SUMMARY of Bohr Formula

Summary:

Two basic quantities by Bohr for hydrogen atom (single electron)

1. Radius, r_n of the n-th Bohr orbit:

in SI unit.

$$r_n = \frac{n^2 h^2 \epsilon_0}{\pi e^2 m} \quad \text{where } \epsilon_0 = 8.84 \times 10^{-12} N^{-1} m^{-2} C^2$$

or $r_n = a_0 n^2$ where a_0 = first Bohr radius.
$= 0.529\ \mathring{A}$

2. Energy, $E_n = -\dfrac{e^2}{8\pi \epsilon_0 r_n}$

or $E_n = -\dfrac{e^4 m}{8 \epsilon_0^2 h^2 n^2}$

or $E_n = -\dfrac{e^2}{8\pi \epsilon_0 n^2 a_0}$

$m = 9.1098 \times 10^{-31}$ kg
$e = -1.60217 \times 10^{-19}$ C
$h = 6.626 \times 10^{-34}$ Js
$n = 1, 2, 3 \ldots$

ENERGY DIFFERENCE, ΔE

$$\Delta E = \frac{e^4 m}{8 \epsilon_0^2 h^2}\left[\frac{1}{n_x^2} - \frac{1}{n_y^2}\right] \quad \text{OR} \quad \Delta E = \frac{e^2}{8\pi \epsilon_0 a_0}\left[\frac{1}{n_x^2} - \frac{1}{n_y^2}\right]$$

After substitution:

in terms of energy

$$\Delta E = (2.178 \times 10^{-18} J)\left[\frac{1}{n_x^2} - \frac{1}{n_y^2}\right]$$

$\Delta E = hc\bar{\nu}$
$\Delta E = h\nu$

in terms of wavelength

$$\frac{1}{\lambda} = \bar{\nu} = (109\,678\ cm^{-1})\left[\frac{1}{n_x^2} - \frac{1}{n_y^2}\right]$$

or

$$\bar{\nu} = (1.1 \times 10^7 m^{-1})\left[\frac{1}{n_x^2} - \frac{1}{n_y^2}\right]$$

in terms of frequency

$$\nu = (3.29 \times 10^{15} Hz)\left[\frac{1}{n_x^2} - \frac{1}{n_y^2}\right]$$

Prepared by
V.Manoharan
vmano@usm.my
manovv1955@yahoo.com
04-6533888 ext 3566