am-que-16002

The wavelengths of light emitted in a transition from level n_2 to level $n_1 < n_2$ is given by

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) \qquad R \text{ in } cm^{-1}$$

Lyman series $n_1 = 1$ $n_2 = 2, 3, \ldots$

$$\lambda = R\frac{n_2^2}{n_2^2 - 1}$$

Using given experimental numbers

$n_2 = 2$ $\quad 1215.68 \times 10^{-8} = \frac{1}{R}\frac{4}{3} \Rightarrow R = 109677.9554\ cm^{-1}$

$n_2 = 3$ $\quad 1025.83 \times 10^{-8} = \frac{1}{R}\frac{9}{8} \Rightarrow R = 109667.2938\ cm^{-1}$

$n_2 = 4$ $\quad 972.54 \times 10^{-8} = \frac{1}{R}\frac{16}{15} \Rightarrow R = 109678.4365\ cm^{-1}$

Average value of $R = 109674.5719$

At this stage one must decide the accuracy to be used for values of R. It is decided by the accuracy in the input values of λ i.e. 1 part in 10^6.

$\therefore$ We take $R \simeq 109674.6$ ← not really very accurate

(Keeping 7 significant digits)

Use this above value of R to compute values of wavelengths for other lines.

Lyman series $\lambda = \frac{1}{R}\frac{n^2}{(n^2-1)}$ $n = 2,3,4\cdots$

Balmer series $\lambda = \frac{1}{R}\frac{4n^2}{n^2-4}$ $n = 3,4,5,\cdots$

Ritz Paschen series $\lambda = \frac{1}{R}\frac{9n^2}{n^2-9}$ $n = 4,5,6,\cdots$

Brakot-series $\lambda = \frac{1}{R}\frac{16n^2}{n^2-16}$ $n = 5,6,7$

The calculated and experimental values are

Lyman series

n	cal	Exp
5	949.78	
6	937.84	

Balmer Series

n	Cal	Exp
3	6564.87	6562.79
4	4862.87	4861.33
5	4341.84	4340.17
6	4103.04	4101.74
7	3971.34	3970.07
8	3890.30	3889.05
9	3836.61	3835.39
10	3799.12	3797.90
11	3771.84	3770.63

Ritz Paschen Series

n	Cal	Exp
4	18756.8	18751.1
5	12822.0	12818.1
6	10941.4	10938

Bracket Series

n	Cal	Exp
5	4.05μ	4.05μ
6	2.62μ	2.63μ

Conclusions The calculated wavelengths agree with the experimental values apart from small differences of the order of 1A° to 2°A in Balmer series and about 4-5A° in Ritz Paschen Series.

Remarks These differences are outside the experimental errors in the observed values.