PHYSICS 232 – CHAPTER 38: PHOTONS, ELECTRONS AND ATOMS

Energy of a photon:

$$E = hf = \frac{hc}{\lambda}$$

Photoelectric effect (V_0 is stopping potential, ϕ is the work function):

$$eV_0 = hf - \phi$$

Electron in an atom going from energy level E_i to E_f:

$$hf = \frac{hc}{\lambda} = E_f - E_i$$

Energy levels of the H atom:

$$E_n = -\frac{me^4}{8h^2\epsilon_0^2 n^2} = -\frac{13.6\ eV}{n^2}$$

Bohr model:

$$L = mvr = n\frac{h}{2\pi} \quad r = n^2 a_0 \quad v = v_0/n$$

where $a_0 = \frac{\epsilon_0 h^2}{\pi m e^2} = 5.29 \times 10^{-11} m$, $v_0 = \frac{e^2}{2\epsilon_0 h} = 2.19 \times 10^6 m/s$.

X-rays produced by electron impact on a target:

$$eV_{AC} = hf_{max} = \frac{hc}{\lambda_{min}}$$

where V_{AC} is the electron accelerating potential.

Compton scattering:

$$\lambda' - \lambda = \frac{h}{mc}(1 - \cos\phi)$$

Stefan-Boltzmann law: intensity from blackbody

$$I = \sigma T^4 \quad \sigma = 5.67 \times 10^{-8} W/m^2 \cdot K^4$$

Wien displacement law: for maximum intensity,

$$\lambda T = 2.9 \times 10^{-3} m \cdot K$$

Planck radiation law: intensity per wavelength,

$$I(\lambda) = \frac{2\pi hc^2}{\lambda^5(e^{hc/\lambda kT} - 1)}$$