

$$n_2 \sin \theta_2 = n_1 \sin \theta_1 \quad \frac{1}{d_1} + \frac{1}{d_2} = \frac{1}{f} \quad \frac{1}{f} = (n - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

$$m = \frac{-d_2}{d_1} \quad |m| = \frac{-h'}{h} \quad m = \frac{f_0}{f_e}$$

$$\vec{E}_{rad} = \frac{1}{4\pi\epsilon_0} \frac{-q\vec{a}_\perp}{c^2 r} \quad \vec{S} = \frac{1}{\mu_0} \vec{E} \times \vec{B} \quad \langle S \rangle = F \quad E = cB$$

$$L = 4\pi r^2 F$$

$$E = E_0 \sin(kx - \omega t + \epsilon) \quad k = \frac{2\pi}{\lambda} \quad \omega = 2\pi f$$

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

$$m\lambda = d \sin \theta \quad m\lambda = W \sin \theta \quad \theta_R = 1.22 \frac{\lambda}{D}$$

$$\delta = \frac{2\pi}{\lambda_0} (n_1 x_1 - n_2 x_2) + (\epsilon_1 - \epsilon_2) \quad \lambda = \frac{\lambda_0}{n}$$

$$\Delta E = Q + W \quad \Delta E = mC\Delta T$$

$$E = \frac{hc}{\lambda} = hf \quad E_N = \frac{-13.6\text{eV}}{N^2} \quad E_g = Mgy$$

$$\Omega_{AB} = \Omega_A \Omega_B \quad \Omega(N, q) = \frac{(q + N - 1)!}{q!(N - 1)!} \quad \text{Pr}(E) \propto \Omega(E) e^{-E/kT}$$

$$\text{Pr}(v) = 4\pi \left(\frac{M}{2\pi kT} \right)^{\frac{3}{2}} v^2 e^{-\frac{Mv^2}{2kT}}$$

$$S = k_B \ln \Omega \quad \frac{dS}{dE_{int}} = \frac{1}{T} \quad \Delta S = \frac{Q}{T}$$

$$v_{rms} = \sqrt{\frac{3kT}{M}} \quad v_P = \sqrt{\frac{2kT}{M}} \quad v_{avg} = \sqrt{\frac{8kT}{\pi M}} \quad \frac{1}{2}mv_{rms}^2 = \frac{3}{2}kT$$

$$\frac{dQ}{dt} = -\kappa A \frac{dT}{dx} \quad d = \frac{1}{\sqrt{2} n\pi D^2}$$

$$\frac{dQ}{dt} = e\sigma AT^4 \quad \lambda_{peak} = \frac{2.9 \times 10^{-3}m - K}{T}$$

$$PV = NkT \quad PV^\gamma = constant \quad \gamma = 1 + \frac{2}{f} \quad C_V = \frac{f}{2}k_B$$

$$dW = -PdV \quad \Delta E = NC_V\Delta T \quad C_P = C_V + k_B$$

$$e = \frac{|W_{net}|}{|Q_H|} = 1 - \frac{Q_L}{Q_H} \quad e = 1 - \frac{T_L}{T_H}$$

Conversions/Constants

$$k = 1.38 \times 10^{-23} \frac{J}{K} \quad 1 \mu m = 10^{-6}m$$

$$h = 6.6 \times 10^{-34} J \cdot s \quad 1 nm = 1 \times 10^{-9} m$$

$$c = 3 \times 10^8 m s^{-1} \quad 1 eV = 1.602 \times 10^{-19} J$$

$$\sigma = 5.6703 \times 10^{-8} \frac{W}{m^2 K^4} \quad 1^\circ = 3600''$$

$$h = 6.6 \times 10^{-34} J \cdot s \quad T[K] = T[^\circ C] + 273$$

$$N_A = 6.02 \times 10^{23}$$

$$q = 1.6 \times 10^{-19} C$$

$$\mu_0 = 4\pi \times 10^{-7} \frac{T \cdot m}{A}$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 N \cdot m^2/C^2$$