Experiment (7)

Application of (Lambert – Beer) law

Introduction:

Spectrophotometric methods include measuring the intensity of incident light and transmitted light at a specific wavelength. There are two types of device are the spectral: (1) Single beam (2) Double beam.

Law (Lambert – Beer):

Absorbs equal parts of the light beams by equal changes in the concentration of the absorbed material when the optical path length in the absorbing material constant.

$$A = \varepsilon C l$$

$\%T = (I / I_o) \times 100$

$A = \log I_o / I$

$= \log 1 / T$

A = absorbance

ε = molar absorbance coefficient ($mol^{-1}.L.cm^{-1}$)

l = long the light path inside the solution (1cm)

T = transmittance

C = concentration ($mol.\ L^{-1}$)

I = the intensity of transmitted light

I_o = intensity of incident light

Wavelength (λ): *The distance between adjacent peaks of a wave packet, that has the standard unit:* $nm = 10^{-9}m$, $A^o = 10^{-10}m$, $\mu m = 10^{-6}m$

The greatest wavelength (λmax): *The wavelength, which has the highest absorption of the substance.*

Light intensity (I): *The number of photons absorbed per second.*

Photon: *Is units of energy.*

Beer-Lambert Law Applications

This law finds applications in various fields such as:

- ***Analytical chemistry:*** *This analysis mainly concentrates on the separation, quantification and identification of matter by spectrophotometry. There is no involvement of extensive pre-processing of the sample to get the results. For example, bilirubin count in a blood sample can be determined by using a spectrophotometer.*

- ***Atomic Absorption:*** *The application of atomic absorption spectrometry (AAS) for the determination of metal concentrations.*
- ***In atmosphere:*** *Solar or stellar radiation in the atmosphere can be described using this law. The law in atmospheric applications has a modified equation.*

Beer-Lambert Law Limitations

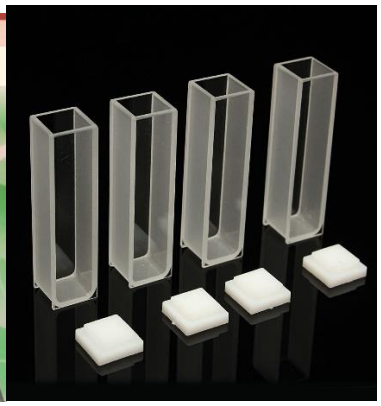
Using this law it becomes easy to study the absorptivity coefficient of the sample when the concentration is low <10mM but as the concentration becomes high >10mM there is a deviation as the electrostatic interactions become more. The value of absorbance should be between (0-1).

Measuring the absorbance of potassium permanganate ($KMnO_4$)

a) Finding (λ_{max}):

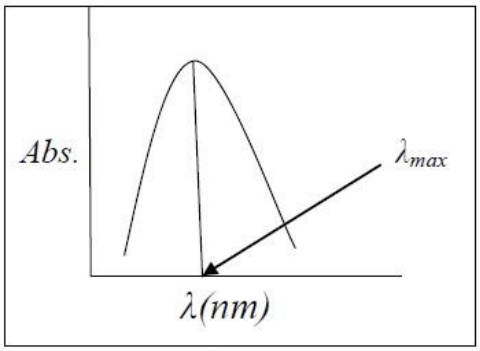
1) Prepare dilute solutions of $KMnO_4$ (0.1M): (1, 3, 5, 7) × 10^{-4}M in volumetric flask (50ml) according to law ($M_1 V_1 = M_2 V_2$).

2) Measure absorbance of the lower concentration (1×10^{-4})M versus water (blank) in the wave length range (400 – 600)nm and that each (10nm) to note the highest absorption value read by the device and install it to be (λ_{max}).



Wave length(nm)	*Absorbance*
400	
410	

600	

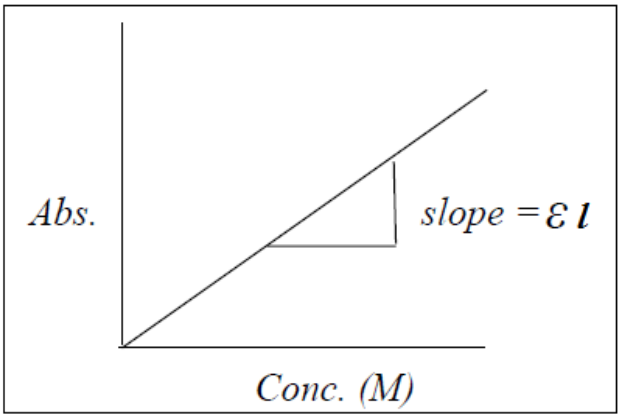


***b) Finding (ε)* & Concentration of unknown:**

1- When you install (λ_{max}) from step (a) was appointed absorbance of each solution.

2- Plot a relationship between absorbance (A) and concentration then determine the molar absorption coefficient (Ɛ) from the slop and the concentration of unknown.

Conc.(mol/L)	*Absorbance*
1×10^{-4}	
3×10^{-4}	
5×10^{-4}	
7×10^{-4}	



Discussion:

1-Is it possible to measure the potassium permanganate in the ultraviolet region near the visible region?

2- What is the difference between ultraviolet and visible spectrum?