &= \Delta \mathbf{p} & \Sigma \mathbf{p}_i &= \Sigma \mathbf{p}_f \\ \mathbf{L} &= \mathbf{p} \times \mathbf{r} & L &= I\omega \end{aligned}$$

Electricity Equations

$$\begin{aligned} E &= k_e \frac{|q|}{r^2} & V &= k_e \frac{q}{r} \\ \mathbf{E} &= \frac{\mathbf{F}}{q} & \Delta V &= Ed \\ \Delta U &= -q\Delta V & \Phi_E &= EA_{\perp} \\ \Phi_E &= \frac{q_{enc}}{\epsilon_o} \end{aligned}$$

Wave & S.H.O. Equations

$$\omega = 2\pi f \quad T = \frac{1}{f} \quad k = \frac{2\pi}{\lambda} \quad v = f\lambda$$

$$y(x, t) = A \sin[kx - \omega t + \varphi]$$

$$v(x, t) = -A\omega \cos[kx - \omega t + \varphi]$$

$$a(x, t) = -A\omega^2 \sin[kx - \omega t + \varphi]$$

$$x(t) = A \cos[\omega t + \varphi] \quad v(t) = -A\omega \sin[\omega t + \varphi]$$

$$a(t) = -A\omega^2 \cos[\omega t + \varphi] \quad \omega = \sqrt{\frac{k}{m}}$$

$$n = 1, 2, 3, \dots \begin{cases} f_n = \frac{nv}{2L} \\ \lambda_n = \frac{2}{n}L \end{cases} \quad n = 1, 3, 5, \dots \begin{cases} f_n = \frac{nv}{4L} \\ \lambda_n = \frac{4}{n}L \end{cases}$$

$$v = \sqrt{\frac{T}{\mu}} \quad \lambda_n = \frac{2L}{n} \quad \mu = \frac{m}{L} \quad f_n = \frac{n}{2L} \sqrt{\frac{T}{\mu}}$$

$$\omega = \sqrt{\frac{g}{L}} \quad f' = f \frac{v \pm v_o}{v \mp v_s}$$

Universal Constants

$$G = 6.674 \times 10^{-11} \frac{N \cdot m^2}{kg^2} \quad k_B = 1.38 \times 10^{-23} J/K$$

$$R = 8.314 \frac{J}{mol \cdot K} \quad R = 0.082057 \frac{L \cdot atm}{mol \cdot K}$$

$$1 atm = 101 kPa \quad N_A = 6.022 \times 10^{23}$$

$$1 L = 0.001 m^3 \quad k_e = 8.99 \times 10^9 \frac{N \cdot m^2}{C^2}$$

$$\epsilon_o = 8.85 \times 10^{-12} \frac{C^2}{N \cdot m^2} \quad k_e = \frac{1}{4\pi\epsilon_o}$$

$$e = 1.602 \times 10^{-19} C \quad m_p = 1.67 \times 10^{-27} kg$$

$$m_n = 1.67 \times 10^{-27} kg \quad m_e = 9.11 \times 10^{-31} kg$$

$$c = 3.0 \times 10^8 m/s \quad v_{sound} = 340 m/s$$

$$\mu_o = 4\pi \times 10^{-7} \frac{T \cdot m}{A}$$

Lens/Mirror Equations

$$\frac{1}{f} = \frac{1}{s} + \frac{1}{s'} \quad M = -\frac{s'}{s} \quad M = \frac{y'}{y}$$

$$n_1 \sin \theta_1 = n_2 \sin \theta_2 \quad n = \frac{c}{v_m}$$

$$\theta_c = \sin^{-1} \frac{n_2}{n_1}$$

Magnetism Equations

$$\mathbf{F} = q\mathbf{v} \times \mathbf{B} \quad F = |q|vB \sin \theta$$

$$B = \frac{\mu_o I}{2\pi r} \quad \frac{F}{L} = \frac{\mu_o I I'}{2\pi r}$$

$$B_x = \frac{N\mu_o I a^2}{2[x^2 + a^2]^{\frac{3}{2}}}$$

General Equations

$$C = 2\pi r \quad P = \frac{F}{A} \quad \rho = \frac{m}{V}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$N = N_o e^{-\frac{\ln 2}{T_{1/2}} t}$$