

## Answer on Question #55649 - Chemistry - General chemistry

### Question:

Find the ratio of de Broglie wavelength in first and third excited state of H atom.

### Answer:

The energy of the electronic level of hydrogen is defined by the equation:

$E_n = -13.6/n^2$ , where  $n$  – the number of level and  $E_n$  – the energy in eV.

Thus, for the first excited state,  $n = 2$  and  $E_2 = -13.6/4 = -3.4$  eV

For the third one,  $n = 4$  and  $E_4 = -13.6/16 = -0.85$  eV

The velocities of electron are found from the equation for kinetic energy:

$E_n = mv_n^2/2$ , where  $m$  – the mass of electron.

$$v_n^2 = 2 E_n/m$$

$$v_n = (2 E_n/m)^{0.5}$$

According to de Broglie's equation the electron can be considered as a wave with the following wavelength:

$\lambda_n = h/(mv_n)$ , where  $h$  – Plank's constant and  $v_n$  – the velocity of electron.

Finally,

the ratio of the wavelength is determined:

$$(\lambda_4/\lambda_2) = v_2/v_4 = (E_2/E_4)^{0.5} = [-3.4/(-0.85)]^{0.5} = 2$$