(a) Find the wavelength of the radiation required to excite the electron in Li^{++} from the first to the third Bohr orbit.
(b) How many spectral lines are observed in the emission spectrum of the above excited system ?

Solution : (a) The energy in the first orbit $= E_1 = Z^2 E_0$ where $E_0 = -13{\cdot}6$ eV is the energy of a hydrogen atom in ground state. Thus for Li^{++},

$$E_1 = 9E_0 = 9 \times (-13{\cdot}6 \text{ eV}).$$

The energy in the third orbit is

$$E_3 = \frac{E_1}{n^2} = \frac{E_1}{9} = -13{\cdot}6 \text{ eV}.$$

Thus, $E_3 - E_1 = 8 \times 13{\cdot}6 \text{ eV} = 108{\cdot}8 \text{ eV}.$

The wavelength of radiation required to excite Li^{++} from the first orbit to the third orbit is given by

$$\frac{hc}{\lambda} = E_3 - E_1$$

or,
$$\lambda = \frac{hc}{E_3 - E_1}$$

$$= \frac{1242 \text{ eV nm}}{108{\cdot}8 \text{ eV}} \approx 11{\cdot}4 \text{ nm}.$$

(b) The spectral lines emitted are due to the transitions $n = 3 \rightarrow n = 2$, $n = 3 \rightarrow n = 1$ and $n = 2 \rightarrow n = 1$. Thus, there will be three spectral lines in the spectrum.