Chapter 30: The Nature of the Atom

Essential Concepts and Summary
Rutherford Scattering and Nuclear Atom

- Rutherford's gold-foil experiment discredited Thomson's plum-pudding model
- Nuclear atom: model in which positive nucleus surrounded by negative electrons
- Although planetary model is more correct than plum pudding, it still has serious flaws
Line Spectra

- Line Spectrum: series of fringes produced when low-pressure gas in sealed tube made to emit e/m waves via large potential difference
- Lyman, Balmer, and Paschen Series (in that order on the right)
- \( R \) is the Rydberg constant

\[
\frac{1}{\lambda} = R \left( \frac{1}{1^2} - \frac{1}{n^2} \right); n = 2, 3, 4, ...
\]

\[
\frac{1}{\lambda} = R \left( \frac{1}{2^2} - \frac{1}{n^2} \right); n = 3, 4, 5, ...
\]

\[
\frac{1}{\lambda} = R \left( \frac{1}{3^2} - \frac{1}{n^2} \right); n = 4, 5, 6, ...
\]

\[
R = 1.097 \times 10^7 \text{ m}^{-1}
\]
Bohr Model

- Works best for hydrogen and singly ionized atoms
- Assumes electrons are in circular, stationary orbits
- Photon is emitted when electron goes from higher to lower energy orbit
- Assumes angular momentum is quantized

\[ E_i - E_f = hf \]
\[ L_n = n \frac{\hbar}{2\pi}; n = 1, 2, 3, \ldots \]
\[ r_n = \left( 5.29 \times 10^{-11} m \right) \frac{n^2}{Z}; n = 1, 2, 3, \ldots \]
\[ E_n = -\left( 13.6 eV \right) \frac{Z^2}{n^2}; n = 1, 2, 3, \ldots \]
Visual References

http://www.geo.arizona.edu/xtal/nats101/s04-15.html