7.1 Outline

- Examine the wavelike properties of light (wavelength, frequency, and speed)
- Describe particle behavior of light in terms of quantized energy and photons
- Line spectra and the Bohr model
- Wave behavior of matter and Heisenberg's Uncertainty Principle
- Quantum mechanics and atomic orbitals
- Representations of orbitals and electron configurations

7.2 Electromagnetic Radiation

- Electromagnetic Radiation – A form of energy that has wave characteristics and that propagates throguh a vacuum at the characteristic speed of light 3.00×10^8 m/s.
- Most subatomic particles behave as PARTICLES
- A combination of an electric component and

7.3 Wavelength and Frequency

- Wavelength – the distance between two adjacent peaks or between two adjacent troughs.
- Frequency – the number of times per second that one complete wavelength passes a point.

7.4 Wavelength-Frequency Relationship

- All electromagnetic radiation moves at the same speed, specifically the speed of light. $c = 2.998 \times 10^8$ m/s.
- The inverse relationship

7.5 Common Frequency Unit

- Frequency is typically expressed in cycles per second, a unit also called a hertz (Hz). A hertz is equivalent to

7.6 Hot Objects

- Solids emit radiation when heated (referred to as *Blackbody radiation*).
- For example, a stove burner glows bright red, while the filament in a tungsten light bulb glows white.
- Hotter objects glow more white.
- Wavelength distribution of radiation clearly depends on temperature.

7.7 Quantization of Energy

- An object can gain or lose enegry by absorbing or emitting radiant energy in discrete QUANTA.
- **Energy of radiation is proportional to frequency**

$$E = h \times \nu \tag{7.1}$$

where $h = 6.626 \times 10^{-34} J \times s$ is Planck's constant

7.8 Photoelectric Effect

- Shining light on a clean metal surface causes electrons to be rejected.
- For example, cesium metal will emit electrons when irradiated by light with a frequency of 4.60×10^{14} Hz or greater. Electrons from cesium will not be ejected if lower frequencies are used.
- Einstein suggested that an incident stream of tiny energy packets (quanta) were responsible for causing electrons to be ejected from the metals surface.
- These discrete energy packets/particles are referred to as "photons".
- Once electrons were ejected, a current could be measured.