Sem 2 (2009/2010) : Quantum Theory

Q1(b) Two strengths of Bohr's atomic model

(i) It matches the observed spectrum of hydrogen gas

(ii) the model can be used for one-electron species.

Two weakness of Bohr's atomic model

(i) the model cannot be used for atoms with more than one electron.

(ii) No reasons were given by Bohr as to why those states with quantized angular momentum were stationary

OR -

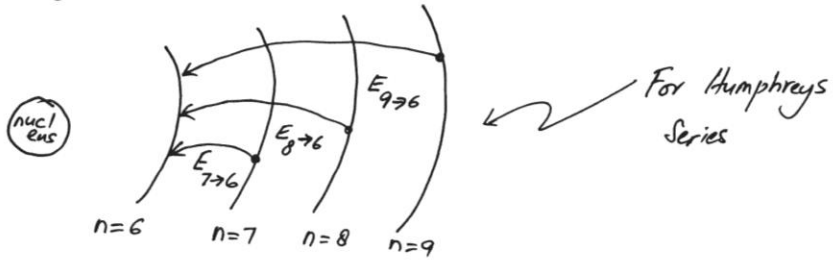
It cannot be used to understand molecular structure.

Sem 2 : 2009/2010 : Q1c

Sem 2 (2009/10) : Quantum Theory

Q1 (c) Lyman Series ($n_f = 1$) ; Balmer Series ($n_f = 2$) ; Paschen Series ($n_f = 3$)

Humphreys Series ($n_f = 6$: ie 5th excited state)



$E_7 - E_6$: corresponds to lowest-energy spectral line

$E_8 - E_6$: " " second lowest-energy spectral line

$E_9 - E_6$: " " third lowest-energy spectral line

Given : $\nu = 5.08 \times 10^{13}\ Hz$

$$\therefore \lambda = \frac{c}{\nu} = \frac{3\times10^{8}\ m s^{-1}}{5.08\times10^{13}\ Hz} = 5.906\times10^{-6}\ m$$

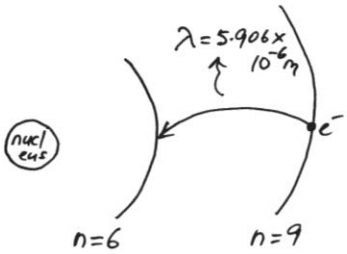
$$\frac{1}{\lambda} = R_H\left[\frac{1}{6^2} - \frac{1}{n^2}\right]$$

$$\left(\frac{1}{5.906\times10^{-6}\ m}\right) = (1.09678\times10^{7}\ m^{-1})\left(\frac{1}{36} - \frac{1}{n^2}\right)$$

$$0.01543 = 0.02778 - \frac{1}{n^2}$$

$$n^2 = 81$$

$\therefore n = 9$ (Ans) ← Corresponds to the 3rd lowest-energy spectral line



(Humphreys Series)

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