Spectrophotometry

Objective

Using "Borderless Lab 365", to determine the transmittance of the solution with different concentration.

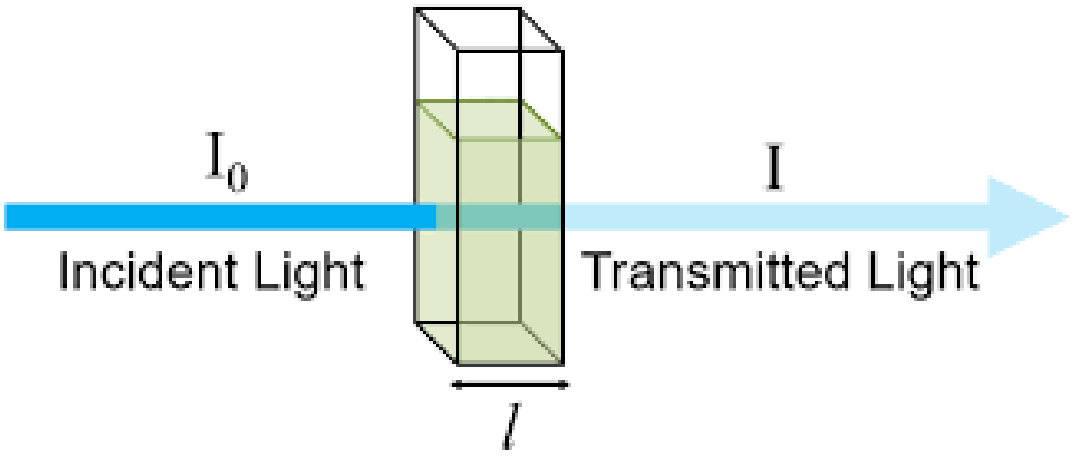
Introduction

- All molecules absorb and emit light differently based on the type of covalent bonds present in the molecule and the amount of molecule in the solution. By using spectrometer, transmittance of solution can be measured to determine the concentration of solution.
- With spectrometer, the rate of the reaction can also be monitored. This experiment will determine the relationship between transmittance and the concentration of the solution.

Theory

1. Beer's-Lambert law
   Beer's-Lambert law, also known as Beer's law, is related to the light attenuation when light passes through a material. This is commonly used in the analysis of chemicals and tracking the rate of reaction.

$$T = 100\% * (\frac{I}{I_0})$$



2. Concentration
   PPM is one of the units used in concentration, especially in very tiny amount of substance (very diluted). In the mathematical explanation, PPM refers to parts per million (1/1000000). In term of concentration, it can be referred to 1 mg/ 1L (molarity) or 1mg/ 1 kg (molality).

$$Molarity = \frac{ppm \times 0.001}{Molar\ mass}$$

Apparatus

- "Borderless Lab 365" Platform
- Water
- Brilliant Blue (Dye, 0.0012mol/dm3 or 1000.0ppm)
  Brilliant Blue is a blue-colored synthetic organic compound. In this experiment, it acts as a reducing agent and indicator, where it is oxidized from blue color to colorless.

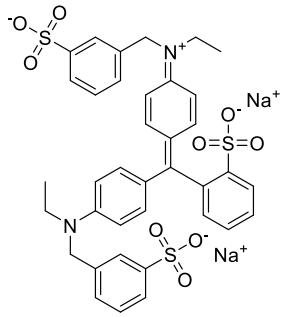


Fig. 1 Brilliant Blue

Procedure

1. Log in the experiment module "Spectrophotometry" on the Borderless Lab 365 platform. https://stem-ap.polyu.edu.hk/remotelab/
2. For Dye, you may choose different amount of volume (0cm^3, 0.125cm^3, 0.25cm^3, 0.625cm^3) by sliding the bar before pressing "ADD" button.
3. Wash the glass tube by pressing "WASH". (Note: you can wash the glass tube 6 times only throughout the session.)
4. "ADD" 1.25 cm^3 water and record the molar absorptivity at 793 nm wavelength or other. Download the graph in SVG/PNG/CSV, or you may use the cursor pointing to the target, it shows the value instantly.
5. Add 0.25 cm^3 dye and record the molar absorptivity at 793 nm wavelength or other.
6. Add the amount of dye to 0.625 cm^3 and record the molar absorptivity at 793 nm wavelength or other.
7. Add the amount of dye to 1.25 cm^3 and record the molar absorptivity at 793 nm wavelength or other.
8. Wash the glass tube by pressing "WASH".
9. Add 1.25 cm^3 dye and record the molar absorptivity at 793 nm wavelength or other.
10. Add 0.625 cm^3 water and record the molar absorptivity at 793 nm wavelength or other.
11. Wash the glass tube again at the end of experiment, and then press "LOGOUT" on the left.

Note:

1. Combination in this experiment as marked in procedure 4-10 is suggestion only. You may conduct the experiment with other combination.
2. Shake the solution when necessary.

Data

Data when the wavelength is _____ nm

Volume of solution (cm^3)	Volume of water (cm^3)	Total volume (cm^3)	Concentration (ppm)	Molar absorptivity (arbitrary unit)	Transmittance (%)
0	1.25	1.25			
0.25	1.25	1.5			
0.625	1.25	1.875			
1.25	1.25	2.5			
1.25	0	1.25			
1.25	0.625	1.875			

Discussion

1. Plot the graph of transmittance against concentration.
2. Why does transmittance decrease as the concentration increase?
3. What is the transmittance with the concentration of 600ppm?
4. What is the concentration when the transmittance is about 85%?