University of Tlemcen *Academic year 2025-2026*
Faculty of technology *ST Engineer*
Science and technology Department

Tutorial Series N°3

Exercise 1

1-Determine the wavelength of radiation:

a/ Visible frequency ν_1 = 500TH,

b/ infrared Frequency ν_2 = 1THz,

c/γ frequency ν_3 = 500 EHz

2-Calculate, in joules and electronvolts, the energies of the photons corresponding to the above frequencies.

3-Compare the order of magnitude of the energies of γ and visible photons. Conclusion.

4-The yellow line in the spectrum of a sodium vapour lamp has a frequency of $5{,}08.10^{14}s^{-1}$. Calculate: The wavelength of the line and the associated wave number

5-Calculate the wavelengths of the traffic lights, assuming that they emit the frequencies: green ($5{,}75.10^{14}$Hz) ; orange ($5{,}15.10^{14}$Hz) and red ($4{,}27.10^{14}$Hz).

6-What is the wavelength of a radio station transmitting at 98,4MHz?

Data *: $c=3.10^8 m.s^{-1}$; 1EHz = 10^{18}Hz ; 1THz = 10^{12}Hz ; $h=6.025.10^{-34}$J.s ; 1eV = $1{,}602.10^{-19}$J.*

EXERCISE 2

Applying the Bohr model to the hydrogen atom, calculate:

1-the energy required to move the electron from the ground state to the 3rd excited state.

2-the frequency of the emitted radiation when the electron transitions from the 3rd excited state to the 2nd excited state.

3-the wavelength required to ionize the electron from the 3rd excited state.

Exercise 3

The spectrum of hydrogen can be broken down into several series. We will confine ourselves here to the first three series by: Lyman, Balmer and Paschen.

1-What is the general expression for the wavelength of a light line?

2- The lines in each series are framed by two lines of wavelength λ_1 and λ_{lim} respectively. What do these two lines correspond to?

3- Calculate λ_1 and λ_{lim} for these 3 first series.

Data : $\mathbf{R_H}$ = 1,096 10^7 m^{-1}

Exercise 4

One of the lines of the Paschen series in the emission spectrum of hydrogen atom has a wavelength = 18750 Å

To which electron transition does this line correspond?

DATA: E_1=-13,6 EV; h = 6,62 10^{-34} J.S, 1EV=1,6 10^{-19} J.

Exercise 5

For the hydrogen atom, the energy for the electron in the ground state is -13.6ev

1-What is the smallest energy it must absorb to reach the first excited state?

2-the wavelength of line in Balmer series for the hydrogen emission spectrum is 486.18 nm.

a-in which rang of the electromagnetic spectrum is this series located?

b-which transition does this line correspond to?

Data: h= 6.62 10^{-34} J.s ; R_H = 1.1 10^7 m^{-1}

EXERCISE 6

A caesium photoelectric cell is successively illuminated by two radiations of frequencies ν_1= $42857.10^{10}s^{-1}$ and ν_2=$55556.10^{10}s^{-1}$. The extraction energy of an electron from this metal is E_0=3.10^{-19}J.

1- Calculate the threshold frequency ν_0.

2- When there is a photoelectric effect?

3- If there is a photoelectric effect, calculate the maximum speed of the electrons stripped from the metal.

4- Calculate the stopping potential in this case.

Data : *m_e=$9,1.10^{-31}$Kg ; h=$6.025.10^{-34}$J.s ; c=3.10^8m.s^{-1}.*

Exercise 7

1-Give the definition of a hydrogen like atom.

2-A hydrogen like atom is experimentally created from a lithium gas (Z=3) subjected to light radiation. What is the hydrogen like atom obtained?

a-Calculate the energy of the first excitation for this ion.

b-Deduce the corresponding wavelength.

c-Calculate the ionisation energy of this atom.

d-Calculate the wavelength corresponding to this transition.

e-To which area of the electromagnetic spectrum do these two wavelengths belong?

Data : h=6.62 10^{-34} J.s R_H= 1.097 10^7m^{-1} C=3 10^8m/s E_0= - 13.6eV 1e.v=1.602 10^{-19}J

EXERCISE 8

Consider the hydrogen like atom Be^{3+} (Z=4). The shortest wavelength line in its spectrum is at 57,3Å.

1) What transition does it correspond to?,

2) Calculate the corresponding energy.

3) Bohr's theory can be used to calculate the energy of the first ionisation of beryllium?

EXERCISE 9

1-When the electron of the helium atom is at the n=1 level, its first ionisation energy is 54,4eV. What is the energy of the fundamental level?

2-A helium atom is in an excited state. One of its electrons is then at the energy level equal to -13,6 eV. What is the wavelength of the radiation emitted when this electron falls back to the fundamental level?

1e.v=1.602 10^{-19}J

Exercise 10

A/1- Calculate the De Broglie wavelength associated with a proton travelling at speed 1.0 x 10^5 m/s. m_p= 1.67 x 10^{-27} kg.

2. A rifle bullet weighs 5g. Calculate the De Broglie wavelength associated, given that it travels through the air at 1930 km.h^{-1}. Conclude.

B/1- What is the error in the velocity of the electron in the hydrogen atom if we know its position r (order of the Bohr radius) to within 0.5%? Conclusion ? Similarly, what error do you get in the speed of a 30,000 kg lorry travelling at 72 km/h if you know its position to within 1 mm? Conclusion? We give the speed of the electron on the first Bohr orbit v = 2,189.10^6 m/s