Experiment #1

Determine amount per liter of Al^{3+} in given sample gravimetrically.

Preparation of reagent.

Step I:-

Acetic acid

$M_1V_1 = M_2V_2$

$0.1 \times 250 = 17 \times V_2$

$V_2 = 1.5 ml$

0.1 M Sodium acetate

$$\text{Molarity} = \frac{\text{Molar mass of Solute}}{\text{Molar mass of Solvent}} \times \frac{1}{\text{vol. cm}^3}$$

$$0.1\ M = \frac{x}{82} \times \frac{1}{1000}$$

$x = 8200$

65 ml of acetic acid + 35 ml of sodium acetate = Buffer Solution (pH = 4-5)

Step II

2% of 8 hydroxyquinoline

2 g of 8 hydroxyquinoline in 10 ml of ethanol and 88 ml of 1 molar acetic acid m dilute soln.

Experiment No. 1

Determine the amount per/l of Al^{3+} in given Sample gravimetrically.

Theory:-

Basic Principle

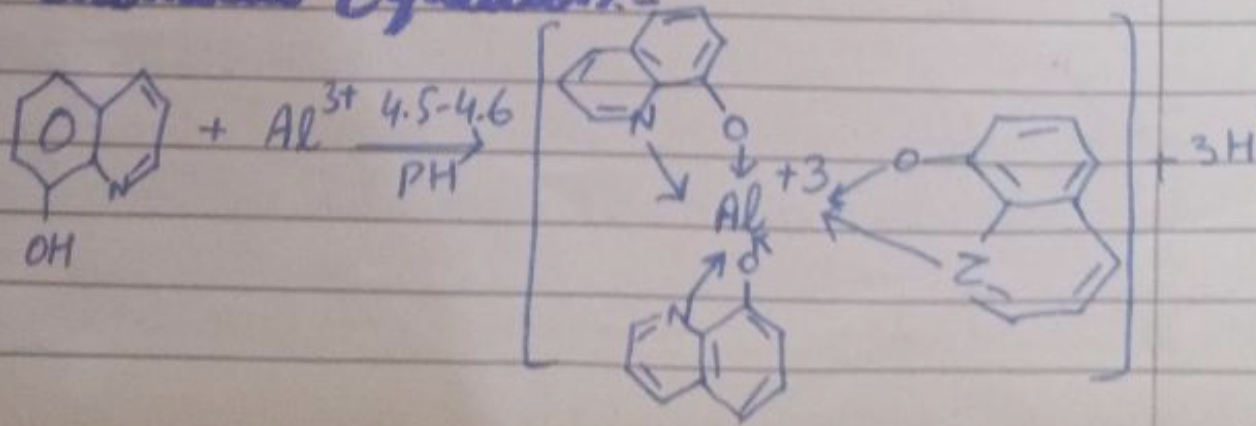
It is a microscopic analytical technique The word gravimetry is derived from two Greek words Grav means weight and metry means measurements. In this technique, the amount of soluble species is determined by converting it into insoluble forms by using some precipitating agents.

Use of gravimetric technique

- This technique may be used in wide scale in fertilizing industry for determination of nutrients like Zn, Pb, Co etc.
- In cement industry for determination of silica, aluminum and calcium.

In electroplating industry for determination of Zn^{+2}, Co^{2+}, Ag^{+} etc.

Chemical Equation:-



Step III :-

1 molar acetic acid = V_1 = 100 cm^3

$M_1V_1 = M_2V_2$

$1 \times 100 = 17 V_2$

$V_2 = 5.88$ ml

Calculations :-

Weight of filter paper = w_1 = 0.9g

wt. of filter paper + ppt = w_2 = 1.12

Net weight = w = 0.22 g

459 g of complex contains Al^{3+} = 27 g

1 g of " " = $\frac{27}{459}$

0.22 " " = $\frac{27}{459} \times 0.22$

= 0.01

20 ml of complex contain Al^{3+} = 0.01 g

1 ml " " = $\frac{0.01}{20}$

1000 ml " " = $\frac{0.01}{20} \times 1000$

= 0.5 g/l

Result :-

The given sample contain 0.5 g/l of Al^{3+}

Preparation of reagents:-

For Buffer:- Acetic acid (0.1M)

Step: 1

Given : Required

$M_1V_1 = M_2V_2$

$0.1 \times M \times 250 = 17M \times V_2$

$1.5\ ml = V_2$

Sodium acetate (0.1 M)

$$\text{Molarity} = \frac{\text{mass of solute}}{\text{molar mass solvent}} \times \frac{1}{\text{volume in } dm^3}$$

$$0.1 = \frac{x}{82} \times \frac{1}{1000}$$

$$x = 8200$$

65 ml of acetic acid + 35 ml of sodium acetate = Buffer soln (PH = 4-5)

Step 2:-

2% of β hydroxy quinoline

2g of β-hydroxy quinoline in 10 ml ethanol and 88 ml of 1 M acetic acid

1 M acetic acid = $V_1 = 100\ cm^3$

$M_1V_1 = M_2V_2$

$1 \times 1000 = 17 \times V_2$

$V_2 = \frac{1000}{17}$

$V_2 = 588\ ml$

Procedure:-

- Take 20 ml of saturated soln of $Al(SO_4)_3$ $18\ H_2O$ at 25°C.
- Add few drops of buffer solution.
- Now add 3-4 drops of buffer solution 8-hydroxy quinoline soln drop wise in above soln.
- Heat it so that precipitates are coagulated.
- Now filter it and weight of filter paper is 0.2g.

Use of aluminium

- Aluminium is malleable and ductile metal.
- Alloy of Al is very important. In construction of aeroplanes and other transports.
- Al is used in huge variety of products including foils, lotion, kitchen, utensils and window.
- It is good conductor of heat and light.
- It can be polished to give highly refractive surface.

Experiment # 2

Determine amount / l of Zn^{2+} in a given Sample gravimetrically.

Preparation of reagent:-

- 3% solution of anthranilic acid
- 5g of $NaHCO_3$ were dissolved in 100ml $+_2O$ to this soln and 3g of anthranilic acid
- 1 % metal salt soln, 1 g of $ZnSO_4 \cdot 7H_2O$ dissolved 99 ml of $+_2O$

373.3 g wt. of complex contain Zn^{2+} = 65.37 g

1 g " " " = $\frac{65.37}{337.3}$

0.263 g " " " = $\frac{65.37}{337} \times 0.26$

20 ml of sample contain = 0.05

1 ml " " " = $\frac{0.05}{20}$

1000 ml of " " = $\frac{0.05}{20} \times 1000$

= 2.5 g/l

Result:-

The given soln contain Zn^{2+} 2.5 g/litre

Experiment No. 2

Determine amount / liter of Zn^{2+} in a given sample by gravimetry.

Principle:-

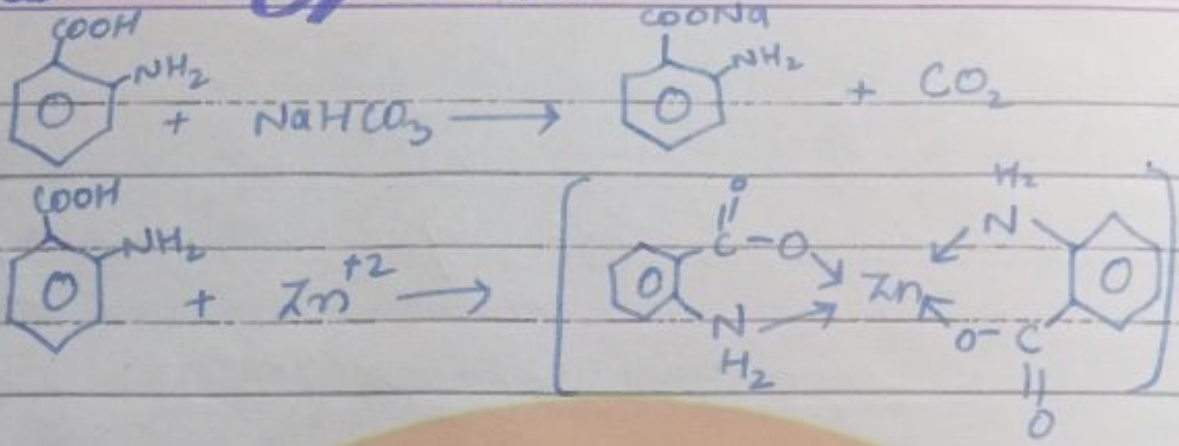
It is a microscopic analytical technique. The word gravimetry derived from Greek word gravy means weight and metry means measurements.

In this technique amount of double specie is determined by converting it into insoluble form by using precipitating agents which may be organic or inorganic in nature.

Use of gravimetric technique

- It is used on wide scale in fertilizer industry.
- For determination of nutrients.
- In cement industry for the determination of silica, Al^{3+}, Co^{2+} etc.
- In electroplating industry for determination of Zn^{2+}, Co^{2+}, Ag^{+} etc.

Chemical Equation:-



Preparation of Reagents:-

8% soln of anthralic acid and 5g of $NaHCO_3$ were dissolved in 100 ml at 25°C of H_2O. In this soln, add 3g of anthralic acid.

1% Metal salt soln: 1g of $ZnSO_4 \cdot 7H_2O$ dissolved in 99 ml of water.

Procedure:-

- Take 20 ml of $ZnSO_4 \cdot 7H_2O$ at 25°C.
- Now add anthralic acid and 10 ml of H_2O.
- Heat it so that ppt are coagulated.
- Now filter it on filter paper and weighed it.
- Weight of filter paper is 0.93 g.
- ppt formed and white in color.

Uses of Zinc.

- It is used for production of zinc base alloys such as brass, nickel, silica, aluminium oxide.

Experiment #3

Determine amount per litre of cd^{2+} in given sample by gravimetrically.

preparation of reagent

- 3% solution of anthranlic acid
- 5g of $NaHCO_3$ was dissolved in 100 ml of H_2O
- To this soln add 3g of anthranilic acid.
- 1% metal salt 1 g of $CdSO_4$ dissolve in 99 ml of H_2O.

Calculation:

wt. of filter paper = w_1 = 1.21

wt. of filter paper + ppt. = w_2 = 1.43

Net weight = 1.43 − 1.21

= 0.22 g

384 g of complex contain cd^{2+} = 108 g

1 g. " " " = $\frac{108}{384}$

0.22 g of " " " " = $\frac{108}{384} \times 0.22$

Experiment No. 3

Determine amount/l of Cd^{2+} in a given sample by gravimetry

Principle:-

In this technique the amount of soluble species is determined by converting it into insoluble species by adding organic or inorganic reagent.

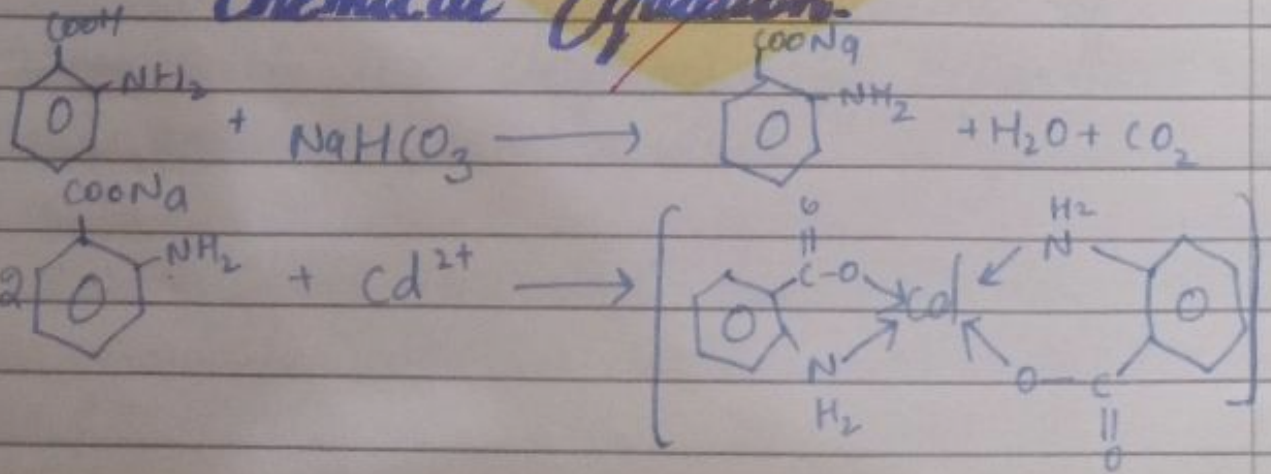
The amount of soluble specie is calculated from steichometric calculations using knowledge of molar weight of ppt obtain.

Use of gravimetric technique

It is used on wide scale on fertilizers industry for determination of nutrients like Zn^{2+}, Cd^{2+}, Pd^{2+} Ag^{+}.

In ument industry for determination of Silica, Al^{3+}, Ca^{2+}.

Chemical Equation



20 ml of sample contain cd^{2+} = 0.66g

1 ml " " " = $\frac{0.06}{20}$

1000ml of sample contain cd^{2+}

= $\frac{0.06}{20} \times 1000$

= 3.2 g/l

Result:-

The given sample contain

cd^{2+} 3.2 g/l

Preparation of Organic Reagent

8% of anthralic acid in $NaHCO_3$, 5 g of $NaHCO_3$ dissolve in 100ml of H_2O and add 3g of anthranilic acid.

1% of metal soln, 1g of $cd(NO_3)_2$ dissolve in 100ml of H_2O.

Procedure:-

Take 20 ml calculated solution of $Cd(NO_3)_2$ at 25°C.

Now add anthranilic acid and add 10 ml of H_2O.

Heat it so that precipitates are coagulated.

Now filter it on filter paper, light pink ppt were obtained.

Uses of Cd^{2+}

The metal is special component of alloys with low-coefficient of expansion and good fatigue resistant.

Cd^{2+} is important for batteries.

It is used in some control rods and shield in nuclear reaction.

Experiment #4

Determine amount / % of Co^{2+} in given Sample gravimetrically.

Preparation of Reagent :-

- 3% Soln of anthranilic acid
- 5g of $NaHCO_3$ of anthranilic acid
- 1 g of metal salt + 1g of cobalt nitrate in 99 ml $+H_2O$.

Calculations :-

wt. of filter paper = $w_1 = 0.93$

wt. of filter paper + ppt = $w_2 = 1.61$

Net weight = $w = 1.61 - 0.93$

$= 0.23$

331 g of metal complexes contain $Co^{2+} = 59$

1 g " " " = $\frac{59}{331}$

0.23 g " " " " = $\frac{59}{331} \times 0.23$

$= 0.04 g$

Experiment # 4

Determine amount /l of Co^{2+} in given gravimetry

Principle:-

In this technique the amount of soluble compound is determined by using some organic or inorganic reagents.

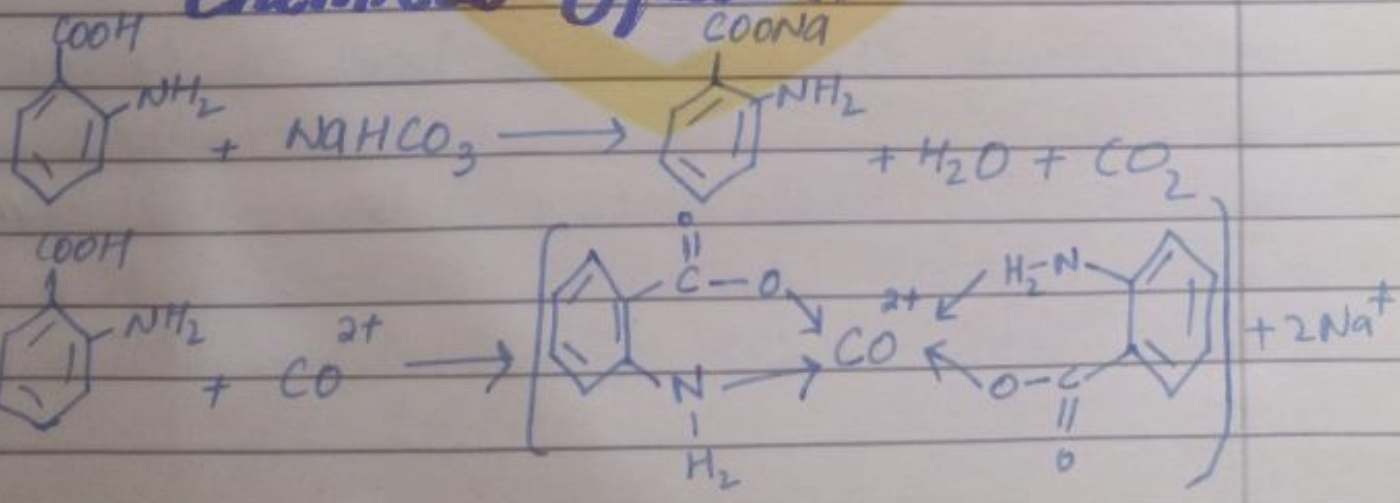
The amount of soluble specie is calculated from stichiometric calculations using knowledge of precipitates obtained.

Uses of gravimetric technique

It is used on wide scale in fertilizes industry for determination of nutrients like Zn^{2+}, Cd^{2+}, SO_4^{2-}, Pd^{2+}.

In Cement industry for determination of Silica, alumina etc.

Chemical Equation



20 ml of sample contain Co^{2+} = 0.04

1 ml " " " = $\frac{0.04}{20}$

1000 ml " " " = $\frac{0.04}{20} \times 1000$

= 2.05

Result :-

The given sample contain Co^{2+} is 2.05 g/l.

Preparation of Reagents

- 5g of $NaHCO_3$ dissolve in 100ml H_2O and add 8g of anthranilic acid.
- 1% metal salt solution 1g of cobalt nitrate dissolve in 999 ml of H_2O.

Procedure:-

- Take 20 ml of soln of calculated cobalt nitrate at 25 C.
- Now add anthranilic acid till ppt obtained.
- Heat soln to coagulate ppt.
- Cool solution at room temperature, weight filter paper and from it calculate
- weight of ppt formed.

Uses of Co^{3+}

- It is used as a source of gamma radiation.
- It is used in razor blades.
- It is used as permanent magnet.
- It is used as alloy for engines and gas turbines.

Experiment # 5:-

Determine amount / l of Ni^{2+} gravimetrically?

Preparation of reagent:-

⇒ **1 % $NiSO_4$ soln**

1 g of $NiSO_4$ is dissolved in H_2O and make volume upto 100 ml.

⇒ **1 % Salicyldoxime**

Dissolve 1 g of Salicyladoxime in 10-15ml of ethanol for completely solubility and then dilute the soln upto 100 ml in H_2O.

Calculations:-

wt. of filter paper = w_1 = 1.19

wt. of filter paper + ppt = w_2 = 1.34

Net weight = w = 1.34 - 1.19

= 0.15 g

Experiment No. 5

Determine amount/l of Ni^{2+} gravimetrically.

principle:-

It is microscopic analytical technique.

Theory:-

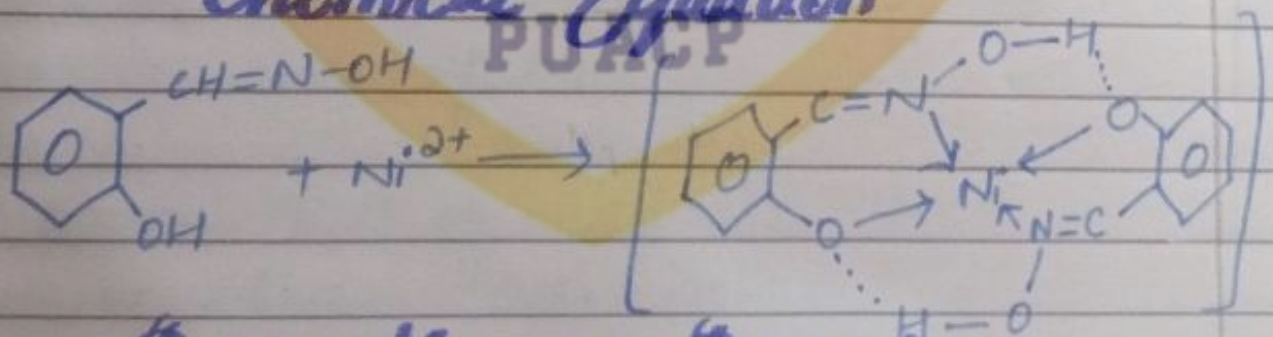
In this technique amount of soluble specie is determined by converting it into insoluble form using organic or inorganic precipitating agent.

Uses of gravimetric technique

It is used on wide scale for determination of nutrients like Zn^{2+}, Co^{2+}, Pb^{2+}, SO_4^{2-}.

In cement industry for determination of silica, Al^{3+}, Co^{2+}. In electroplating industry for determination of Zn^{2+}, Co^{2+}, Ag^{2+}.

Chemical Equation



Preparation of Reagents

1% $NiSO_4$ soln:-

330 g of complex contain Ni^{2+} = 58.6 g

1 g " " " = $\frac{58.6}{330}$

0.15 g " " = $\frac{58.6}{330} \times 0.15$

= 0.02 g

20 ml of " = Ni^{2+} = $\frac{0.02}{20}$

1 ml " " =

1000 ml " " = $\frac{0.02}{20} \times 1000$

= 1.33 g/l

Result:-

The amount of Ni^{2+} in given Sample is 1.33 g/l.

1 g of $NiSO_4 \cdot 6H_2O$ is dissolved in 99 ml of water and make volume upto 100 ml.

Salicyl aldoxime :-

- Dissolve 1 g of salicylaldoxime ion in 10-15 ml of ethanol for complete solubility and dilute soln upto 100 ml of H_2O.

Procedure:-

- Add 20 ml of $NiSO_4$ in a flask. Add few drops of salicylaldoxime soln until ppt are formed.
- Heat soln that ppt are coagulated.
- Green color ppt are formed.
- filter out and weight ppt obtained.

uses of Ni^{2+}

- Most uses of nicked are alloys metals namely nickel salt, bronze and
- nicked iron. stainless steel is made of nicked.

Experiment #6:-

Determine amount of Ni^{2+} in given sample using nitron gravimetrically.

Preparation of organic Reagent:-

⇒ **0.1 % soln of nitron**

For 0.1 % soln of nitron takes 0.1 g of nitron and dissolve in 5 M acetic acid and make total soln 100ml.

⇒ **5 ml Acetic acid**

Take 3.5 ml of acetic acid. Dissolve in 95 ml of water to make 5 M acetic acid.

Calculation:-

wt. of filter paper = w_1 = 1.5 g

wt. of filter paper + ppt = w_2 = 1.71

Net weight = $w = w_2 - w_1 = 1.71 - 1.5$

= 0.21

Experiment No. 6

Determine amount of NO_3^{1-} in given sample using nitron by gravimetrically.

Principle:-

Gravimetry is microscopic analytical technique.

Theory:-

In this technique the amount of soluble specie is determined by converting into insoluble specie using organic or inorganic reagent.

Preparation of solution

For 10% soln of nitron, take 0.1g of nitron and dissolve in 5M of acetic acid and make total volume of soln 100ml.

If nitron soln does not dissolve readily we can also dissolve few ml of ethanol in 95 ml total volume of 100 ml.

5M acetic acid

Take 3.5M of acetic acid and dissolve in 95 ml of H_2O to make 5M acetic acid.

0.1% solution of $Ag(NO_3)_2$

In distilled water dissolve 0.1g of $Ag(NO_3)_2$

374 g of complex contain NO_3^{1-} = 62 g

1 g " " " = $\frac{62}{374}$

0.21 g " " " = $\frac{62}{374} \times 0.21$

20 ml sample contain NO_3^{1-} = 0.034

1 ml " " " = $\frac{0.034}{20}$

1000 ml " " " = $\frac{0.034}{20} \times 1000$

= 1.75 g/l

Result:-

The amount of NO_3^{1-} in given sample is 1.75 g/l.

in 5g of CH_3COOH to make total 100ml of sdn.

Chemicals

- Ethanol
- acetic acid
- Nitron
- Aluminium nitrate.

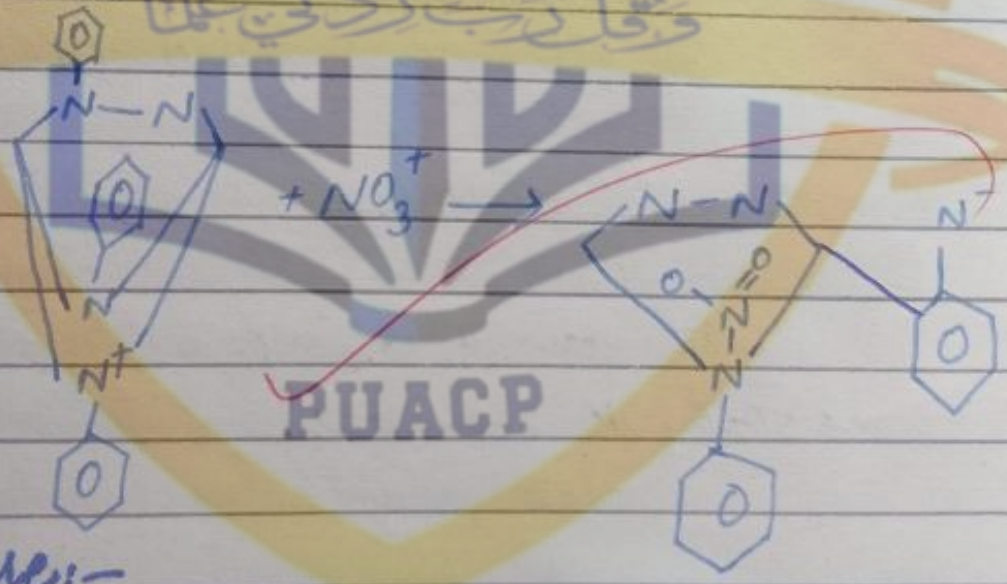
Uses of nitrates:-

A rich source of nitrates in human body comes from leafy food.

It is used in fertilizer and agriculture industry.

A rich source is found in Earth crust and in the form of Crile.

Equation:-



Procedure:-

- Take 20 ml of saturated of given sample at 25°C.
- Add nitron sdn and few drops of ethanol to dissolve the nitron completely.
- Heat it so that ppt are being formed and coagulate filter and weight it.

Experiment # 7 :-

Determine amount / ℓ of Bi^{3+} gravimetrically.

⇒ Preparation of reagent :-

Dissolve 1 g of $Bi(NO_3)_3$ in $+H_2O$ and make it upto 100 ml.

⇒ 1% Pyrogallol

Dissolve 1 g of pyrogallol in hot $+H_2O$ and dilute upto 100 ml. $+H_2O$ used because pyrogallol is insoluble in cold $+H_2O$

Calculations :-

wt. of filter paper = w_1 = 1.27

wt. of filter paper + ppt = w_2 = 1.37

Net weight = $w = w_2 - w_1 = 1.37 - 1.27$

= 0.1 g

331 g of complex contain Bi^{3+} = 209

1 g " " " = $\frac{209}{331}$

0.1 g " " " = $\frac{209}{331} \times 0.1$

Experiment No. 7

Determine amount/l of Bi^{+3} gravimetrically.

Principle:-

It is microscopic analytical technique

Theory:-

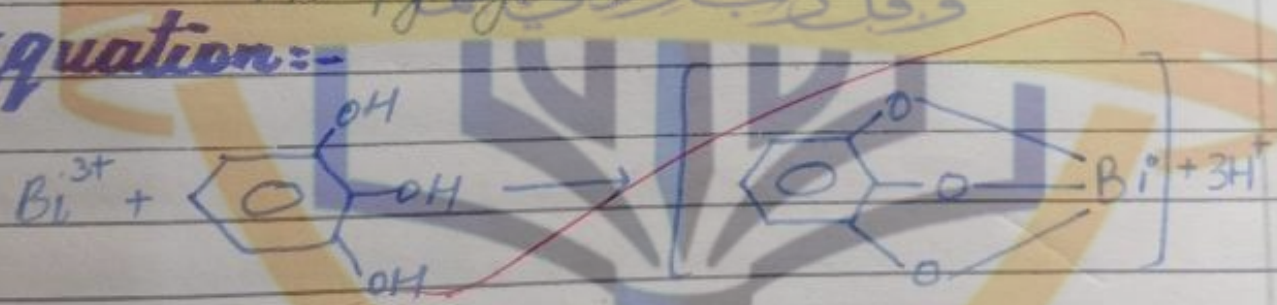
In this technique the amount of soluble specie is determined by converting it into insoluble specie using organic or inorganic reagents.

Chemical:-

1% $Bi(NO_3)_2$ soln

1% Pyragallol soln

Equation:-



Preparation of soln:-

1% $Bi(NO_3)_2$

- Dissolve 1g of $Bi(NO_3)_2$ in water and make it dilute upto 100 ml.

1% Pyragallol

- Dissolve 1g of pyragallol in hot H_2O and make volume upto 100ml Pyragallol is insoluble in cold water.

20 ml sample contain Bi^{3+} = 0.06

1 ml " " = $\frac{0.06}{20}$

1000 ml " " " = $\frac{0.06}{20} \times 1000$

= 3.15 g/l

Result :-

The amount of Bi^{3+} in a given Sample is 3.15 g/l.

Uses of Bi^{3+}

- It is used as thermocouple naturals.
- It is used in cosmatics.
- The alloy of Bismith is used in auto-matic fire sprinkles.
- In detection system and in electronic fuses.
- Bi^{3+} is usually mixed with other metal like lead, iron or cd to form melting alloy.

Procedure:-

Take 20 ml of sample solution. Add 1% Pyragallol ~~Soln dropwise to the sample~~ soln. Until in soln ppt are formed.

Heat the soln so that ppt are coagulated.

No filter it and weight ppt formed.

Brown color ppt are formed.

Experiment # 8:-

Determine amount of Fe^{3+} in given Sample gravimetrically.

preparation of Reagent:-

- **Buffer soln:-**

$$M_1V_1 = M_2V_2$$
$$0.1 \times 250 = 17 \times V_2$$
$$V_2 = 1.5 \text{ ml}$$

- **0.1 M sodium Acetate:-**

65 ml of CH_3COOH + 35 ml of CH_3COONa = Buffer Solution (PH 4-5)

- **2% 8 hydroxyquinoline**

2 g of 8 hydroxyquinoline dissolve in 10 ml ethanol for complete solubility and 88 ml of 1 M acetic acid is added.

1 M CH_3COOH

$$M_1V_1 = M_2V_2$$
$$1 \times 100 = 17 \times V_2$$
$$V_2 = 5.8$$

Experiment #8

Determine amount/l of Fe^{3+} in a given sample gravimetrically.

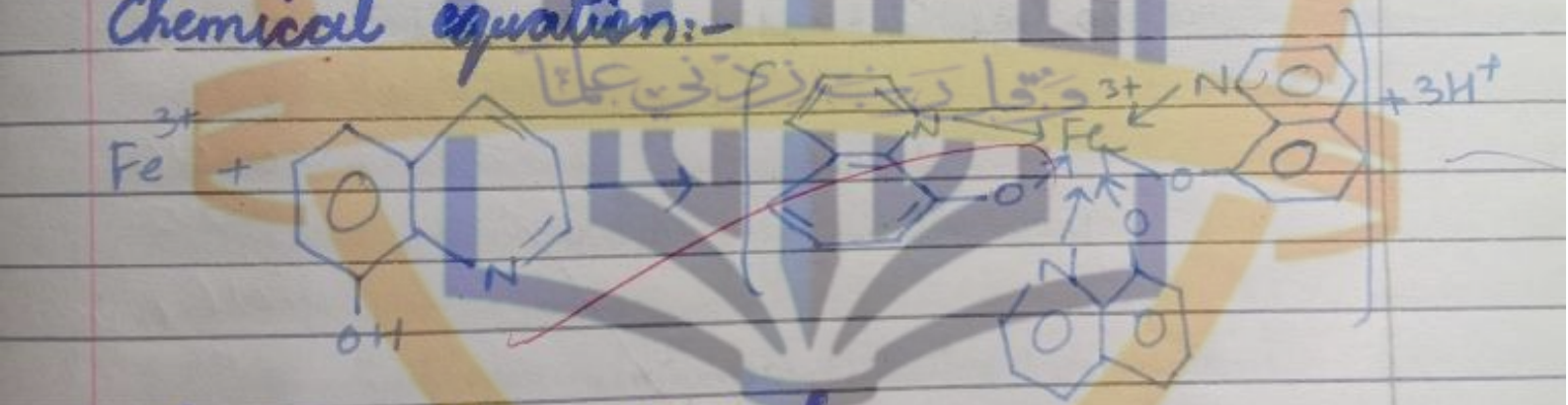
Principle:-

It is microscopic analytical technique.

Theory:-

In this technique the amount of sample specie is determined by converting it into insoluble specie using some organic or inorganic reagents.

Chemical equation:-



Preparation of Soln:-

Buffer Soln

Given = Required

$M_1V_1 = M_2V_2$

$0.1 \times 250 = 17 \times V_2$

$V_2 = \frac{0.1 \times 250}{17}$

$V_2 = 1.5$ ml

Calculation :-

wt. of filter paper = w_1 = 1.20 g

wt. of filter paper + ppt = w_2 = 1.34 g

Net weight = w = 1.34 - 1.20

= 0.14 g

488 g of complex contain Fe^{3+} = 55.8

1 g " " " = $\frac{55.8}{488}$

0.14 g " " " =

$= \frac{55.8}{488} \times 0.14$

20 ml of complex contain Fe^{3+} = 0.016

1 ml " " = $\frac{0.016}{20}$

1000 ml " " =

$\frac{0.016}{20} \times 1000$

= 0.8 g/l

Result :-

The amount of Fe^{3+} in a given sample is 0.8 g/l.

0.1 M CH_3COONa

$$\text{Molarity} = \frac{\text{mass of solute}}{\text{molar mass}} \times \frac{1}{\text{vol } dm^3}$$

$$0.1 = \frac{x}{82} \times \frac{1100}{1000}$$

$$x = 0.1 \times 82 \times 0.1$$

$$x = 0.82\ g$$

65 ml of CH_3COOH + 35 ml of CH_3COONa = [Buffer soln, PH = 4-5]

2 % 8 hydroxy quinoline

2g of hydroxyquinoline dissolved in 100 ml of ethanol, for example solubility 88 ml of 1M acetic acid is added

1 M acetic acid

Given = Required

$M_1V_1 = M_2V_2$

$V_2 = 5.88$ ml

Procedure:—

- Take 20 ml of saturated solution of Fe^{3+} at 25 °C.
- Add few drops of buffer solution.
- Now add 8-hydroxyquinoline soln. dropwise in above soln.
- Heat it so that ppt are coagulated
- Green ppt are obtained.

Experiment # 9:-

Determine amount/l. of Cl^- using 0.05 M $AgNO_3$ soln.

⇒ Preparation of reagent:-

(a) 0.02 M of NaCl:-

$$0.025\ M = \frac{x}{59} \times \frac{1}{100/1000}$$

$$x = 0.025 \times 59$$

$$x = 1.475\ g/100\ ml$$

(b) 0.05 M of $AgNO_3$

$$0.05\ M = \frac{x}{169} \times \frac{1}{100/1000}$$

$$x = \frac{0.05 \times 169}{10}$$

$$x = 0.84\ g/100\ ml$$

Chemical Equation:-

$$AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$$

Experiment No. 9

Determine amount/l of Cl^- using 0.05 M $AgNO_3$ soln.

Principle:-

It is precipitation titration.

Theory:-

The reciprocal of resistance is termed as conductance.

Unit of conductance is Siemen. (S).

Resistance is directly propotional to length and inversely propotional to area.

$$R = \rho \frac{l}{A}$$

ρ is known as resistivity. Reciprocal of resistivity is called conductivity.

$$K = \frac{l}{\rho}$$

Conductance of electrolyte soln depends upon ions present and their concentration at particular temperature.

When soln is diluted, conductance decreases since few ions are present. For strong electrolytes molar conductivity inceases

vol. of $AgNO_3$	conductance (ms)
0	1.47
3	1.314
6	1.190
9	1.083
12	1.172
15	1.266
18	1.36
21	1.516
24	1.621
27	1.718
30	1.80

Calculation:-

$AgNO_3$ = NaCl

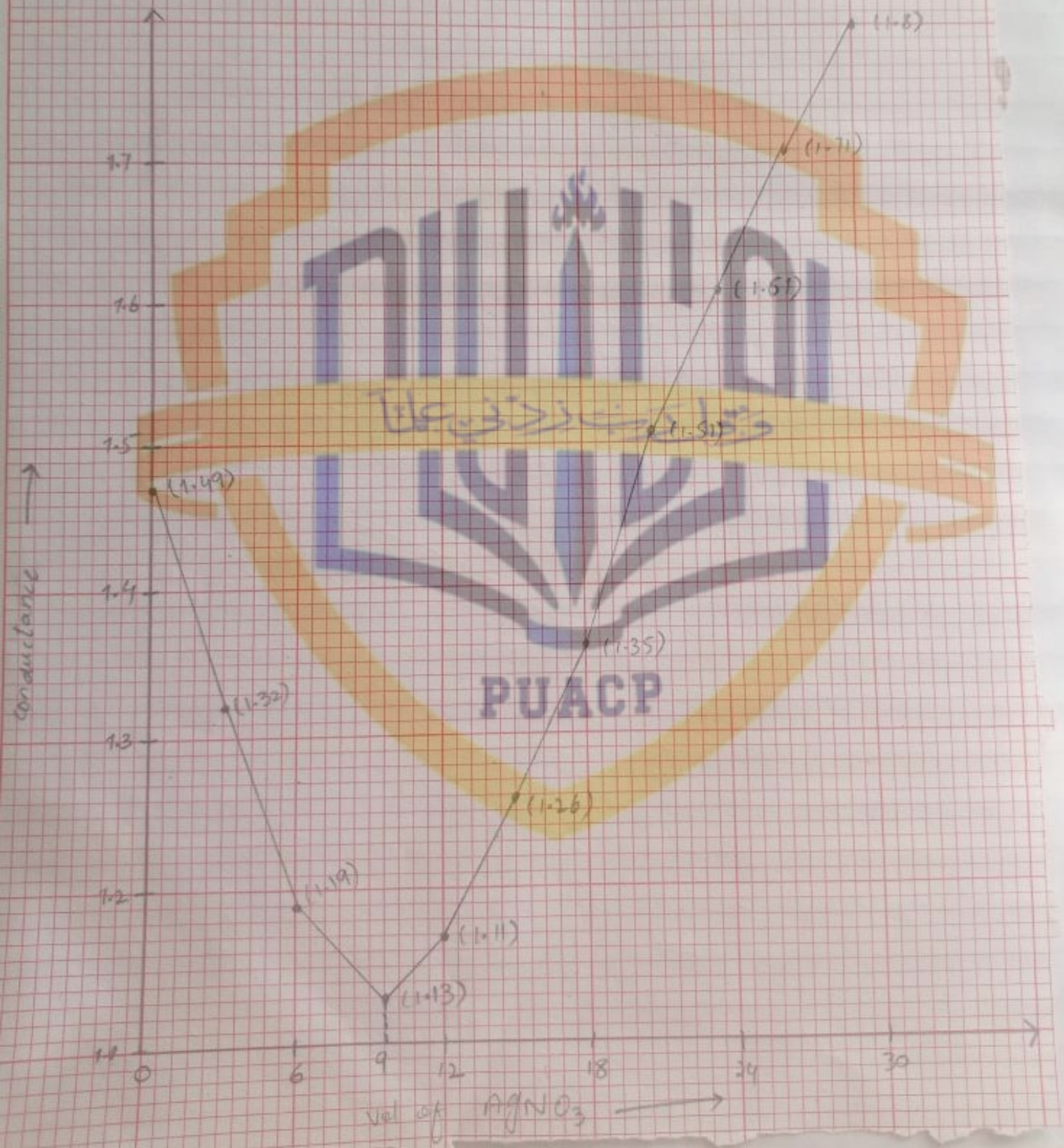
$M_1V_1 = M_2V_2$

$0.05 \times 9 = M_2 \times 25$

$M_2 = 0.018\ M$

Exp No 9.

- Scale
- Along x-axis
  1 B.B = 6
  1 S.B = 0.6
- Along y-axis
  1 B.B = 1.1
  1 S.B = 0.11



but it approaches to limiting value. Known as molar conductivity at infinite dilution.

Conductometer

Instrument that is used to measure conductance. In short conductance decrease due to rapid fall of conc. of Cl^- ions. After equivalence point, conductivity rises due to increase in conc. of Ag^+ ions.

Uses of Cl^- ion.

- Chlorine belong to group VII A of periodic table and have uses.
- Used for preserving food.
- used as bleaching agent in paper and pulp industry.

Uses of Ag^+ ion

- Atomic no. is 47 and mass no is 108.
- used in jewellery electroplating.
- In decoration of sweets.
- Co-ordination no. is 2 and complexes are linear.

Procedure:—

- 25 ml of sample soln NaCl was taken in beaker 0.05 M $AgNO_3$ taken in burette.
- Add 2 ml of it to sample and measure the conductance.

Strength of Cl^- = molarity × atomic wt. of Cl^-

= 0.018 × 35.5

= 0.639 g/dm^3

Result:-

The amount / ℓ of Cl^- in a given sample is 0.639 g/l

- The conductance falls in start and rises after equivalence point.
- plot graph b/w volume of $AgNO_3$ on x-axis and conductance on y-axis.

Experiment #10:-

Standardize given mixture of $CH_3COOH + HCl$ conductometrically.

Preparation of reagent:-

(i) $HCl = NaOH$

$M_1 = ?$ $\quad M_2 = 0.1$

$V_1 = 5$ $\quad V_2 = 9$

$n_1 = 1$ $\quad n_2 = 1$

$$\frac{M_1V_1}{n_1} = \frac{M_2V_2}{n_2}$$

$$M_1 = \frac{M_2V_2}{n_2} \times \frac{n_1}{V_1} = \frac{0.1 \times 9}{1} \times \frac{1}{5}$$

$M_1 = 0.18\ M$

(ii) $CH_3COOH = NaOH$

$M_3 = ?$ $\quad M_4 = 0.1$

$V_3 = 5$ $\quad V_4 = 3(12-9)$

$n_3 = 1$ $\quad n_4 = 1$

$$\frac{M_3V_3}{n_3} = \frac{M_4V_4}{n_4}$$

$$M_3 = \frac{0.1 \times 3}{1} \times \frac{1}{5} = 0.06\ M$$

(i) Strength of HCl = Molarity x mol. wt

$= 0.18 \times 36.5$

$= 6.57\ g/dm^3$

(ii) Strength of CH_3COOH = Molarity x mol. wt

$= 0.06 \times 60$

$= 3.6\ g/dm^3$

Experiment No. 10

Standardize the given mixture of $CH_3COOH + HCl$ conductometrically

Principle:-

It is acid base titration.

Theory:-

The reciprocal of resistance is conductance Units of conductance is Seiman (S).

Resistance is directly proportional to length and inversly proportional to Area.

$$R = \rho \frac{l}{A}$$

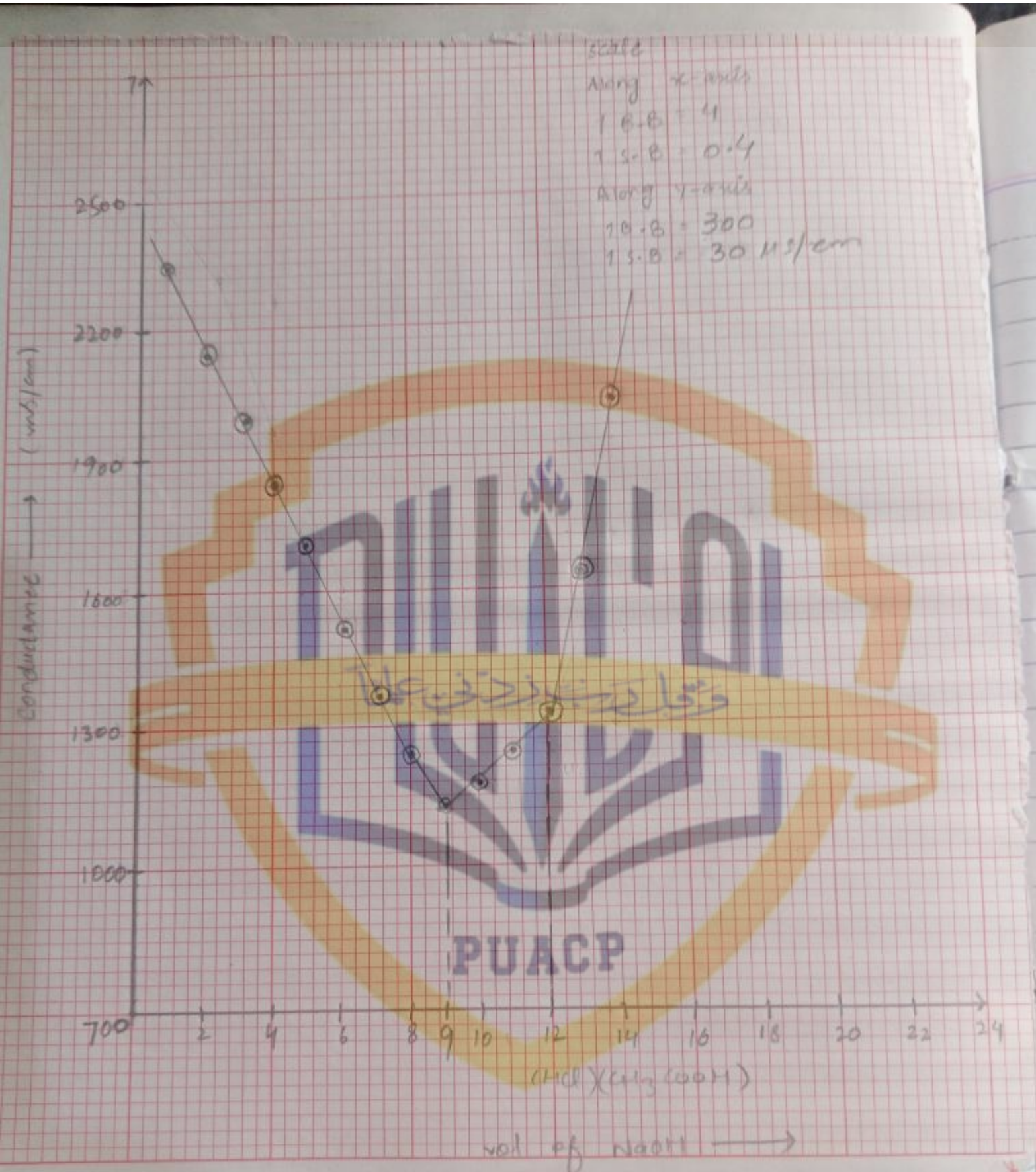
Conductivity is the reciprocal of resistivity conductance of electrolyte soln depend upon ion present and their conc. at particulate temp.

When soln is diluted conductance decreases since few ions are present. For strong electrolyte molar conductivity increases as dilution increases.

But it approaches limiting value known as molar conductivity at infinite dilution.

Basis for conductometric titration

In start, the conductivity decreases due to rapid fall of conc. of H^+ ions of



(ii) HCl = 6.57 gl dm^{-3}

(iii) CH_3COOH = 3.6 gl dm^{-3}

Observation & Calculations:-

	Volume of NaOH	Observed Conductance (μs/cm)
1	1	1990
2	2	1840
3	3	1709
4	4	1545
5	5	1365
6	6	1243
7	7	1190
8	8	1260
9	9	1270
10	10	1320
11	11	1657
12	12	2050
13	13	2230

Result:-

Strength of each acid in mixture as

(i) HCl = 6.57 gl dm^3

(ii) CH_3COOH = 3.6 gl dm^3

of strong acid HCl, after equivalence the conductivity slowly rises due to slow dissociation of H^+ ions of weak acid. After that H^+ ions of weak acid competes with OH^- ions of strong base (NaOH) and sharp rise of conductivity is obtained.

Procedure:-

- Take 25 ml of CH_3COOH and 25 ml of HCl and takes mixture of both acids in beaker.
- Take 0.1 M NaOH in burette.
- Now 2 ml of it is added to sample soln.
- Measure the conductance. The conductance falls in start and slowly rise after second equivalent point.
- The graph b/w vol. of NaOH and conductance is plotted.

Experiment # 11:-

Determine conc. of Ni^{2+} Calorimetrically or spectrophotometrically:

Preparation of reagent:-

1- Stock soln:- Molar mass of compound :- Molar mass of Ni

$$= \frac{237.7}{58.7} = 0.4/1000 \text{ ml } H_2O.$$

2- Prep of different ppm conc. from stock soln

(i) Prep of 10 ppm soln

Given = Required

$C_1V_1 = C_2V_2$

$1000 \times V_1 = 10 \times 1000$

$V_1 = 1 \text{ ml}/100 \text{ ml } H_2O.$

(ii) Prep of 15 ppm soln

Given = Required

$C_1V_1 = C_2V_2$

$1000 \times V_1 = 15 \times 100$

$V_1 = 1.5 \text{ ml}/100 \text{ ml } H_2O.$

(iii) Prep of 20 ppm soln

$C_1V_1 = C_2V_2$

$1000 V_1 = 20 \times 100$

$V_1 = 2 \text{ ml}/100 \text{ ml } H_2O.$

Experiment No. 11

Determine conc. of Ni^{2+} calorimetry or spectrophotometrically.

Theory:-

Measurement of sample by caliberation curve as a result of standard soln analysis is known as Calorimetry analysis.

spechoscopy

It is interaction of electromagnetic radiations with matter.

Types:-

Atomic :-

It is further subdivided into atomic absorption spechroscopy.

Molecular:-

Further include UV, visible spectroscopy, IR spectroscopy, NMR spectroscopy, Mass spectroscopy.

Sources of excitation

Sources of excitation can be flamed by hollow cathode lamp. Inductive coupled plasma (Icp).

Beer lambert law

UV/visible spectra based upon beer lambert law which states that

(iv) Prep of 25 ppm soln:-

$$C_5V_5 = C_6V_6$$
$$1000 \times V_5 = 25 \times 100$$
$$V_5 = 2.5/100\text{-ml } H_2O$$

(v) Prep of 30 ppm soln:-

$$C_7V_7 = C_8V_8$$
$$1000 \times V_1 = 30 \times 100$$
$$V_1 = 3\text{-ml}/100\text{ml}$$

(vi) Prep of 35 ppm soln:-

$$C_9V_9 = C_{10}V_{10}$$
$$1000 \times V_9 = 35 \times 100$$
$$V_9 = 3.5\text{ml}/100\text{ml}$$

(vii) Prep of 40 ppm soln:-

$$C_{11}V_{11} = C_{12}V_{12}$$
$$1000 \times V_{11} = 40 \times 100$$
$$V_9 = 4.0/\text{ml } H_2O.$$

Preparation of DMG

Dissolve 0.1 g of DMG in ethanol and make vol. upto 100ml.

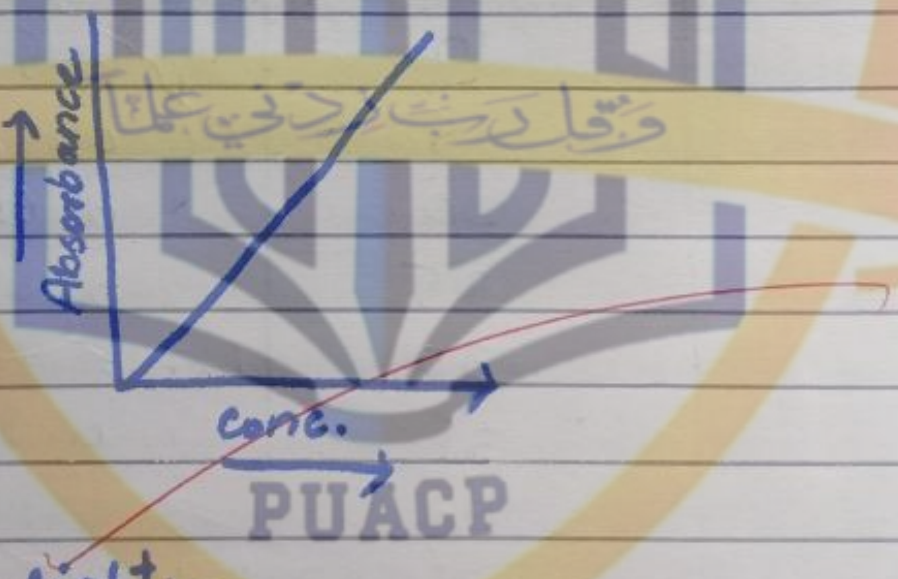
The adsorption of light by sample is directly propotional to conc. and path length of sample.

$$A \propto c\,l$$

$$A = a.c.l$$

As we fix length of path length that is $l = 1cm$ then

$$A \propto c$$



Source of light:-

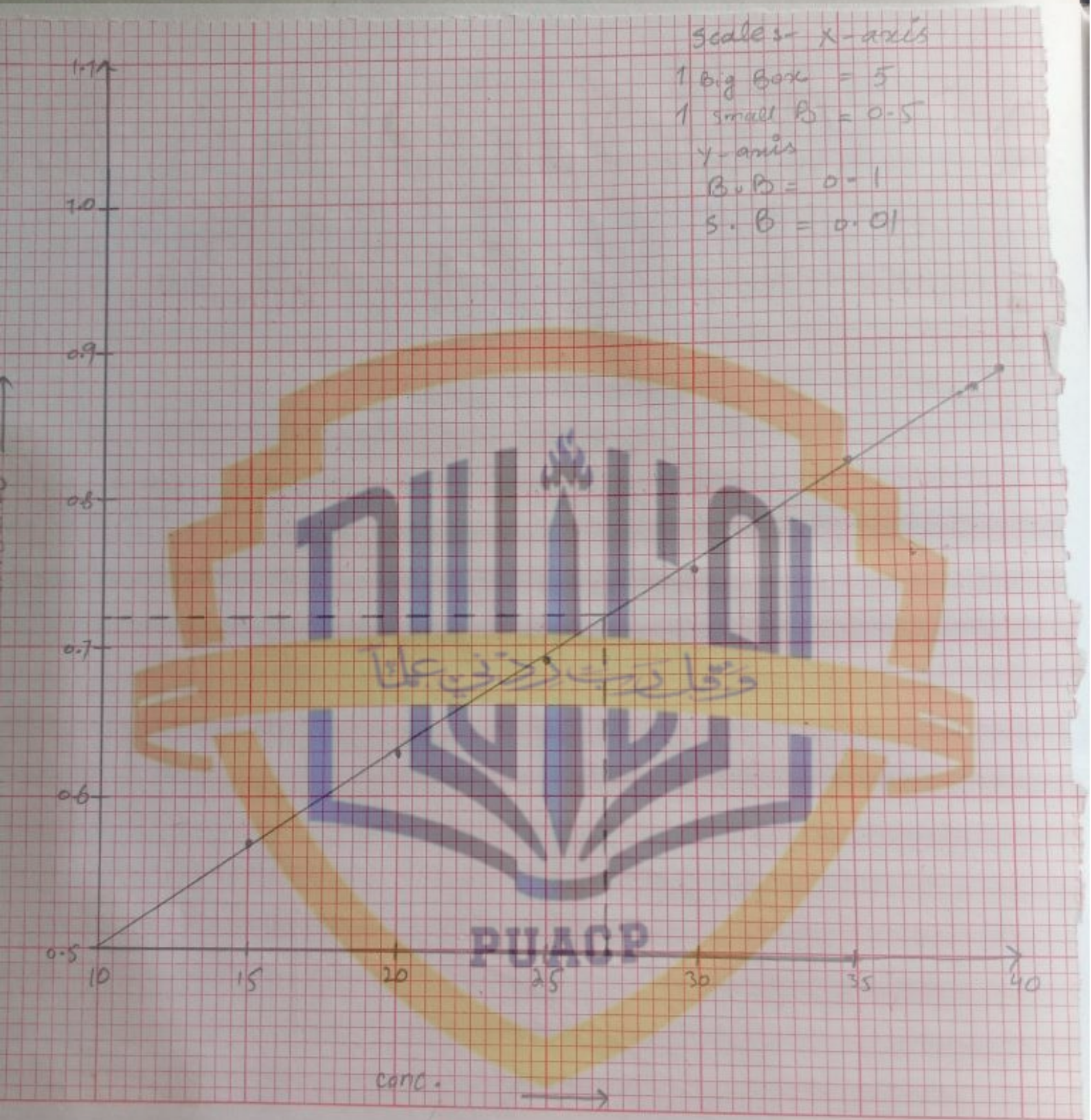
Deutrium tungsten.

Curvette

Curvette are made up of quartz

Chemical Equation:-

$$NiCl_2 + 6H_2O \longrightarrow Ni^{4+}$$



Result:-

Conc. of unknown sample is

2ml of liq NH_3 + 15ml H_2O

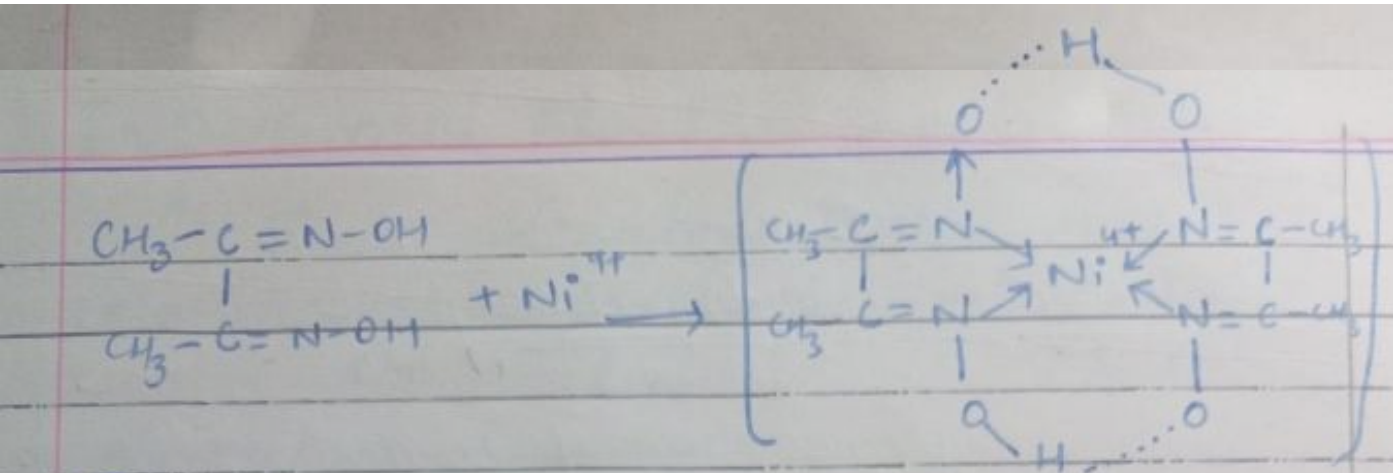
$$NH_3 + H_2 \longrightarrow NH_4OH$$

Observation:-

concentration PPm	Absorbance
10	0.5
15	0.556
20	0.629
25	0.695
30	0.755
35	0.820
40	0.885
Unknown	0.472

Result:-

Conc. of unknown sample is 27 ppm at absorbance.



Procedure:—

- Prepare stock soln of $NiCl_2 \cdot 6H_2O$. From this stock solution. Futhur prepare the conc. soln from 10ppm - 40 ppm.
- Then taken seven test tubes and tag them.
- Add 5 ml of each ppm conc. of each Test tubes, then add 1 ml of Br water as oxidizing agent. to convert Ni^{2+} to Ni^{4+}
- Then add 1-2 drops of NH_4OH act as a catalyst. Now add 5 ml of complexating agent.
- Allow to stand for 15 min.
- Take readings from spectrophotometre and plot graph.

Uses of Ni^{2+}

- Chemical element having atomic no 28.
- It is used as metal alloy like steel, brasses and bronze.
- It is used in production of rechargeable batteries, electric generators.

Experiment # 12

Determine conc. of Fe^{2+} colorimetry or spectrophotometry.

Preparation of reagent

(a) Stock Soln:- = $\frac{\text{Molar mass of compound}}{\text{Molar mass of } Fe^{2+}}$

$= \frac{278}{56} = 4.97 / 100 \text{ ml } H_2O.$

(b) Prep of different ppm conc. from stock.

(1) Prep of 10ppm soln:-

Given = Required

$C_1V_1 = C_2V_2$

$1000 \times V_1 = 10 \times 100$

$V_1 = \frac{1000}{1000} = 1 \text{ ml} / 100 H_2O$

(ii) preparation of 15 ml soln:-

$C_3V_3 = C_4V_4$

$1000 \times V_1 = 15 \times 100$

$V_1 = 1.5 \text{ ml} / H_2O$

Experiment No. 12

Determine concentration of Fe^{2+} colorimetry or spectrophotometrically.

Theory:-

The measurement of conc. of sample by caliberation as a result of standard soln analysis is known as colorimetric analysis.

Spectroscopy

It is the interaction of electromagnetic radiation with matter. There are various types of spectroscopy.

Atomic:-

It is further divided into

- atomic adsorption
- atomic emission

Molecular

Further includes

- UV visible spectroscopy
- NMR spectroscopy
- IR spectroscopy
- Mass spectroscopy

Source of excitation

- It can be flamed by hollow cathode lamp.
- Inductively coupled plasma (ICP)

(3) prep of 20 ppm soln:-

$$C_1V_1 = C_2V_2$$

$$1000 \times V_1 = 20 \times 100$$

$$V_1 = 2ml // 100ml\ H_2O.$$

(4) prep of 25 ppm soln:-

$$C_1V_1 = C_2V_2$$

$$1000 \times V_1 = 25 \times 100$$

$$V_1 = 2.5ml / 100ml\ H_2O.$$

(5) prep of 30 ppm soln:-

$$C_2V_2 = C_3V_3$$

$$1000 \times V_2 = 30 \times 100$$

$$V_2 = 3ml / 100ml\ H_2O$$

(6) prep of 35 ppm soln

$$C_4V_4 = C_5V_5$$

$$0.1 \times 250 = 17 \times V_2$$

$$V_2 = 1.5\ ml$$

(7) prep of 40 ppm soln

$$C_6V_6 = C_7V_7$$

$$1000 \times V_6 = 40 \times 100$$

$$V_6 = 4ml / 100\ H_2O.$$

Beer lambert law

It states that

The adsorption of light by simple is directly propotional to conc. and path length of sample.

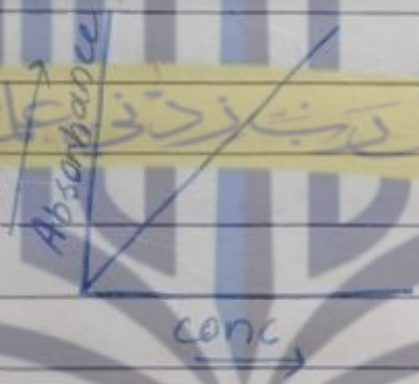
$$A \propto C.l.$$

$$A = a.c.l$$

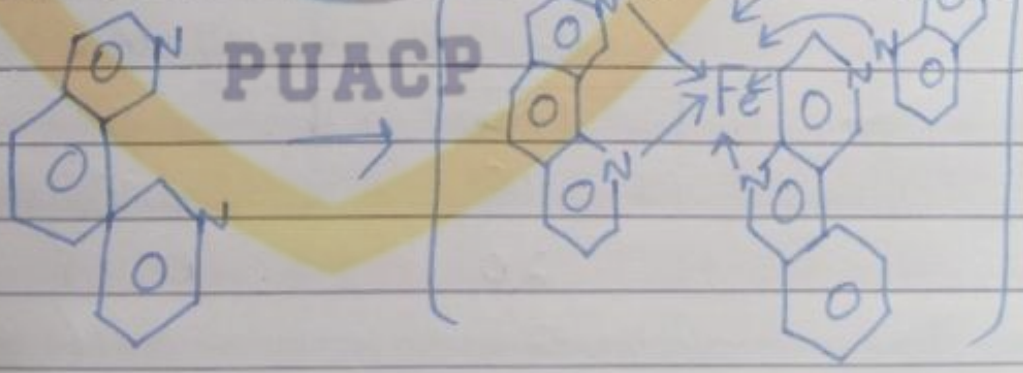
As we fix path length that is $l = 1\,cm$ then

$$A \propto C$$

Caliberation Curve



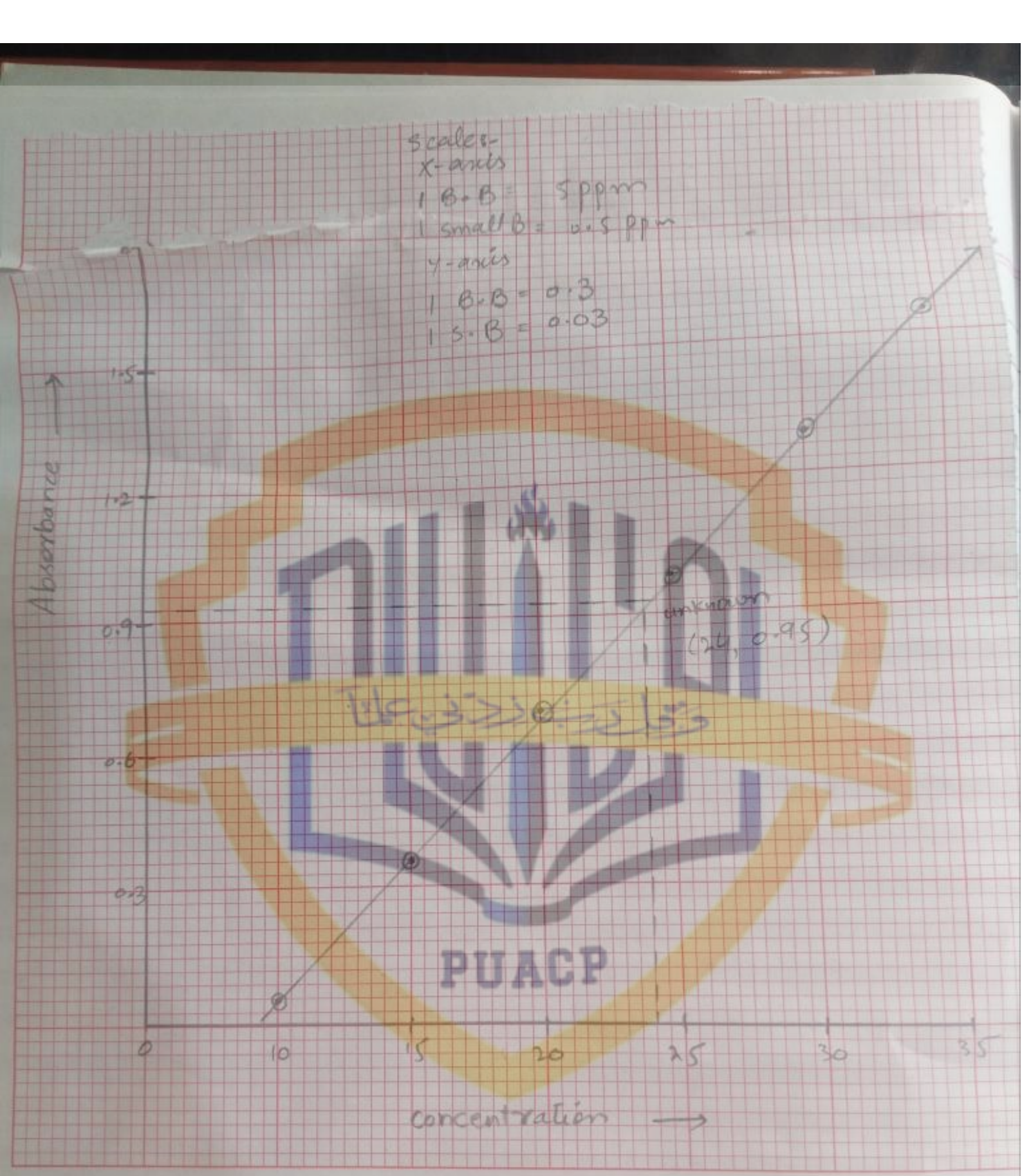
Equation:-

Fe^{2+} + 

Procedure:-

- Prepare soln of $FeSO_4 \cdot 7H_2O$ from this stock soln. Further prepare seven conc. soln from 10 ppm - 40 ppm.

Scales:-
X-axis
1 B.B = 5 ppm
1 small B = 0.5 ppm
y-axis
1 B.B = 0.3
1 S.B = 0.03



30	1.29
35	1.62
40	1.94
Unknown	0.9

Preparation of Buffer Solns:-

(i) 0.1 M CH_3COOH:-

$$M_1V_1 = M_2V_2$$

$$0.1 \times 250 = 17 \times V_2$$

$$x = 1.5 \text{ ml}$$

(ii) 0.1 M CH_3COONa

$$0.1M = \frac{x}{82} \times \frac{1}{100/1000}$$

$$x = 0.82 \text{ g}$$

⇒ Preparation of 1% 8 hydroxyquinoline:-

1g of soln and make volume upto 100 ml with Buffer

⇒ Prep. of 0.25%

ppm	Absorbance
10	0.1
15	0.33
20	0.65
25	0.96
30	1.29
35	1.62
40	1.94
Unknown	0.9

- Then take Seven test tubes and tag them.
- Add 5 ml of each ppm conc. to each test tubes, then add 1ml of Br-water as oxidizing agent to convert Ni^{2+} to Ni^{4+}.
- Then add 1-2 drops of NH_4OH act as a catalyst. Now add 5ml of complexating agent i.e 1-10 phenanthroline.
- Allow to stand for 15 min.
- Take reading from spectrograph/ Spectrophotometer and plot graph.

Uses of Ferrous

- It is strong metal and used in manufacturing of machine, tools, ships, used in building parts.
- Used in manufacturing diff tools, surgical equipments and appliances.
- Used in production of steels.

Experiment # 13:-

Determine conc. of Cr^{3+} Colorimetry.

Preparation of reagent

1. Stock soln:- $\frac{\text{molar mass of comp}}{\text{molar mass of}}$

$= \frac{194.2}{54}$

$= 0.373$ g/100 ml

2) Preparation of diff ppm from stock soln:-

(i) Prep of 10 ppm soln:-

$C_1V_1 = C_2V_2$

$1000 \times V_1 = 10 \times 100 \quad V_1 = 1 \text{ ml}/100 \text{ ml}$

(ii) Prep of 15 ppm soln:-

$C_1V_1 = C_2V_2$

$1000 \times V_1 = 15 \times 100$

$V_1 = 1.5 \text{ ml}/100 \text{ ml } H_2O$

(iii) Prep of 20 ppm soln:-

$1000 \times V_1 = 20 \times 100 \text{ ml}$

$V_1 = 2 \text{ ml}/100 \text{ ml } H_2O$

Experiment No. 13

Determine conc. of Cr^{3+} calorimetrically.

Theory:-

Measurement of sample by caliberation curve are result of standard soln analysis is known as calorimetric analysis.

spectroscopy is the interaction of electromagnetic radiation with matter.

Beer lambert law

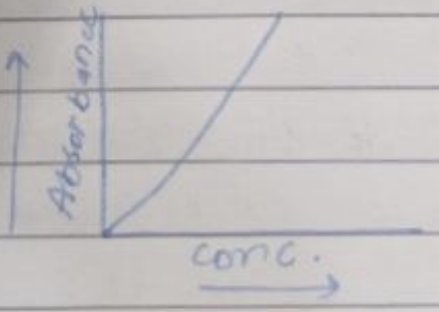
The absorption of light by the sample is directly proportional to conc. and path length.

$$A \propto c.l$$

$$A = \varepsilon . c . l$$

As we know that path length is fixed that $l = 1cm$ then

$$A \propto c$$



(iv) Prep of 25 ppm:-

$$C_1V_1 = C_2V_2$$

$$V_1 \times 1000 = 25 \times 100$$

$$V_1 = 2.5 \text{ ml}/100 \text{ ml } H_2O.$$

(v) Prep of 30 ppm:-

$$C_1V_1 = C_2V_2$$

$$1000 \times V_1 = 30 \times 100 \text{ ml } H_2O.$$

$$V_1 = 3 \text{ ml}/100 \text{ ml } H_2O.$$

(vi) Prep of 35 ppm:-

$$C_1V_1 = C_2V_2$$

$$1000 \times V_1 = 35 \times 100$$

$$V_1 = 3.5 \text{ ml}/100 \text{ ml } H_2O.$$

(vii) Prep of 40 ppm:-

$$C_1V_1 = C_2V_2$$

$$1000 \times V_1 = 40 \times 100$$

$$V_1 = 4 \text{ ml}/100 \text{ ml } H_2O.$$

Prep. of complexating agent

Take 0.25 ml of diphenyl carbazon dissolve it in 30 ml of ethanol and then dilute upto 100ml with $+H_2O$.

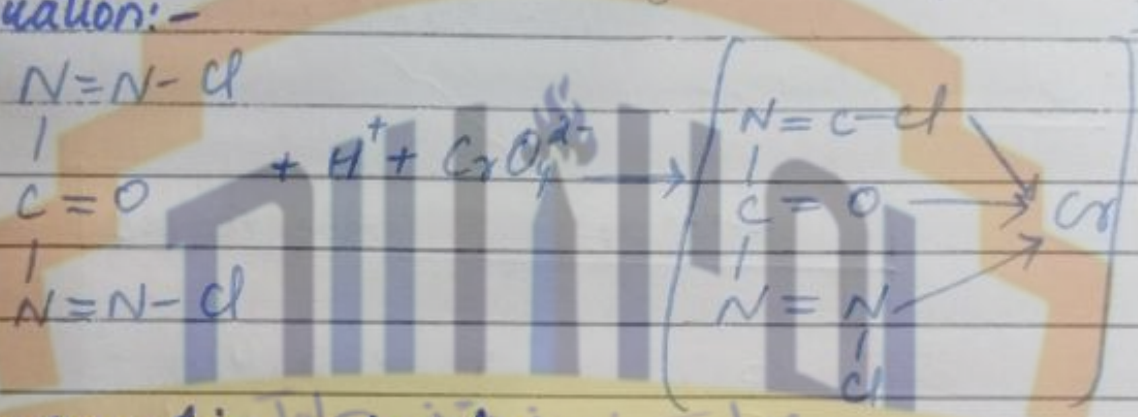
Draw back:-

spectrophotometer does not give accurate reading of highly concentrated soln.

Source of light:-

In UV/visible spectrophotometer the source is deutrium tungstun lamp.

Equation:-



Preparation of soln:-

5 M H_2SO_4

Given	Required
M_1V_1	$= M_2V_2$
$18V_1$	$= 6 \times 100$
V_1	$= \frac{6 \times 100}{18}$

$V_1 = 33.9$ ml/100ml H_2O

Stock solution:-

$$= \frac{\text{Molar mass of compound}}{\text{Molar mass of K}}$$

$$= \frac{194.2}{52} = 3.72 \text{g/100ml } H_2O$$

scale:- x-axis

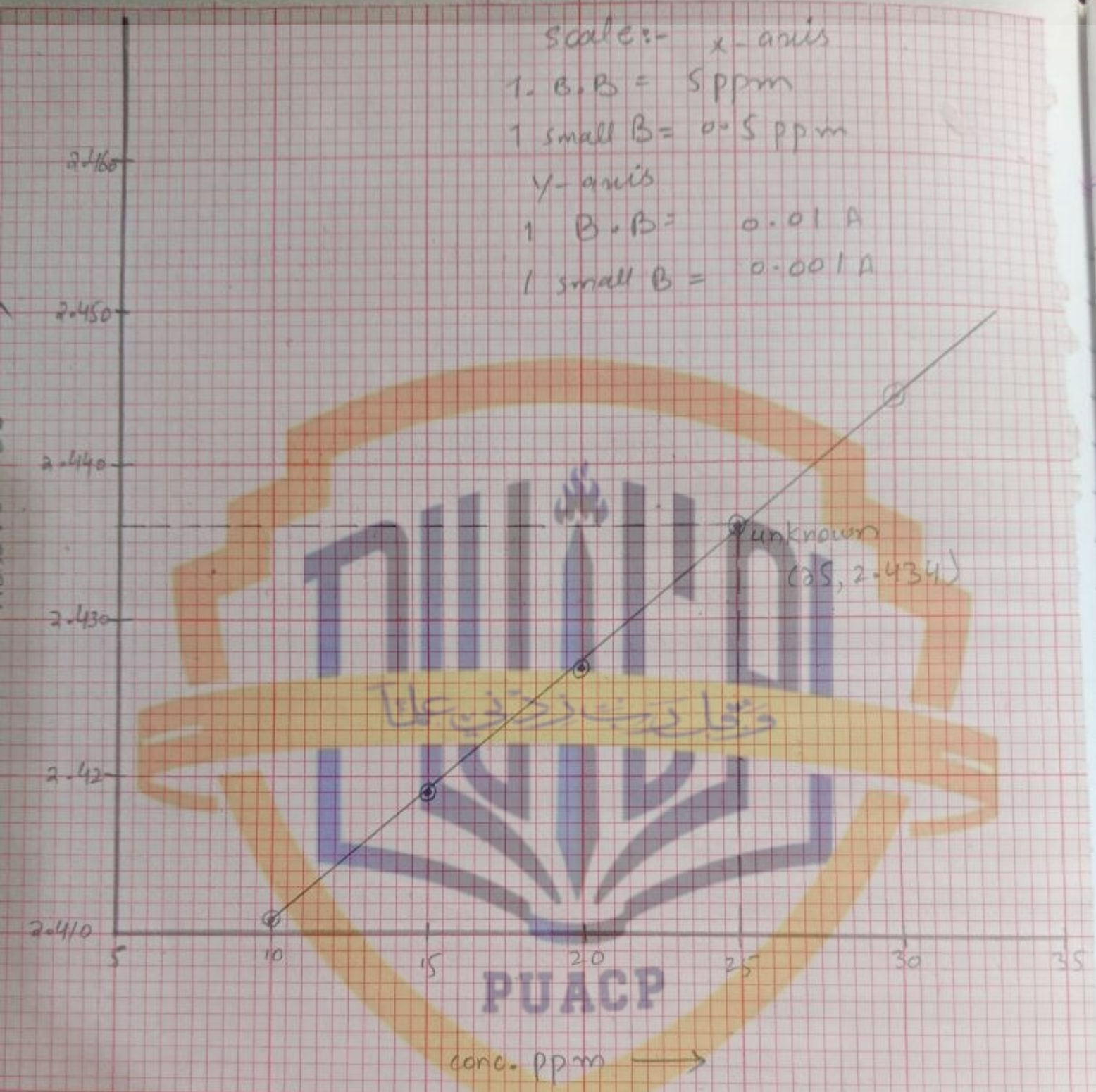
1 B.B = 5 ppm

1 small B = 0.5 ppm

Y-axis

1 B.B = 0.01 A

1 small B = 0.001 A



Result:-

The conc. of unknown sample is 23 ppm at absorbance 2.430.

prep. of 6M H_2SO_4:-

$$M_1V_1 = M_2V_2$$

$$18 \times V_1 = 6 \times 100$$

$$V_1 = \frac{6 \times 100}{18}$$

$V_1 = 33.3$ ml / 100 ml H_2O.

Observation:-

Conc.	Absorbance
10	2.410
15	2.418
20	2.425
25	2.433
30	2.441
35	2.499
40	2.456
unknown	2.430

Result:-

The conc. of unknown sample is 23 ppm at absorbance 2.430.

= 0.373/100 ml = 1000 PPm.

From this stock soln further prepare seven conc. from 10ppm-40ppm.

Preparation of complexating agent

Take 0.25 g of diphenyl carbozone dissolve it into 30ml of ethanol and then dilute upto 100ml of H_2O.

Procedure:-

- Prepare a stock soln of $K_2Cr_2O_7$ from this stock soln prepare seven conc. soln from 10ppm-40ppm.
- Then take 7 test tubes and add 5 ml of each ppm soln in each tube. Now add 1 ml of 6 M H_2SO_4 and 5 ml of complexating agent i.e diphenyl carbazone.
- Allow it to stand for 15 min.
- Take reading or check absorbance in spectrophotometer or calorimeter and then
- plot a calibration curve.

↳ -The color of complex is voilet.

⇒ Uses of Cr

- Used to harden the steel in manufacturing of stainless steel.
- used to produce alloy
- Cr-plotting used to give a polish mirror finish to steel.
- Cr-plate is used in bathroom fitting.
- Cr-plated car and bikes parts are also common such as bumper.

Experiment # 14:-

Determine amount / l of Cu^{2+} gravimetrically.

1) Preparation of Reagent:-

=> 1% $CuSO_4$ soln:-

Dissolve 1g of $CuSO_4$ in $+H_2O$ and make volume upto 100ml.

=> 1% Salicyldoxime

Dissolve 1g of salicyldoxime in 10.15 ml ethanol for completely soluble and make vol. upto 100ml.

وقل رب زدني علما

Calculations:-

wt. of filter paper = w_1 = 1.21

wt. of filter paper = w_2 = 1.27

Weight = $w_2 - w_1$

= 1.27 − 1.21

= 0.15 g

335g of complex contain Cu^{2+} = 64

1g " " " = $\frac{64}{335}$

Experiment No. 14

Determine amount /l of Cu^{2+} gravimetrically.

Theory:—

In this technique amount of soluble specie is determined by converting it into insoluble specie by using some precipitating agents which may be organic or inorganic reagents.

The amount of soluble specie is calculated by using the knowledge of molar weight of specie formed.

Use of gravimetric technique

It is used on wide scale in fertilizer industry for determination of nutrients.

In cement industry for determination of silica, Al^{3+}, Ca^{2+}.

In electroplating for determination of Zn^{2+}, Ca^{2+}, Ag^{+} etc.

$= 0.15$

0.15g " " $= \frac{64}{335} \times 0.15$

20 ml of sample contain $Cu^{2+} = 0.028g$

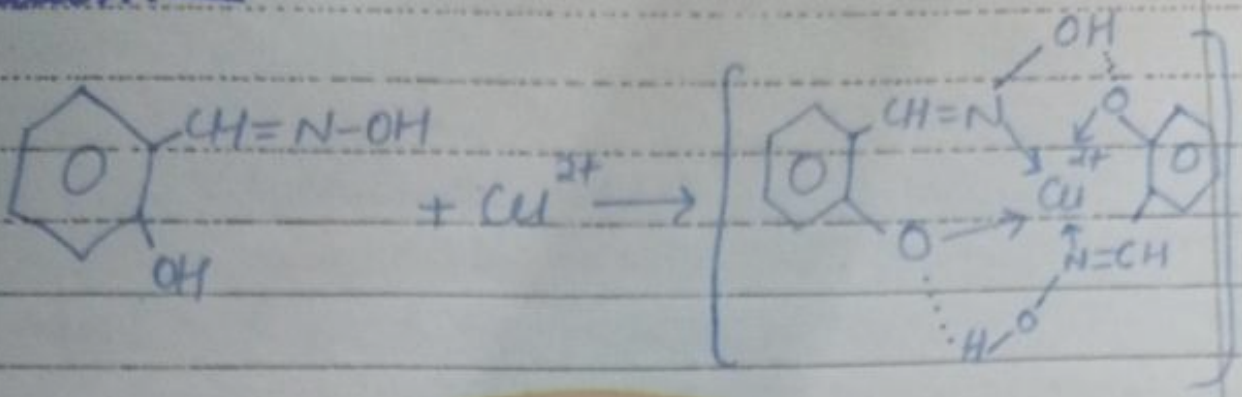
1ml " " " $= \frac{0.028}{20} \times 1000$

$= 1.49/l$

Result:-

The amount/l of Cu^{2+} in given sample is 1.4 g/l.

Equation:—



Preparation of soln:—

1 % $CuSO_4$ soln

Dissolve 1 g of $CuSO_4$ in H_2O and make the volume upto 100 ml.

1 % Salicylaldoxime.

Dissolve 1 g of Salicylaldoxime in 10-15 ml ethanol for the complete solubility of it and make volume upto 100 ml of H_2O.

Procedure:—

- Take 20 ml of $CuSO_4$ soln in tank.
- Add few drops of Salicylaldoxime soln until ppt formed.
- Heat soln so that precipitates are coagulated. Filter it and yield its weight of ppt.

- ppt are light green yield of ppt is 0.15g

Uses of Cu^{2+}

- In building constructions used for power generation and transmission.
- Used for manufacturing of electric power.
- used in production of industrial machinery and transportation vehicles.