A hydrogen atom in a state of binding energy 0.85 eV makes a transition to a state of excitation energy of 10.2 eV.

a. What is the initial state of the hydrogen atom?

b. What is the final state of the hydrogen atom?

c. What is the wavelength of the photon emitted?

3. a. Let n_1 be the initial state of electron. Then,

$$E_1 = -\frac{13.6}{n_1^2}\text{eV}$$

Here, $E_1 = -0.85$ eV

$$\therefore \quad -0.85 = -\frac{13.6}{n_1^2}$$

or $\quad n_1 = 4$

b. Let n_2 be the final excitation state of the electron. Since excitation energy is always measured with respect to the ground state, therefore

$$\Delta E = 13.6\left[1 - \frac{1}{n_2^2}\right]$$

Here, $\Delta E = 10.2$ eV

$$\therefore \quad 10.2 = 13.6\left[1 - \frac{1}{n_2^2}\right]$$

or $\quad n_2 = 2$

Thus, the electron jumps from $n_1 = 4$ to $n_2 = 2$.

c. The wavelength of the photon emitted for a transition between $n_1 = 4$ to $n_2 = 2$, is given by

$$\frac{1}{\lambda} = R_\infty\left[\frac{1}{n_2^2} - \frac{1}{n_1^2}\right]$$

$$\frac{1}{\lambda} = 1.09 \times 10^7\left[\frac{1}{2^2} - \frac{1}{4^2}\right]$$

$$\lambda = 4860 \text{ Å}$$