DPP 02

SOLUTION

1. Total energy gained by the atom will be 25.2eV.

   13.6eV energy is needed to remove the electron from the orbit.

   Remaining energy will be almost available in the form of KE of electron.

   One electron of 11.6eV will be detected.

2. For shortest wavelength in Balmer series, $n_1 = 2; n_2 = \infty$

   $\therefore \ \frac{1}{\lambda} = R\left[\frac{1}{4} - \frac{1}{\infty}\right]$ or $\lambda = \frac{4}{R}$

   For shortest wavelength in Brackett series, $n_1 = 4; n_2 = \infty$

   $$\therefore \ \frac{1}{\lambda'} = R\left[\frac{1}{4^2} - \frac{1}{\infty^2}\right]$$

   or $\lambda' = \frac{16}{R} = 4 \times \frac{4}{R} = 4\lambda$

3. As the collision is inelastic, that means some part of kinetic energy is converted into some other form due to collision. In this case, the KE of incident electron can be absorbed by H atom and it can absorb only 10.2eV out of 11.2eV, so that it can reach to 1^{st} excited state and the electron leaves with remaining energy, i.e., 1.0eV.

4. For a collision of neutron with hydrogen atom in ground state to be inelastic (partial or complete), the minimum KE of striking neutron must be 20.4eV. [This condition is derived in theory.] As the energy of the given incident neutron is less than 2.4eV, the collision must be elastic.

5. The energy gained by hydrogen atom corresponds to its transition from $n = 1$ to $n = 3$ state.

   $$\Delta E = 13.6\left(1 - \frac{1}{9}\right) = 13.6 \times \frac{8}{9} = 12.1\text{eV}$$

6. Wavelength emitted by photon during its transition

   $$= \frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right); n_1 = 1, n_2 = n$$

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

   $$\frac{1}{n^2} = 1 - \frac{1}{\lambda R} = \frac{\lambda R - 1}{\lambda R}; n^2 = \frac{\lambda R}{\lambda R - 1}$$

   $$\therefore n = \sqrt{\frac{\lambda R}{\lambda R - 1}}$$

7. As per classical atomic model, Rutherford's model collapse because in Rutherford's model, the electron revolves around the nucleus and release energy and finally fall into the nucleus.

8. When electron transit to a higher level, the KE decreases, while potential energy and total energy increases.

9. Mass of Muon,

$\bar{M}_{\mu} = 207 \times \text{mass of electron} = 207 \times m_e$

Charge on moon, $q_{\mu} = \text{Charge on}$

$\text{electron} = q_e$

Ionization energy of hydrogen atom $= +13.6\text{eV}$. If electron is replaced by muon, then,

New ionization energy would be, $E = \frac{-13.6 M_{\mu}}{M_e}$

So, new ionization energy $= 13.6 \times 207 = 2815.2\text{eV}$

So, new ionization potential would be $= 2815.2\text{ V}$