

8.282 - Spectroscopic Notation

The attached Figure represents an energy level diagram for the hydrogen atom. The principal quantum number n associated with each energy level is shown, as well as the corresponding energy. Selected spectral lines associated with four series of transitions are also shown. A particular series is defined by the energy level n to which the electron makes a transition. Transitions to levels 1, 2, 3, and 4 are designated Lyman, Balmer, Paschen, and Brackett series, respectively. Each series merits its own name because of the central role that hydrogen played in helping to unravel the basic nature of spectral lines in particular, and quantum mechanics, in general. Transitions from $n+1$ to n are further labelled with α ; $n+2 \rightarrow n$ with β ; $n+3 \rightarrow n$ with γ ; etc.

Spectral lines of heavier elements are sometimes designated with the letters K, L, M, N... for lines associated with transitions to levels with principal quantum numbers $n=1, 2, 3, 4, \dots$, respectively. The $\alpha, \beta, \gamma, \dots$ designation still refers to values for the change in n equal to 1, 2, 3..., respectively.

Example 1: Fe K α

Transition in the element iron (Fe) to the $n=1$ level (K $\Rightarrow n=1$) from the $n=2$ level ($\alpha \Rightarrow \Delta n=1$).

Example 2: Pb L β

Transition in the element lead (Pb) to the $n=2$ level (L $\Rightarrow n=2$) from the $n=4$ level ($\beta \Rightarrow \Delta n=2$).

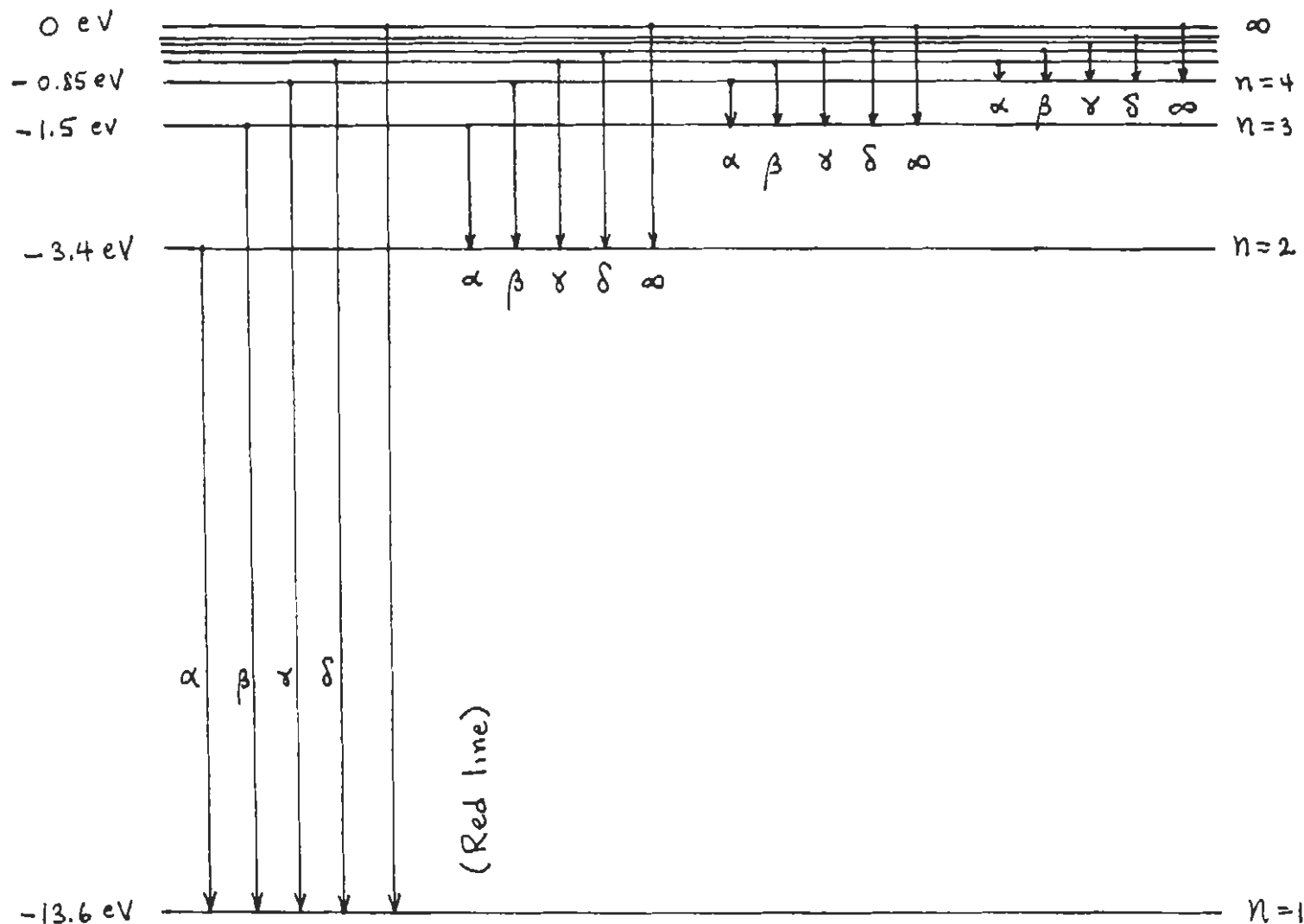
Hydrogen Spectrum

$$E_n = -13.605 \text{ eV}/n^2$$

Bohr energy levels

$$\Delta E_{n' \rightarrow n} = 13.605 \text{ eV} \left[\frac{1}{n^2} - \frac{1}{n'^2} \right]$$

$$E_n \quad \frac{1}{\lambda_{n' \rightarrow n}} = \frac{1}{911.76 \text{ \AA}} \left[\frac{1}{n^2} - \frac{1}{n'^2} \right] \quad \text{Balmer formula}$$



(Red line)

Vacuum Wavelengths

1216 \AA 1026 \AA 973 \AA 950 \AA 912 \AA	6565 \AA 4863 \AA 4342 \AA 4103 \AA 3647 \AA	$18,756 \text{ \AA}$ $12,822 \text{ \AA}$ $10,941 \text{ \AA}$ $10,052 \text{ \AA}$ $8,206 \text{ \AA}$	$40,523 \text{ \AA}$ $26,259 \text{ \AA}$ $21,661 \text{ \AA}$ $19,451 \text{ \AA}$ $14,588 \text{ \AA}$
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Lyman (1906) Series (Ultraviolet)
Balmer (1885) Series
Paschen (1908) Series (Infrared)
Brackett (1922) Series

Also called $H\alpha, H\beta, H\gamma \dots$