15. Calculate the frequency, energy and wavelength of the radiation corresponding to the spectral line of lowest frequency in Lyman series in the spectra of H atom. Also calculate the energy for the corresponding line in the spectra of Li^{2+}

($R_H = 1.09678 \times 10^7\ m^{-1}$, $c = 3 \times 10^8\ ms^{-1}$, $h = 6.625 \times 10^{-34}\ Js$)

Sol. $$\frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$= R_H\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{3}{4}R_H$$

$$\lambda = \frac{4}{3R_H} = \frac{4}{3} \times \frac{1}{1.09678 \times 10^7\ m^{-1}} = 1.216 \times 10^{-7}\ m$$

$$v = \frac{c}{\lambda} = \frac{3 \times 10^8\ ms^{-1}}{1.216 \times 10^{-7}\ m}$$

$$= 2.47 \times 10^{15}\ s^{-1}$$

$$E = h\upsilon = 6.625 \times 10^{-34}\ Js \times 2.47 \times 10^{15}\ s^{-1} = 16.36 \times 10^{-19}\ J$$

$$E_{Li^{2+}} = Z^2 \times E_H = 3^2 \times 16.36 \times 10^{-19}\ J$$

$$= 147.24 \times 10^{-19}\ J$$