# Practical work n°1

## Spectrophotometric Assay of Potassium Permanganate ($KMnO_4$)

### 1- Introduction

A spectrophotometer is an analytical instrument used to measure the amount of light absorbed by a solution at a specific wavelength. It allows quantitative analysis of chemical species in solution by detecting the intensity of transmitted light. Spectrophotometry is widely used in chemistry, biology, and biochemistry to determine concentrations of colored or colorless compounds.

The Beer–Lambert law (also called Beer's law) establishes a linear relationship between the absorbance of light by a solution and the concentration of the absorbing species:

$$\mathbf{A = \varepsilon.l.c}$$

Where :

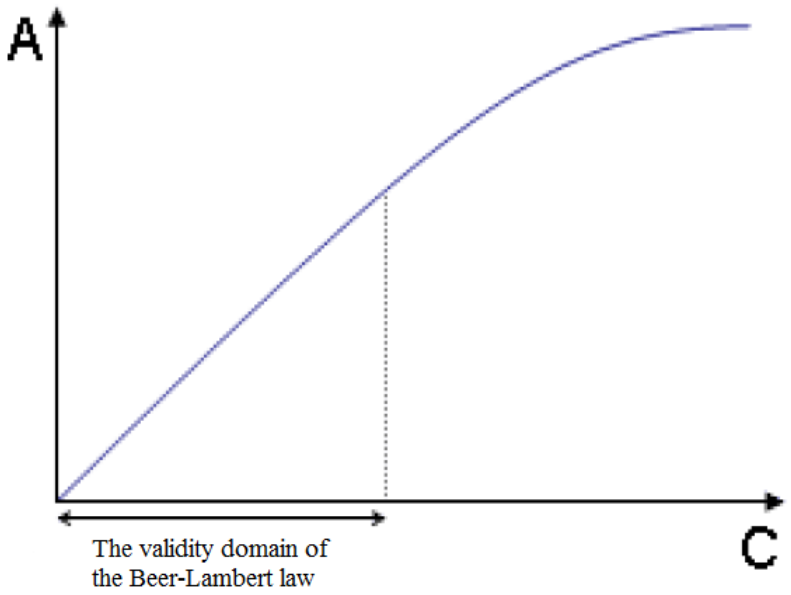
**A** = absorbance (unitless)

**ε** = molar absorptivity ($L \cdot mol^{-1} \cdot cm^{-1}$)

**l** = path length of the cuvette (cm)

**c** = concentration of the solution ($mol \cdot L^{-1}$)

To determine the unknown concentration of a given solution ($KMnO_4$ solution), it is first necessary to construct a calibration curve, following the relation $A = \varepsilon \times l \times C$.




**Important note :** The Beer-Lambert law is not valid for concentrations above $10^{-2}$ M or for absorbance values exceeding 2.

## 2-Objective of the practical work

-Spectrophotometer operation

-Determination of an unknown $KMnO_4$ concentration [Cx]

## 3- Materials and chemicals

-Spectrophotometer

-Beakers

-1 L volumetric flask

-Droppers

-Watch glass

-5 mL pipettes

-Test tubes

-Vortex mixer

-Pipette filler (or pipette bulb)

-Analytical balance

-Distilled water

-$KMnO_4$

## 4- Experimental procedure

### 4-1- Preparation of Potassium Permanganate ($KMnO_4$) Stock Solution

- Accurately weigh 1.58 g of potassium permanganate ($KMnO_4$) using an analytical balance.
- Transfer the weighed $KMnO_4$ into a 1 L volumetric flask.
- Add a small volume of distilled water and gently swirl until the solid is completely dissolved.
- Make up the solution to the calibration mark with distilled water.
- Stopper the flask and mix thoroughly by repeated inversion to obtain a homogeneous 10 mM stock solution.

### 4-2- Preparation of a calibration dilution series according to the following table.

| Tube No | Dilution factor | Final volume (mL) | Molarity (mM) | Concentration (mg/mL) | Absorbance |
|---|---|---|---|---|---|
| 1 | 1/2 | 10 | | | |
| 2 | 1/4 | 10 | | | |
| 3 | 1/8 | 10 | | | |
| 4 | 1/16 | 10 | | | |
| 5 | 1/32 | 10 | | | |

-Complete the table above.

-Set the wavelength λmax ≈ 525 nm on the spectrophotometer.

-Zero the absorbance (A) using the blank solution (distilled water).

-Measure the absorbance (A) of each solution.

-Plot the calibration curve by graphing Absorbance (A) as a function of concentration (C), A=f(C) using graph paper.

-Given a $KMnO_4$ solution of unknown concentration ($C_x$):

- Measure its absorbance (A).
- Determine the corresponding concentration $C_x$ from the calibration curve and express it in mg/mL.