Topic 12 Atomic Structure (HL)

Syllabus:

12.1 Electrons in atoms

In an emission spectrum, the limit of convergence at higher frequency corresponds to the first I.E

Trends in first I.E. across periods account for the existence of main energy levels and sub-levels in atoms

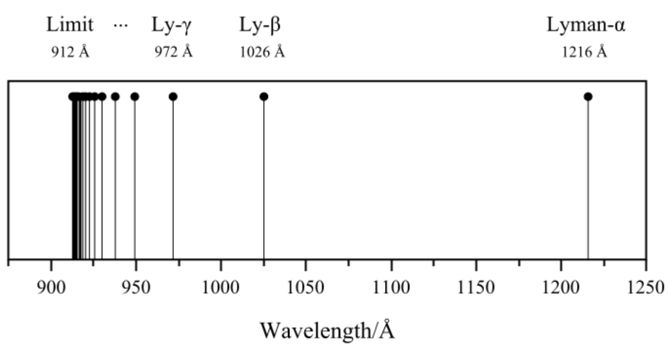
Successive I.E. data for an element give information that shows relations to electron configurations

12.1 Electrons in atoms

(A) Convergence limit and ionization energy

- The ionization energy of hydrogen can be calculated from the convergence limit of the Lyman series.
- The ionization energy of hydrogen is the energy required to remove the e^- from the hydrogen atom from ground state (n=1) to the infinity (n=∞).
- From the convergence limit, we can calculate the ionization energy of hydrogen using

  $$\mathbf{E = hv = h\frac{c}{\lambda}}$$



- **Example**

  Given that the wavelength of the convergence limit = 9.12×10^{-8} m, h = 6.626×10^{-34} Js, c = 2.998×10^{8} ms^{-1}

  Energy per photon = $h\frac{c}{\lambda}$ = (6.626×10^{-34} Js x 2.998×10^{8} ms^{-1})/ 9.12×10^{-8} m

  = 2.179×10^{-18} J

  Ionization energy per mole of H atom = 2.179×10^{-18} J x 6.022×10^{23} mol^{-1}

  = 1312 kJ mol^{-1}

- **Determine energy using E = hv = h$\frac{c}{\lambda}$**

  Key thing: 1nm = 10^{-9} m

  Find the energy, in kJ, of a photon of red light. Given that the wavelength is 650.0 nm.

  Energy = (6.626×10^{-34} Js x 2.998×10^{8} ms^{-1})/ (650.0×10^{-9}) m