

Question 4. An electron in a hydrogen atom undergoes a transition from an orbit with quantum number n_i to another with quantum number n_f . V_i and V_f are respectively the initial and final potential energies of the electron. If $V_i / V_f = 6.25$, then the smallest possible n_f .

Solution: (5)

The potential energy of an electron in Bohr's model is given by (assuming Coulombic force)

$$U = -Kze^2 / r$$

Where, r = radius

& radius for Bohr's orbital (for mono-electronic system) $= 0.529 n^2 / z$

$$\text{so, } U_i / U_f = r_f / r_i = n_i^2 / n_f^2 \dots (1)$$

As, given $n_i / n_f = 6.25$

By comparing the above equation and equation (1).

$$n_i / n_f = \sqrt{6.25}$$

$$n_i / n_f = 2.5$$

$$\text{So, } n_i / n_f = 5 / 2$$

It can be written as,

$$n_i = 5 n_f / 2$$

so the final value of $n_f = 5$.