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Problem 52.6 (RHK)

The wavelength of the K_α *line from iron is* 19.3 pm. (a) *We have to find the energy difference between the two states of the iron atom that give rise to this transition*. (b) *We have to find the corresponding energy difference for the hydrogen atom. We have to explain why the difference is so much greater for iron than for hydrogen*.

Solution:

The wavelength of the K_α line from iron is 19.3 pm. Therefore, the energy difference between the two states of the iron atom that give rise to this transition will be

$$E_K - E_L = \frac{1240}{19.3} \text{ keV}$$
$$= 64.25 \text{ keV}.$$

The corresponding energy levels of hydrogen atom have principal quantum number $n = 1$, and $n = 2$, respectively. The energy difference of the corresponding energy levels of the hydrogen atom therefore is

$$\Delta E = 13.6\left(\frac{1}{1^2} - \frac{1}{2^2}\right) \text{ eV}$$

$$= 10.2 \text{ eV}.$$

(b)

The difference in energy of the K_α transition in iron and the corresponding transition in the hydrogen atom is that the atomic number of iron is 26 and that of hydrogen is 1. Therefore, the energy of the K_α transition in iron will be of the order 26^2 times 10.2 eV, the energy of the corresponding transition of the hydrogen atom.