Evaluation

Exercise 01

1. A light is monochromatic if it contains only one radiation of a given wavelength λ.
   True ☐ False ☐
2. The absorbance of a sample, denoted as A, is a dimensionless quantity.
   True ☐ False ☐
3. The color of a solution is the complementary color of the radiations absorbed by the solution.
   True ☐ False ☐
4. In an IR spectrum, the strong absorption band located between 3200 cm^{-1} and 3400 cm^{-1} is due to the C-O bond.
   True ☐ False ☐

Exercise 02

Choose the correct answer(s) in each case:

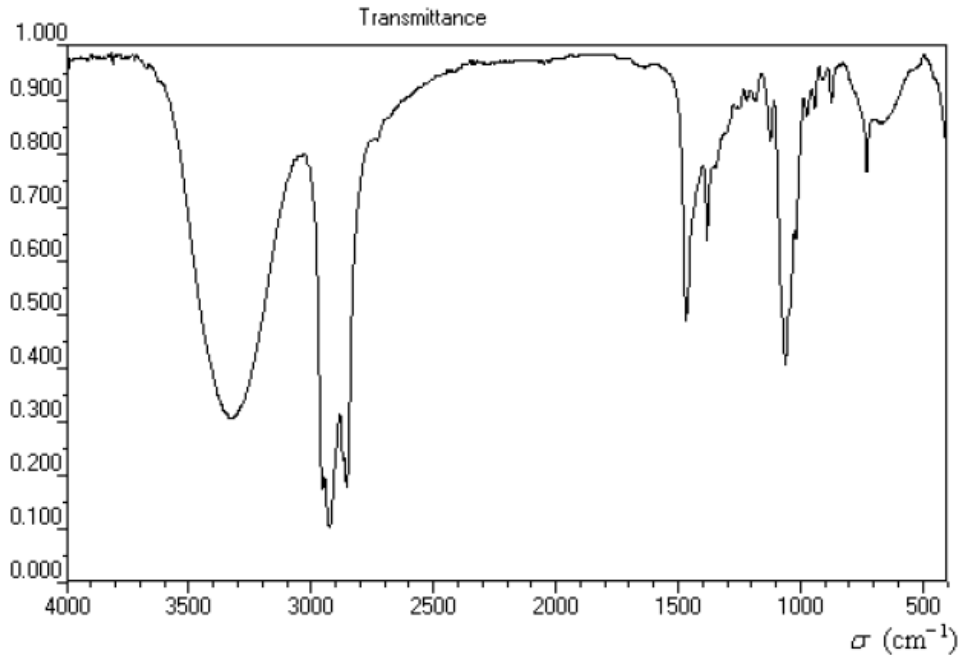
1. The wavelength range of visible light is:
   a. 40–80 µm
   b. 400–800 µm
   c. 400–800 nm
2. The wavelengths in the infrared range are:
   a. Greater than those of visible light
   b. Smaller than those of visible light
3. A yellow-colored solution:
   a. Absorbs green light radiations
   b. Absorbs red light radiations
   c. Absorbs violet light radiations

4. A colorless liquid:
   a. Absorbs all the radiations of white light
   b. Does not absorb in the visible range
   c. Does not absorb any radiation
5. The wavenumber is:
   a. The opposite of the wavelength
   b. The inverse of the wavelength
   c. A quantity expressed in cm^{-1}
6. A strong absorption between 1650 and 1800 cm^{-1} identifies:
   a. An O-H bond
   b. A C=O bond

Exercise 03

We are provided with the infrared spectrum of an oxygenated organic compound, denoted as B, with the molecular formula **$C_4H_{10}O$.**

1. Using the molecular formula, show that this compound **B** cannot be a carboxylic acid or an ester.
2. Using the spectrum, show that **B** cannot contain a carbonyl group.
3. Knowing that **B** is a linear molecule, determine the structural formulas of the two possible isomers for **B**.



Exercise 04

Monitoring a Reaction via Spectrophotometry

We are interested in the reaction of cupric ions $\mathbf{Cu^{2+}}$ in an aqueous basic solution (with controlled pH) with an anionic species called EDTA, denoted as $\mathbf{Y^{4-}}$.

The reaction equation is as follows:

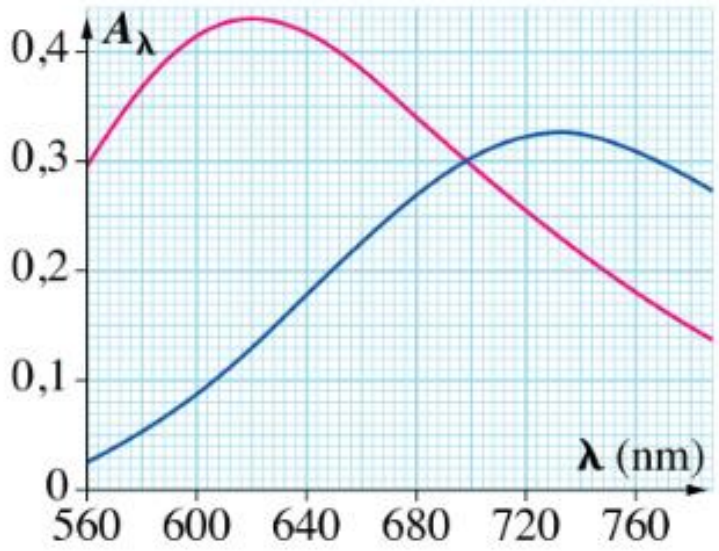
$$Cu^{+2} + Y^{-4} \rightarrow CuY^{-2}$$

Below are the absorption spectra of:

A solution of $\mathbf{Cu^{2+}}$ **(aq)** and $\boldsymbol{SO_4^{-2}}$ **(aq)** (pink curve).

A solution of $\mathbf{CuY^{2-}}$ **(aq)** and $\boldsymbol{SO_4^{-2}}$ **(aq)** (blue curve).

The spectra were obtained using solutions with a concentration $\mathbf{C_0 = 5.0\times10^{-2}\ mol/L}$, in cuvettes with a path length $\boldsymbol{l}$ **= 1.0 cm**. Only $\mathbf{Cu^{2+}}$ and $\mathbf{CuY^{2-}}$ are colored.



1- Determine the wavelength corresponding to the maximum absorption $\boldsymbol{\lambda_m}$. What is the corresponding color?
2- What is the color of the solution?
3- Determine the maximum absorbance $\mathbf{A_{max}}$. Deduce the molar absorption coefficient of $\mathbf{Cu^{2+}}$, denoted $\boldsymbol{\varepsilon_{Cu}}$, at the wavelength $\boldsymbol{\lambda_m}$.
4- What is the absorbance of the CuY^{2-} solution at the previously determined $\boldsymbol{\lambda_m}$?
5- Deduce the molar absorption coefficient of $\mathbf{CuY^{2-}}$, denoted $\boldsymbol{\varepsilon_Y}$, at the wavelength $\boldsymbol{\lambda_m}$.

Exercise 5

Thin Layer Chromatography Analysis of Lavender Essential Oil

The thin-layer chromatogram shown was obtained with the following samples:

A: Lavender essential oil

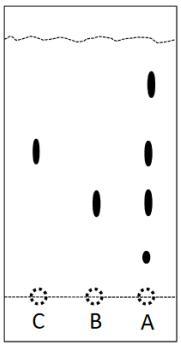
B: Linalool

C: Linalyl acetate

Based on the chromatogram:

1- Which are pure substances and which are mixtures?

2- Which molecules can be identified in lavender essential oil?



Exercise 6

Infrared Spectrum Analysis of an Organic Compound

An infrared spectrum is provided for an organic compound containing carbon, hydrogen, and oxygen, with the molecular formula $\mathbf{C_7H_6O_2}$.

1- Calculate the degree of unsaturation.

2- Interpret the IR spectrum.

3- Determine the structural formula (topological representation) of the compound.