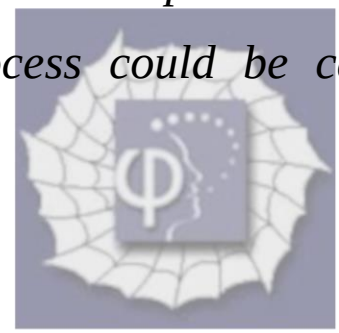
718.

Problem 49.46 (RHK)

To remove an inner, most tightly bound, electron from an atom of molybdenum requires energy of 20 keV. *If this is to be done by allowing a photon to strike the atom, we have to find* (a) *the associate wavelength of the photon*; (b) *identify the region of the electromagnetic spectrum in which the photon lies*; (c) *and answer whether this process could be called a photoelectric effect.*



Solution:

(a)

Wavelength λ corresponding to a photon that has energy of 20 keV required for making free the most tightly bound electron from a molybdenum atom can be found from the relation

$$\frac{hc}{\lambda} = 20\times10^{3}\times1.6\times10^{-19}\ \text{J}$$

$$= 3.2\times10^{-15}\ \text{J},$$

or

$$\lambda = \frac{6.63\times10^{-34}\times3\times10^{8}}{3.2\times10^{-15}}\ \text{m} = 6.22\times10^{-11}\ \text{m} = 0.622\ \text{pm}.$$

(b)

As the wavelength of the photon required for removing the most tightly bound electron of a molybdenum atom is of the order of pm, it lies in the x-ray region of the electromagnetic spectrum.

(c)

In photoelectric effect a free electron is emitted from a metal surface by absorbing energy from a photon, the recoil momentum is shared by the lattice to which electron is weakly linked. On the other hand when a tightly bound electron is emitted from an atom, the recoil momentum is taken by the ionised atom.