Tutorial series N 4

Exercise 1

1. Photoelectric threshold

A photovoltaic cell with a cesium cathode is illuminated with a wavelength λ=495 nm and then with radiation of wavelength λ=720 nm. The extraction energy of a cesium electron is $E0=3.00.10^{-19}$ J

a. Calculate the wavelength λ_0 corresponding to the photoelectric threshold.

b. Verify that photoelectric emission exists with only one of the two previous radiations.

2. Electron emission velocity

A vacuum photocell is illuminated with monochromatic light. The energy of extraction of an electron from the cathode metal is $E0=3.00.10^{-19}$ J . The wavelength of the radiation is 600 nm a. What is the maximum kinetic energy E_c(max) of an emitted electron?

b. What is the maximum velocity Vmax of an emitted electron?

Exercise 2

Monochromatic radiation with a frequency of $9.12\ 10^{14}\ s^{-1}$ is shone on a hydrogen atom (H) already excited at the n= 2 level. Is the energy of the radiation sufficient to pull the electron out of the H atom? Calculate the speed of the ejected electron.

Exercise 3

The energy levels of the hydrogen atom have the following value in eV: $E_n = -13.6 / n^2$.

What is the wavelength of the emitted λ produced during de-excitation from the E_4 level to the E_2 level? To which domain does this radiation belong?

$h = 6{,}626 . 10^{-34}$ J.s ; $c = 3{,}00 . 10^{8}$ m.s^{-1} ; 1,00 eV = $1{,}60 . 10^{-19}$ J.

Exercise 4

1. Calculate (by two methods) the energy of photons emitted in transitions between the following energy levels:

4➔1,

5➔2,

3➔1,

2. Calculate the ionization energy of a level 5 electron.

Exercise 5

Which of this series of quantum numbers {n, ℓ, mℓ, ms} are possible and which are not allowed?

a. {3, 2, 1, +1/2}

b. {2, 2, 0, -1/2}

c. {3, -1, 0, +1/2}

d. {4, 2, −2, 1}

e. {3, 1, 0, −1/2}