

84

G.36

$$V = \frac{me^4}{64\pi^3\epsilon_0^2\hbar^3} \left(\frac{1}{n_2^2} - \frac{1}{n_1^2} \right) = R_\infty \left(\frac{1}{n_2^2} - \frac{1}{n_1^2} \right)$$

$$E_n = -\frac{me^4}{32\pi^2\epsilon_0^2\hbar^2} \frac{Z^2}{n^2} = \cancel{2\pi^2\hbar^2} \left(\frac{R_\infty}{n^2} \right)$$

\Rightarrow Energy $\propto \left(\frac{Z}{n} \right)^2$

if $z_{eff} = Z-1$

so V becomes

~~$$V = CR_\infty$$~~

$$V = CR_\infty \left(\frac{Z^2}{n_2^2} - \frac{Z^2}{n_1^2} \right)$$

let $Z = z_{eff} = Z-1$

$$V = CR_\infty (Z-1)^2 \left(\frac{1}{n_2^2} - \frac{1}{n_1^2} \right)$$

~~Let $n_2 = \infty$ $n_1 =$~~

$$k_2 \Rightarrow \begin{cases} n_2 = 1 \\ n_1 = 2 \end{cases}$$

so

$$V = CR_\infty (Z-1)^2 \left(\frac{1}{1^2} - \frac{1}{2^2} \right)$$

$$= CR_\infty (Z-1)^2 \left(\frac{3}{4} \right)$$

For the most of hydrogen spectrum, we have $n_2 = \infty$ and $n_1 = 1, 2, 3, \dots$. For the Lyman series, $n_1 = 1$ and $n_2 = 2, 3, 4, \dots$. For the Balmer series, $n_1 = 2$ and $n_2 = 3, 4, 5, \dots$. For the Paschen series, $n_1 = 3$ and $n_2 = 4, 5, 6, \dots$. For the Brackett series, $n_1 = 4$ and $n_2 = 5, 6, 7, \dots$. For the Pfund series, $n_1 = 5$ and $n_2 = 6, 7, 8, \dots$. For the Humphreys series, $n_1 = 6$ and $n_2 = 7, 8, 9, \dots$. For the Rydberg series, $n_1 = \infty$ and $n_2 = \infty$. For the Lyman series, $n_1 = 1$ and $n_2 = 2, 3, 4, \dots$. For the Balmer series, $n_1 = 2$ and $n_2 = 3, 4, 5, \dots$. For the Paschen series, $n_1 = 3$ and $n_2 = 4, 5, 6, \dots$. For the Brackett series, $n_1 = 4$ and $n_2 = 5, 6, 7, \dots$. For the Pfund series, $n_1 = 5$ and $n_2 = 6, 7, 8, \dots$. For the Humphreys series, $n_1 = 6$ and $n_2 = 7, 8, 9, \dots$. For the Rydberg series, $n_1 = \infty$ and $n_2 = \infty$.