Light Energy, Quantum Numbers, and Periodic Trends

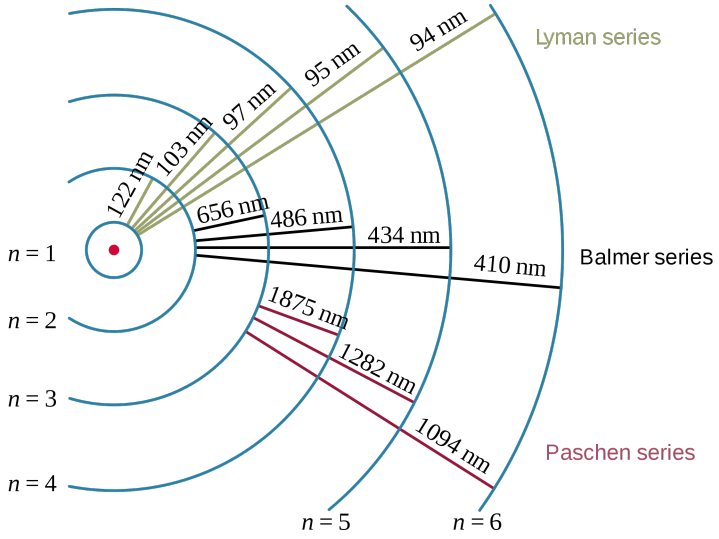
Nov 6, 2023

Light Energy and Bohr Model

1) Describe the Bohr Model. What is the model's limitation(s)?

2) Calculate the energy (E) and wavelength (λ) of a photon of light with a frequency (ν) of 6.165×10^{14} Hz. Compute the energy for a mole of photons.

3) For the hydrogen emissions and absorption, describe what regions of the electromagnetic radiation spectrum do the Lyman series, Balmer series, and Paschen series reside.



4) Another way to write the Rydberg equation is the following:

$$\Delta E = 2.18 \times 10^{-18}\ \text{J}\left(\frac{1}{n_i} - \frac{1}{n_f}\right) \tag{1}$$

Obtain the equation from the formula shown in class.

$$\frac{1}{\lambda} = 1.097 \times 10^{-2}\ \text{nm}\left(\frac{1}{n_i} - \frac{1}{n_f}\right) \tag{2}$$

5) An electron from a hydrogen atom emits a wavelength of 433 nm falling to $n = 2$. Determine what initial energy level n did the electron fall from.

6) Light with a frequency of is 2.1×10^{15} Hz incident on a metal whose work function is 7.21×10^{-19}. Determine the velocity of emitted electrons. (Hint: Kinetic energy is $\frac{1}{2}mv^2$ where m is the mass of electron 9.109×10^{31} kg and v is the velocity.)

7) For the classical and quantum pictures of light energy, describe the differences and similarities for emission and absorption. Draw a energy level diagram to illustrate this point.

Quantum Numbers and Electron Configuration

8) Define the Heisenberg Uncertainty principle.

9) For energy level $n = 4$, what values of l, m_l, and m_s are allowed?

10) Write the electron configurations both the long and shorthanded ways.

a) Ag

b) Pb

c) Hg

d) Ra

e) Yb

11) Draw the orbital diagram of Na and Cl satisfying the Aufbau principle and Hund's rule to fill the orbitals.

Periodic Trends

12) Describe why the atomic radius of a neutral atom shrinks going across the periodic table. Why does the atomic radius increase going down the column?

13) Describe the trend for electronegativity. Determine the following bonds are ionic or covalent based on the difference between electronegativity. Use the ptable website.

a) H-Cl

b) Na-Cl

c) O-H

d) O-F