Problem-solving Example 16

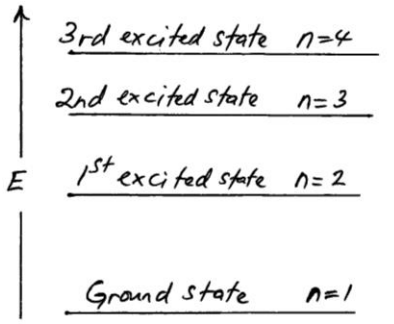
Consider two different hydrogen atoms.
The electron of the first hydrogen atom is at Bohr orbit of $n=1$
The electron of the second hydrogen atom is at Bohr orbit of $n=4$

a) which atom is at its ground state?
b) which atom is at excited state & which excited state?
c) In which hydrogen atom, the electron moves faster?
d) which hydrogen atom require highest energy to remove its electron to infinity.

Solution

a) Ground state when $n=1$: the first hydrogen atom is at its ground state (most stable state)

b) $n=4$ is 3rd excited state.
So the second hydrogen atom is at third excited state.



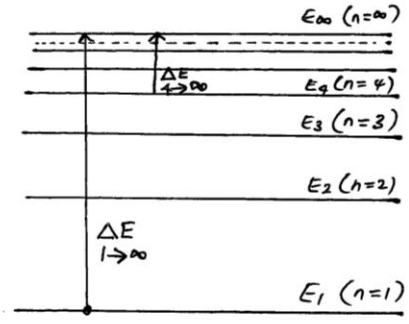
c) First Bohr postulate :

$$mvr_n = n\frac{h}{2\pi}$$

or $$v = \frac{nh}{2\pi m r_n}$$

So $$v \propto \frac{1}{r_n}$$

When r_n is small; v is large (more faster)
Thus the electron is $n=1$ (ground state) of the first hydrogen atom moves faster



d) The first hydrogen atom require higher energy to remove the electron to infinity.

$$(E_\infty - E_1) > (E_\infty - E_4)$$

to remove electron from $n=1$ to $n=\infty$

to remove electron from $n=4$ to $n=\infty$

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