Equations

Special Relativity

$$\Delta t = \frac{\Delta t_p}{\sqrt{1 - v^2/c^2}} \qquad L = L_p\sqrt{1 - v^2/c^2}$$

$$\beta = \frac{v}{c} \qquad \gamma = \frac{1}{\sqrt{1-\beta^2}}$$

Bohr Model for Hydrogen

$$r_n = \frac{n^2\hbar^2}{m_e k_e e^2} = n^2 a_0$$

$$E_n = -\frac{m_e k_e^2 e^4}{2\hbar^2}\left(\frac{1}{n^2}\right) = -\frac{1}{n^2}E_1$$

$$\Delta E = \pm hf$$

Photons

$$E = hf \qquad c = f\lambda \qquad E = pc$$

Compton Scattering: $\Delta\lambda = \frac{h}{m_e c}(1 - \cos\theta)$

deBroglie Wavelength: $\lambda = \frac{h}{mv}$

Photoelectric Effect

$$hf = \phi + KE_{\max} \qquad \phi = hf_c$$

$$KE_{\max} = \frac{1}{2}mv_{\max}^2 = PE = eV_s$$

Heisenberg Uncertainty Principle

$$\Delta x \Delta p \geq \frac{h}{4\pi} \qquad \Delta E \Delta t \geq \frac{h}{4\pi}$$

Propagation of Uncertainties: $Y = \frac{AB}{C} \implies \frac{\Delta Y}{Y} = \frac{\Delta A}{A} + \frac{\Delta B}{B} + \frac{\Delta C}{C}$

Constants

$$k_e = 8.99 \times 10^9 \ \frac{\mathrm{N \cdot m^2}}{\mathrm{C^2}}$$

$$e = 1.60 \times 10^{-19}\ \mathrm{C}$$

$$\epsilon_\circ = 8.85 \times 10^{-12}\ \frac{\mathrm{C^2}}{\mathrm{N \cdot m^2}}$$

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

$$h = 6.63 \times 10^{-34}\ \mathrm{J \cdot s}$$

$$m_p = 1.67 \times 10^{-27}\ \mathrm{kg} \quad \text{(proton)}$$

$$m_e = 9.11 \times 10^{-31}\ \mathrm{kg} \quad \text{(electron)}$$

$$a_0 = 0.0529\ \mathrm{nm}$$

$$E_1 = 13.6\ \mathrm{eV}$$

$$1\ \mathrm{eV} = 1.60 \times 10^{-19}\ \mathrm{J}$$

$$\hbar \equiv \frac{h}{2\pi}$$