

Mechanics

$$F = ma, \quad p = mv, \quad K = \frac{1}{2}mv^2, \quad E = K + U$$

Electricity

$$F_e = k \frac{|q_1 q_2|}{r^2}, \quad F_e = qE, \quad E_q = k \frac{|q|}{r^2}$$

$$\Delta U = q\Delta V, \quad \Delta V = -E\Delta s, \quad u_E = \frac{1}{2}\epsilon_0 E^2$$

$$V_q = k \frac{q}{r}, \quad U_q = k \frac{q_1 q_2}{r}$$

$$C = \frac{Q}{V}, \quad C = \kappa\epsilon_0 \frac{A}{d}, \quad E_{cap} = \frac{1}{2}QV$$

Circuits

$$I = \frac{\Delta Q}{\Delta t}, \quad V = IR, \quad R = \rho \frac{L}{A}$$

$$\rho = \rho_0(1 + \alpha\Delta T), \quad R = R_0(1 + \alpha\Delta T)$$

$$P = \frac{\Delta E}{\Delta t}, \quad P = IV$$

$$x_{rms} = \frac{x_{max}}{\sqrt{2}}, \quad P_{av} = I_{rms}V_{rms}$$

$$R_{eq} = R_1 + R_2 + R_3 + \dots \text{ (Series)}$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots \text{ (Series)}$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots \text{ (Parallel)}$$

$$C_{eq} = C_1 + C_2 + C_3 + \dots \text{ (Parallel)}$$

$$V = \mathcal{E}(1 - e^{-t/\tau}), \quad V = V_0 e^{-t/\tau}, \quad \tau = RC$$

Magnetism

$$F_m = qvB \sin \theta, \quad r = \frac{mv}{qB}, \quad u_B = \frac{1}{2\mu_0} B^2$$

$$F_m = ILB \sin \theta, \quad \tau = NIAB \sin \theta$$

$$F_m = \mu_0 \frac{I_1 I_2 l}{2\pi a}, \quad B = \frac{\mu_0 I}{2\pi r}, \quad B_{loop} = N \frac{\mu_0 I}{2R}$$

$$B = \mu_0 nI, \quad n = \frac{N}{l}$$

Constants

$$k = 8.9876 \times 10^9 \frac{N \cdot m^2}{C^2}, \quad e = 1.6022 \times 10^{-19} C$$

$$m_e = 9.1094 \times 10^{-31} kg, \quad m_p = 1.6726 \times 10^{-27} kg$$

$$\epsilon_0 = 8.8542 \times 10^{-12} \frac{C^2}{N \cdot m^2}, \quad \mu_0 = 4\pi \times 10^{-7} \frac{T \cdot m}{A}$$

$$c = 2.9979 \times 10^8 \frac{m}{s}, \quad 1eV = 1.6022 \times 10^{-19} J$$

Magnetic Flux

$$\Phi = BA \cos \theta, \quad \mathcal{E} = -N \frac{\Delta \Phi}{\Delta t}, \quad |\mathcal{E}| = L \left| \frac{\Delta I}{\Delta t} \right|$$

$$\mathcal{E} = NAB\omega \sin \omega t, \quad |\mathcal{E}| = Blv, \quad \frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{I_s}{I_p}$$

$$L = \mu_0 n^2 A l, \quad n = \frac{N}{l}, \quad U_B = \frac{1}{2} LI^2$$

$$I = I_0(1 - e^{-t/\tau}), \quad I = I_0 e^{-t/\tau}, \quad I_0 = \frac{V}{R}, \quad \tau = \frac{L}{R}$$

Electromagnetic Waves

$$c = f\lambda, \quad f' = f \left(1 \pm \frac{u}{c} \right), \quad E = cB, \quad u_{EM} = \epsilon_0 E^2 = \frac{B^2}{\mu_0}$$

$$I = \frac{P}{A}, \quad I = cu_{EM}, \quad I_{ave} = \frac{c\epsilon_0 E_{max}^2}{2}, \quad c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$$

Geometrical Optics

$$f = \pm \frac{1}{2} R, \quad \frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}, \quad m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$$

$$v_n = \frac{c}{n}, \quad \lambda_n = \frac{\lambda}{n}, \quad n_1 \sin \theta_1 = n_2 \sin \theta_2$$

Wave Optics

$$\Delta l = m\lambda, \quad \Delta l = \left(m - \frac{1}{2} \right) \lambda, \quad y = L \tan \theta$$

$$d \sin \theta = m\lambda, \quad d \sin \theta = \left(m \pm \frac{1}{2} \right) \lambda$$

$$D \sin \theta = m\lambda, \quad d \sin \theta = m\lambda, \quad d = \frac{1}{N}$$

$$\frac{2d}{\lambda_n} = m + \frac{1}{2}, \quad \frac{2d}{\lambda_n} = m$$

$$\frac{2d}{\lambda_n} = m, \quad \frac{2d}{\lambda_n} = m - \frac{1}{2}$$

$$I = \frac{1}{2} I_0, \quad I = I_0 \cos^2 \theta, \quad \tan \theta_B = \frac{n_1}{n_2}$$

$$\theta_{min} = 1.22 \frac{\lambda}{D}$$

Quantum Physics

$$E = hf, \quad E = pc, \quad c = f\lambda$$

$$K_{max} = hf - W_0, \quad f_0 = \frac{W_0}{h}$$

$$\lambda = \frac{h}{p}, \quad \Delta\lambda = \frac{h}{m_e c} (1 - \cos \theta)$$

$$\Delta p \Delta y \geq \frac{h}{4\pi}, \quad \Delta E \Delta t \geq \frac{h}{4\pi}$$

Atomic Physics

$$\frac{1}{\lambda} = R_B \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right), \quad n_i > n_f$$

$$L_n = r m_e v_n = \frac{nh}{2\pi}$$

$$r_n = \alpha_B \frac{n^2}{Z}, \quad \alpha_B = \frac{h^2}{4\pi^2 m_e k e^2}$$

$$v_n = \beta_B \frac{Z}{n}, \quad \beta_B = \frac{2\pi k e^2}{h}$$

$$E_n = -E_0 \frac{Z^2}{n^2}, \quad E_0 = \frac{2\pi^2 m_e k^2 e^4}{h^2} = 13.6 \text{ eV}$$

$$K(n=1), \quad L(n=2), \quad M(n=3), \quad N(n=4)$$

$$s(l=0), \quad p(l=1), \quad d(l=2), \quad f(l=3)$$

Nuclear Physics

$$E = |\Delta m|c^2, \quad r = (1.2 \text{ fm})A^{1/3}$$

$$N = N_0 e^{-\lambda t}, \quad T_{1/2} = \frac{\ln 2}{\lambda}$$

$$R = \frac{\Delta N}{\Delta t}, \quad R = R_0 e^{-\lambda t}, \quad R_0 = \lambda N_0$$

Temperature and The Ideal Gas

$$T_F = \frac{9}{5}T_C + 32, \quad T_C = \frac{5}{9}(T_F - 32), \quad T = T_C + 273.15$$

$$\Delta L = \alpha L_0 \Delta T, \quad \Delta A \approx 2\alpha A_0 \Delta T, \quad \Delta V = \beta V_0 \Delta T, \quad \beta \approx 3\alpha$$

$$PV = Nk_B T, \quad PV = nRT, \quad U = \frac{3}{2}NkT$$

$$K_{av} = \left(\frac{1}{2} m v_{av}^2 \right) = \frac{3}{2} kT, \quad v_{rms} = \sqrt{\frac{3k_B T}{m}} = \sqrt{\frac{3RT}{M}}$$

Heat, and Heat Transfer

$$C = \frac{Q}{\Delta T}, \quad c = \frac{Q}{m\Delta T}, \quad L = \frac{Q}{m}, \quad Q = \frac{kA\Delta T}{L}t$$

$$P = e\sigma A T^4, \quad P_{net} = e\sigma A (T^4 - T_s^4)$$

Thermodynamics

$$\Delta U = Q - W$$

$$W = P\Delta V, \quad W = NkT \ln \left(\frac{V_f}{V_i} \right)$$

$$W = Q_h - Q_c, \quad Eff = \frac{W}{Q_h}, \quad COP = \frac{Q_c}{W}$$

$$W_{max} = Eff_{max} Q_h, \quad Eff_{max} = 1 - \frac{T_c}{T_h}$$

$$\Delta S = \frac{Q}{T}, \quad S = k_B \ln(W)$$

Constants

$$h = 6.6261 \times 10^{-34} \text{ Js} = 4.1357 \times 10^{-15} \text{ eV}$$

$$R_B = 1.097 \times 10^7 \text{ m}^{-1}, \quad m_n = 1.6749 \times 10^{-27} \text{ kg}$$

$$1u = 1.660540 \times 10^{-27} \text{ kg} = 931.5 \text{ MeV}/c^2$$

$$k_B = 1.3806 \times 10^{-23} \frac{\text{J}}{\text{K}}, \quad N_A = 6.0221 \times 10^{23} \text{ mol}^{-1}$$

$$R = kN_A = 8.3145 \frac{\text{J}}{\text{mol K}}, \quad 1 \text{ cal} = 4.186 \text{ J}$$

$$\sigma = 5.67 \times 10^{-8} \frac{\text{J}}{\text{s m}^2 \text{ K}^4}$$