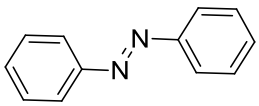
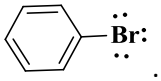
Exercises

Exercise 01

Identify all possible electronic transitions for the following molecules:

C_2H_6, CH_3NH_2, 

, 

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Exercise 02

1. **Calculate ε_{max}** for a compound with the following data:
    - Maximum absorption (**A**) = **1.2**
    - Path length of the cell (***l***) = **1 cm**
    - Concentration = **1.9 mg** in **25 mL** of solution
    - Molar mass = **100 g/mol**
2. **Calculate the molar absorptivity coefficient** for a solution with:
    - Concentration = $\mathbf{10^{-4}}$ **M**
    - Path length of the cuvette (***l***) = **2 cm**
    - Incident light intensity ($\mathbf{I_0}$) = **85.4**
    - Transmitted light intensity (**I**) = **20.3**

Exercise 03

A potassium permanganate aqueous solution (**C = 1.28 × 10^{-4} M**) has a transmittance of **0.5** at **525 nm** when using a cuvette with a **10 mm** optical path length.

1. **Calculate the molar absorptivity coefficient** of permanganate at this wavelength.
2. If the concentration is doubled, calculate the **absorbance** and **transmittance** of the new solution.

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 $\mathbf{Y^{4-}}$.

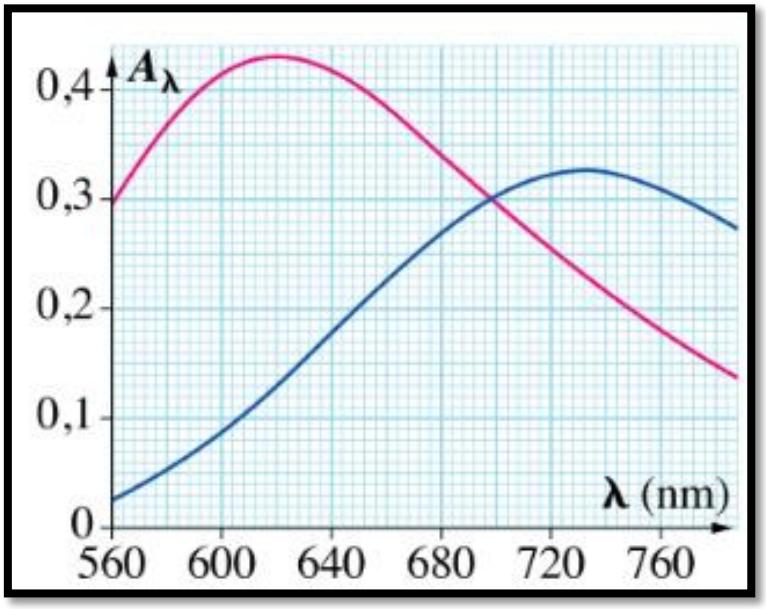
The reaction equation is as follows:

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

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 $\boldsymbol{\lambda_m}$.