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1st cycle of NAAC Accreditation : • "A" Grade for 5 years (w.e.f. 30-10-2017)

Subject :- Chemistry Experiment / Tutorial / Assignment No. :- 6 Page :- 1 Date :- / /

DETERMINATION OF MOLAR EXTINCTION COEFFICIENT

- **Aim:** To determine molar extention coefficient for known and unknown solution of potassium permangnate solution at λmax using Colorimeter.

- **Objectives:**

After performing the practical, the learner will be able to:

PRO 1: Understand the theory behind coloured $KMnO_4$ solution.
PRO 2: Understand the uses of Colorimeter and Glassware.
PRO 3: Determine the absorbance of solution.
PRO 4: Determine Molar Extinction coefficient.

- **Apparatus:**

  - Colorimeter
  - 250 mL & 100 mL volumetric flask.
  - 0.01 N $KMnO_4$ solution.

Determination of Molar Extinction Coefficient at λ_{max} using Colorimeter.

Observation:

PRO 1:

a] The relation between absorbance and transmittance is given by $A = -\log_{10} T$ equation

b] It has been observed that with increasing concentration, absorbance of solution is increasing.

PRO 2:

a] Light source used in colorimeter is tungsten filament lamp having polychromatic light whereas most commonly used detector is Photovoltaic cell.

b] Cuvette or sample holder used in colorimeteric analysis can be made up glass because it does not affect or absorb in visible region.

PRO 3:

Observation table:

Obs. No.	Concentration of $KMnO_4$ sol^n in m/dm^3	Absorbance of Soln. "A"	Molar Extinction Coefficient $\epsilon = A/bc$
1	4×10^{-5}	0.17	0.0425×10^5
2	8×10^{-5}	0.38	0.0475×10^5
3	12×10^{-5}	0.57	0.0475×10^5
4	16×10^{-5}	0.68	0.0418×10^5
5	Unknown sol^n.	0.55	0.0475×10^5

PRO 4:

Molar Extinction Co-efficient:

$\epsilon = \frac{A}{bC}$ Unit = Lit/mol cm

(1) ϵ for concentration (c) 4×10^{-5} m/dm^3 and Absorbance (A) 0.17

$\epsilon = \frac{A}{bC} = \frac{0.17}{4 \times 10^{-5}} = 0.0425 \times 10^5$ Lit/mol cm.

(2) ϵ for concentration (c) 8×10^{-5} m/dm^3 and Absorbance (A) 0.38

$\epsilon = \frac{A}{bC} = \frac{0.38}{8 \times 10^{-5}} = 0.0475 \times 10^5$ Lit/mol cm

(3) ϵ for concentration (c) 12×10^{-5} m/dm^3 and Absorbance (A) 0.57

$\epsilon = \frac{A}{bC} = \frac{0.57}{12 \times 10^{-5}} = 0.0475 \times 10^5$ Lit/mol cm

(4) ϵ for concentration (c) 16×10^{-5} m/dm^3 and Absorbance (A) 0.68

$\epsilon = \frac{A}{bC} = \frac{0.68}{16 \times 10^{-5}} = 0.0418 \times 10^5$ Lit/mol cm.

(5) ϵ, $0.0475^{\times 10^5}$ for concentration Unknown (c), by Graph and Absorbance (A) 0.55

$\epsilon = \frac{A}{bC} \Rightarrow 0.0475 \times 10^5 = \frac{0.55}{C}$

$\Rightarrow C = \frac{0.55}{0.0475 \times 10^5}$

$\Rightarrow \boxed{C = 11.57 \times 10^{-5} \text{ m/dm}^3}$

Result & Discussions:

PRO 1: $KMnO_4$ Solution when Incident with Ray of White Light, Reflects Purple Color while Absorbing Everything Else, Hence to Human Eye the Solution Looks Purple. This color is due to Transitions of charge within the Compound. As on Dilution the Color changes from Purple Tint to Pink.

PRO 2: Colorimeter is an Analytical Instrument based on Beer-Lambert's Law & is used to find the Concentration of a Solution by Measurement of its Relative Absorption of Light. It consists of a Straight Arrangement of Point Source of visible Light passing through Alterable Filters producing beams of Light of Diffrent wavelength which are incident on a cleansed Curette containing the solution and a Detector setup to Analyze the Absorption.

PRO 3: The Absorption of Light by $KMnO_4$ Solution is obtained by Giving Calorimeter a Blank. i.e. Distilled water & then the solution. This procedure is repeated to find Absorption of all Possible Wavelengths in Calorimeter. Precise Handling of the Curettes is Required as Fingerprints while Holding can Alter the Readings. The wavelength at which the Absorbance is found to be Highest, is called λmax i.e. Peak Wavelength.

PRO 4: Absorbance of Solutions with diffrent Concentrations along with the Unknown is Calculated using,

Colorimeter at Molar Extinction. Peak Wavelength. By obtaining λ_{max} First, the Procedure is simplified considerablly. Molar Extinction Coefficient - ϵ is calculated for solution of Each Concentration & Compared & Recurring value is considered ideal. The Concentration of Unknown is then Calculated using Graph.

Conclusion :

The Molar Extinction Coefficient - ϵ for $KMnO_4$ solution is 0.0475×10^5 Lit/mol/cm. The Concentration of Unknown Solution is 11.6×10^{-5} m/dm^3.

Precautions:

While performing the practical, the learner must:
1. Ensure that chemicals must be handled carefully.
2. Ensure selection of proper filter.
3. Ensure use of blank filter or Wavelength changed.
4. Safe handling of Curette.

Quiz:

1] What is equation of Beer's Lambert Law? Explain the term involved in the Equation:

⇒ The Beer-Lambert's Law states that,
Absorbance of Light of Color Compounds is Directly proportional to Concentration & Path Length.

$$A \propto b.C$$

$$A = \epsilon.b.C$$

where, A = Absorbance of Light for the given Compound
b = Path Length covered by the Light
C = Concentration of given Solution.

2] How will you adjust the wavelength?

⇒ The Wavelength of Light can be Adjusted using a Filter by Passing a Beam of Light through it. A Filter only allows a certain wavelength to pass through it and blocks the other wavelength. A standard Colorimeter has a Setup of 8 Alterable Filters to obtain visible Light Rays of Diffrent Wavelength.

3] Path length of Curette used in this experiment is:?

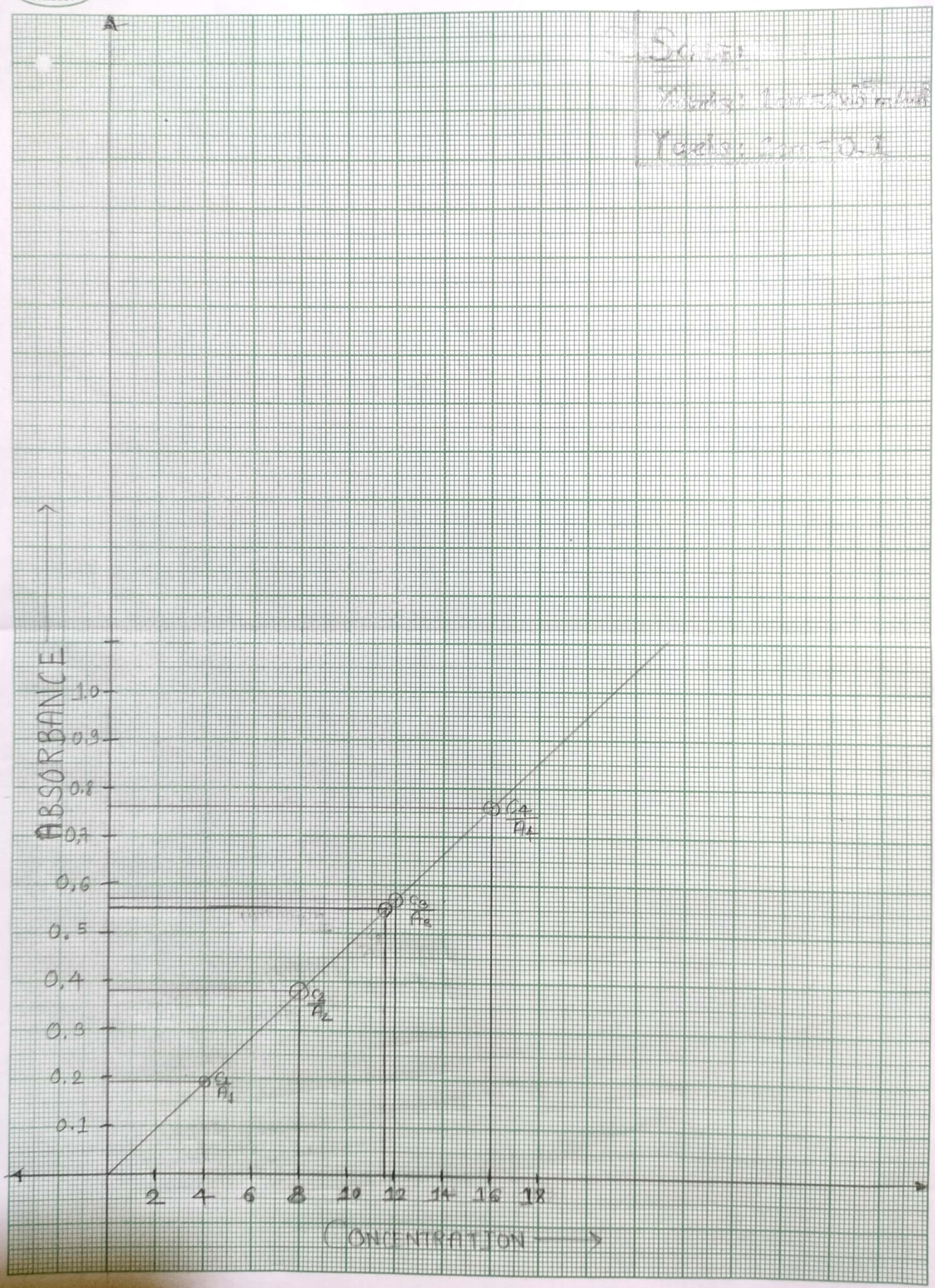
⇒ Path length of Curette used in this experiment is 10mm.

4] Is this technique useful for measuring concentration of colourless solution?

⇒ As Colorimeter is used to determine concentration of coloured solution it is not possible to measure concentration of colourless solution using this technique.

Objective	PRO 1	PRO 2	PRO 3	PRO 4	Total
Weight					Score
Points					
Score					

Earned Points (EP) =	Marks in 100 = EP*20
Total score / 80 =	=


ABSORBANCE
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
2
4
6
8
10
12
14
16
18
CONCENTRATION
C1 A1
C2 A2
C3 A3
C4 A4