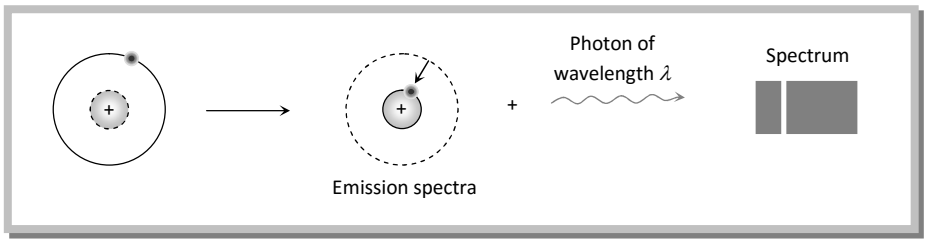
Hydrogen Spectrum and Spectral Series.

When hydrogen atom is excited, it returns to its normal unexcited (or ground state) state by emitting the energy it had absorbed earlier. This energy is given out by the atom in the form of radiations of different wavelengths as the electron jumps down from a higher to a lower orbit. Transition from different orbits cause different wavelengths, these constitute spectral series which are characteristic of the atom emitting them. When observed through a spectroscope, these radiations are imaged as sharp and straight vertical lines of a single color.



Spectral series

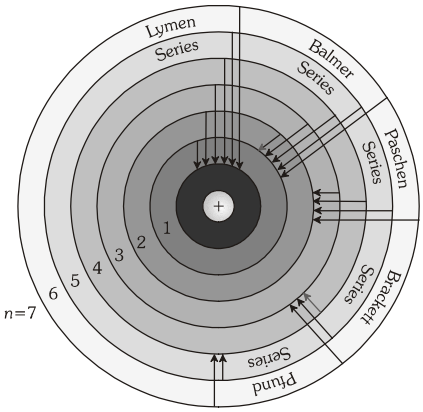
The spectral lines arising from the transition of electron forms a spectra series.

(i) Mainly there are five series and each series is named after it's discover as Lymen series, Balmer series, Paschen series, Bracket series and Pfund series.

(ii) According to the Bohr's theory the wavelength of the radiations emitted from hydrogen atom is given by

$$\frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

Where n2 = outer orbit (electron jumps from this orbit), n1 = inner orbit (electron falls in this orbit)



(iii) First line of the series is called first member, for this line wavelength is maximum (λmax)

(iv) Last line of the series ($n2 = \infty$) is called series limit, for this line wavelength is minimum (λmin)

Spectral series	Transition	Wavelength (λ) $= \frac{n_1^2 n_2^2}{(n_2^2 - n_1^2)R} = \frac{n_1^2}{\left(1 - \frac{n_1^2}{n_2^2}\right)R}$		$\frac{\lambda_{max}}{\lambda_{min}} = \frac{(n+1)^2}{(2n+1)}$	Region
		Maximum wavelength $(n_1 = n \text{ and } n_2 = n+1)$ $\lambda_{max} = \frac{n^2(n+1)^2}{(2n+1)R}$	Minimum wavelength $(n_2 = \infty, n_1 = n)$ $\lambda_{min} = \frac{n^2}{R}$		
1. Lymen series	n2 = 2, 3, 4 ...∞ n1 = 1	$\lambda_{max} = \frac{(1)^2(1+1)^2}{(2\times1+1)R} = \frac{4}{3R}$	n1 = n = 1 $\lambda_{min} = \frac{1}{R}$	$\frac{4}{3}$	Ultraviolet region
2.Balmer series	n2 = 3, 4, 5 ...∞ n1 = 2	n1 = n = 2, n2 = 2 + 1 = 3 $\lambda_{max} = \frac{36}{5R}$	$\lambda_{min} = \frac{4}{R}$	$\frac{9}{5}$	Visible region
3. Paschen series	n2 = 4, 5, 6 ...∞ n1 = 3	n1 = n = 3, n2 = 3 + 1 = 4 $\lambda_{max} = \frac{144}{7R}$	n1 = n = 3 $\lambda_{min} = \frac{9}{R}$	$\frac{16}{7}$	Infrared region
4. Bracket series	n2 = 5, 6, 7 ... ∞ n1 = 4	n1 = n = 4, n2 = 4 + 1 = 5 $\lambda_{max} = \frac{400}{9R}$	n1 = n = 4 $\lambda_{min} = \frac{16}{R}$	$\frac{25}{9}$	Infrared region
5. Pfund	n2 = 6, 7, 8 ...	n1 = λ = 5, n2 = 5 + 1	$\lambda_{min} = \frac{25}{R}$	$\frac{36}{11}$	Infrared

series	∞ n1 = 5	= 6 $\lambda_{\max} = \frac{900}{11R}$			region