GOVERNMENT OF TAMIL NADU

DIPLOMA COURSE IN
ENGINEERING & TECHNOLOGY

BASIC CHEMISTRY

FIRST SEMESTER

A Publication Under
Government of Tamil Nadu
Distribution of Free Text book Programme
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Untouchability is a sin
Untouchability is a crime
Untouchability is an inhuman

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Government of Tamil Nadu

First Edition - 2024
(Published Under Regulation 2023)

Content Creation
Directorate of Technical Education

https://dte.tn.gov.in/

Printing & Publishing

This book has been printed on 60 G.S.M.
paper. Printed by web offset at:

THE NATIONAL ANTHEM
FULL VERSION

Jana-gana-mana-adhinayaka jaya he
Bharata-bhagya-vidhata
Punjaba-Sindhu-Gujarata-Maratha-
Dravida-Utkala-Banga
Vindhya-Himachala-Yamuna-Ganga
Uchchhala-jaladhi-taranga
Tava Subha name jage, TavaSubhaasisa mage,
Gahe tava jaya-gatha.
Jana-gana-mangala-dayaka jaya he
Bharata-bhagya-vidhata.
Jaya he, jaya he, jaya he,
Jaya jaya jaya jaya he.

-Rabindranath Tagore

SHORT VERSION

Jana-gana-mana-adhinayaka jaya he
Bharata-bhagya-vidhata.
Jaya he, jaya he, jaya he,
Jaya jaya jaya jaya he.

AUTHENTIC ENGLISH TRANSLATION OF THE NATIONAL ANTHEM

Thou art the ruler of the minds of all people,
Thou dispenser of India's destiny.
Thy name rouses the hearts of the Punjab, Sind,
Gujarat and Maratha, of Dravida, Orissa and Bengal
It echoes in the hills of the Vindhyas and Himalayas,
mingles in the music of the Yamuna and Ganges
and is chanted by the waves of the Indian Sea.
They pray for Thy blessings and sing Thy praise
The saving of all people waits in Thy hand,
Thou dispenser of India's destiny.
Victory. Victory, Victory to Thee

THE NATIONAL INTEGRATION PLEDGE

“I solemnly pledge to work with dedication to preserve and strengthen the freedom and integrity of the nation.”

“I further affirm that I shall never resort to violence and that all differences and
disputes relating to religion, language, region or other political or
economic grievances should be settled by peaceful and
constitutional means.”

INVOCATION TO GODDESS TAMIL

Bharat is like the face beauteous of Earth clad in wavy seas;
Deccan is her brow crescent-like on which the fragrant ‘Tilak’ is the blessed Dravidian land.
Like the fragrance of that ‘Tilak’ plunging the world in joy supreme reigns Goddess Tamil with
renown spread far and wide.
Praise unto You, Goddess Tamil, whose majestic youthfulness, inspires awe and ecstasy

PREFACE

We are delighted to present this new edition of the Basic Chemistry textbook, meticulously crafted through invaluable feedback and recommendations from esteemed subject experts, faculty members, and industrial professionals.

In alignment with the dynamic landscape of technological advancements, this book has been thoughtfully curated to bridge the gap between foundational scientific principles and the latest engineering innovations. It endeavours to facilitate a seamless transition for students, empowering them with the essential knowledge to navigate the complexities of contemporary engineering practices.

With a dedicated focus on nurturing problem-solving abilities, honing presentation skills, and fostering critical thinking concerning environmental issues, this edition strives to equip learners with a comprehensive skill set essential for their professional journey.

We trust that this textbook, in its current iteration, will not only provide profound insights but also instil a pragmatic approach to learning chemistry. It is our fervent hope that students will embrace this resource as a catalyst for innovative solutions to environmental challenges.

We extend our heartfelt gratitude to all individuals whose unwavering dedication has contributed to shaping this edition, thereby enriching the educational experience of budding diploma students.

THE AUTHORS

1000231430	BASIC CHEMISTRY	L	T	P	C
Practicum		2	0	2	3

Introduction

Engineering is the application of the principles of basic science. The present syllabi of Basic Chemistry compiled for Diploma Engineering students restricts itself to certain limits, where it concentrates on basic concepts and useful applications viz. solution chemistry, surface chemistry, engineering polymeric materials like plastics, rubbers and electrochemistry, types of battery, preventions of corrosion. Enriching social awareness is an important component of education, hence, environmental chemistry aspects like air pollution, solid waste management and green chemistry are also included.

Course Objectives

The objective of this course is to enable the students to

- Outline the importance of acids, base pH Indicators with industrial applications.
- Illustrate the adsorption properties of colloidal particles, catalyst and their application.
- Examine the engineering polymeric materials like rubber & plastics.
- Explain about electrochemistry, electrochemical cells, batteries and to know about corrosion and prevention.
- Appreciate the importance of Environmental Chemistry.

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Enumerate the concentration, strength & pH of acids & base.
CO2: Demonstrate the catalytic & colloidal principles & properties
CO3: Elucidate the composite & usage of plastics and polymer products
CO4: Articulate the principles in electroplating, batteries and corrosion.
CO5: Interpret the effect of environmental hazards and the need of Green Chemistry.

Pre-requisites

High School Science

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Practicum		2	0	2	3

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2		2	1	1
CO2	3	3	2		2	1	1
CO3	3	3	2		2	1	1
CO4	3	3	3		2	1	1
CO5	3	3	3		2	1	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

- It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome-based and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).

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Practicum		2	0	2	3

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Lab Assessment	Written Test	Lab Assessment	Written Examination
Duration	2 hours				3 hours
Exam Marks	30	20	30	20	100
Converted to	10	10	10	10	60
Marks	20		20		60

1000231430	BASIC CHEMISTRY	L	T	P	C
Practicum		2	0	2	3

Unit I	**SOLUTION CHEMISTRY**	
Solution –Solute, Solvent - dilute and concentrated solution – methods of expressing the concentration of the solution – molality – molarity – normality(simple numerical problems only). Properties of acids and bases -Lewis concept of acids and bases –advantages - pH and pOH – Definition – Indicator – Definition – Buffer solution – Definition – Types of buffer solution with examples – Application of pH in industries.		6
Ex 1. Estimation of sulphuric acid Ex 2. Estimation of strong acid by pH metry		6
Unit II	**SURFACE CHEMISTRY**	
Colloids – Definition – True solution and Colloidal solution – Differences – lyophilic colloids and lyophobic colloids (definitions only) – Properties - Tyndall effect – Brownian movement – Industrial applications of colloids. Smoke Precipitation by Cottrell’s method, Purification of water, Catalyst – Definition – Positive – Negative catalyst – Definition – Types of catalysis – Homogeneous and Heterogeneous catalysis examples– Characteristics of a catalyst – Industrial applications of catalysts.		6
Ex 3. Preparation of lyophilic colloids and lyophobic colloids		6
Unit III	**CHEMISTRY OF ENGINEERING MATERIALS**	
Plastics – types – Types of Polymerization-Addition and condensation polymerization Thermoplastics and Thermoset plastics – Differences – Mechanical properties of plastics – Advantages of plastics over traditional materials-Natural polymer – Rubber – Extraction of rubber from latex - defects of natural rubber – Vulcanization – Compounding of rubber –Ingredients and their functions.		6
Ex 4. Preparation of thermosetting resin-Urea-formaldehyde resins		6
Unit IV	**ELECTRO CHEMISTRY**	
Electronic concept of oxidation and reduction– electrolytes -classification-strong, weak and non-electrolyte – examples – electrolysis – definition – Mechanism – Industrial applications of Electrolysis - Chrome plating - Primary Battery – Secondary Battery – Definition, examples & construction of Li-ion Battery. Corrosion (Definition)– Differential aeration theory only – Factors Influencing Rate of Corrosion. – Methods of Prevention of Corrosion (qualitative).		6
Ex 4. Preparation of thermosetting resin-Urea-formaldehyde resins		6

Unit V	ENVIRONMENTAL CHEMISTRY	
Air pollution – Definition – Air pollutants (SO2, H2S, HF, CO and Dust) – Sources and Harmful effects – Formation of Acid Rain – Harmful effects – Green House Effect – Causes – Ozone layer depletion and its harmful effects- Global warming – Harmful effects – Control of Air Pollution. Solid Waste – Definition – Problems – Types of Solid waste methods of Disposal – Land fill and Incineration – Recycling – Definition – Examples – Advantages of Recycling (Basic ideas) Green Chemistry Definition – Goals of Green Chemistry.		6
Ex 7. Crystallization of copper sulphate and identification of ions Ex 8. Decolorization of clayey water using sand bed.		6
TOTAL HOURS		60

Suggested List of Students Activity

- Mini Projects like working model of experiments like chrome plating, tinning and sand bed
- Better understanding through work sheets / Quiz/Oral Testing
- Crossword puzzles and poster making

Reference

- Textbook on Chemistry for XI standard (TN State Board)
- Textbook on Chemistry for XII standard (TN State Board)
- Essentials of Physical Chemistry, Bahl & Tuli, 28th edition, S.Chand Publishing House.
- A textbook of Engineering Chemistry, Dr.Sunita Rattan, 2020 reprint, S.K.Kataria&Sons
- Textbook of Physical Chemistry, P.L Soni,O.P.Dharmarha & U.N.Dash,2022 edition, S.Chand Publishing House.

Web-based / Online Resources

https://libguides.lib.msu.edu/chemistry/teachonline

https://www.khanacademy.org/science/chemistry

https://phet.colorado.edu/

https://www.sciencebysimulation.com/chemreax/Faq.aspx

SOLUTION CHEMISTRY

UNIT 1

Solution – Solute, Solvent – dilute and concentrated solutions – methods of expressing the concentration of solutions – molality – molarity – normality (simple numerical problems only) – Properties of acids and bases – Lewis concept of acids and bases – advantages – pH and pOH – Definition – Indicator – Definition – Buffer solution – Definition – Types of buffer solutions with examples – Applications of pH in industries.

Introduction

Study of solutions is important in chemistry. Solutions represent homogeneous mixtures composed of two or more components. They play a key role in our everyday life, scientific research and chemical industries.

In a solution, the substance present in the larger amount is called the solvent, while the one present in a smaller amount is the solute. The solute dissolves in a solvent to form a homogeneous solution.

Solution

A solution is a homogeneous mixture of one or more solute(s) in a solvent.

Example: Sugar in water, salt in water, sugar and salt in water etc.

Solute

A solute is a substance that can be dissolved by a solvent. In general, it is present in low quantity in a solution.

Solvent

Solvent is a substance that dissolves the solute. In general, it is present in large amount in a solution.

Dilute solution

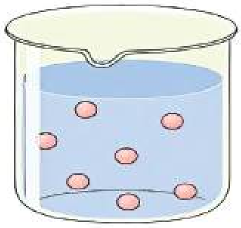
Dilute solutions are solutions which contain a low quantity of solute dissolved in a large amount of solvent.

Example: 1 g of sugar in 100 mL of water

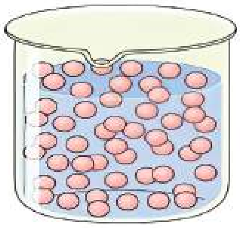
Concentrated solution

Concentrated solutions are solutions which contain a relatively large quantity of solute dissolved in a solvent.

Example: 10 g of sugar in 100 mL of water



Dilute solution



Concentrated solution

Methods of expressing the concentration of a solution

The amount of the solute dissolved in unit quantity of the solvent is called concentration.

Various methods of expressing the concentration of the solution

1. Molality – ‘m’
2. Molarity – ‘M’
3. Normality – ‘N’

Molality – ‘m’

The molality of a solution is the number of moles of solute present in 1000g of the solvent.

$$\text{Molality (M)} = \frac{\text{Number of moles of solute} \times 1000\text{g of solvent}}{\text{Mass of the solvent in Wg}}$$

$$\text{Number of moles of solute} = \frac{\text{Mass of a solute}}{\text{Molar mass of the solute}} = \frac{w}{M}$$

$$\text{Molality (m)} = \frac{w \times 1000g}{M \times W(g)}$$

where $\frac{w}{M}$ = Number of moles of solute

w = Mass of the solute

M = Molar mass of the solute

W = Mass of the solvent in grams

Problems

1. Calculate the molality of a solution containing 3 g of solute (Molar mass = 60) in 100 g of the solvent.

$$\text{Number of moles of solute} = \frac{\text{Mass of a solute}}{\text{Molar mass of the solute}} = \frac{w}{M}$$

$$\text{Molality (m)} = \frac{w \times 1000g}{M \times W(g)}$$

Mass of solute (w) = 3 g

Molar mass of solute (M) = 60

Mass of solvent (W) = 100 g

$$\text{Molality (m)} = \frac{3 \times 1000}{60 \times 100}$$

$$= 0.5 \text{ m}$$

The molality of the solution = 0.5 m

2. Calculate the molality of a solution prepared by dissolving 4g of sodium hydroxide (Molar mass = 40) in 1 kg of water.

$$\text{Molality (m)} = \frac{\text{Number of moles of solute} \times 1 \text{ kg}}{\text{Mass of solvent in Kg}}$$

$$\text{Molality (m)} = \frac{w \times 1000g}{M \times W(g)}$$

Mass of sodium hydroxide (w) = 4 g

Molar mass of sodium hydroxide (M) = 40

Mass of water in grams (W) = 1 kg = 1000 g

$$\text{Molality (m)} = \frac{4 \times 1000}{40 \times 1000}$$

$$= 0.1 \text{ m}$$

The molality of the solution = 0.1 m

Molarity –'M'

The molarity of a solution is the number of moles of solute present in one litre of the solution.

$$\text{Molarity (m)} = \frac{\text{Number of moles of solute}}{\text{Volume of solution in litres}}$$

$$\text{Molarity (m)} = \frac{w \times 1000mL}{M \times V(mL)}$$

where $\frac{w}{M}$ = Number of moles of solute

w = Mass of the solute

M = Molar mass of the solute

V = Volume of the solution in mL

Problems

1. Calculate the molarity of the solution prepared by dissolving 20 g of sodium hydroxide (Molecular mass = 40) in 1 litre of the solution.

$$\text{Molarity (m)} = \frac{\text{Number of moles of solute}}{\text{Volume of solution in litres}}$$

$$\text{Molarity (m)} = \frac{w \times 1000mL}{M \times V(mL)}$$

Mass of sodium hydroxide (w) = 20 g

Molecular mass of sodium hydroxide (M) = 40

Volume of solution (V) = 1 litre = 1000 mL

$$\text{Molality (M)} = \frac{20 \times 1000}{40 \times 1000}$$

$$= 0.5 \text{ M}$$

The molarity of the solution = 0.5 M

2. Find out molarity of acetic acid (Molecular mass = 60) solution when 1.24 grams of acetic acid is dissolved in 500 mL of the solution?

$$\text{Molarity (m)} = \frac{\text{Number of moles of solute}}{\text{Volume of solution in litres}}$$

$$\text{Molarity (m)} = \frac{w \times 1000\text{mL}}{M \times V(\text{mL})}$$

Mass of acetic acid (w) = 1.24 g

Molecular mass of acetic acid (M) = 60

Volume of solution (V) = 500 mL

$$\text{Molarity (M)} = \frac{1.24 \times 1000}{60 \times 500}$$

$$= 0.04 \text{ M}$$

The molarity of the solution = 0.04 M

Normality – 'N'

The normality of a solution is the number of gram equivalents of solute present in one litre of the solution.

$$\text{Normality (N)} = \frac{\text{Number of gram equivalents of solute}}{\text{Volume of solution in litre}}$$

Number of gram equivalents of solute =

$$\frac{\text{Mass of the solute}}{\text{Equivalent mass of the solute}} = \frac{W}{E}$$

$$\text{Normality (N)} = \frac{w \times 1000\text{mL}}{E \times V(\text{mL})}$$

where $\frac{w}{E}$ = Number of gram equivalents of solute

w = Mass of the solute

E = Equivalent mass of the solute

V = Volume of the solution in mL

Problems

1. What is the normality of a solution containing 3.16 g of potassium permanganate (Equivalent mass = 31.6) in 500 mL of water?

$$\text{Normality (N)} = \frac{\text{Number of gram equivalents of solute}}{\text{Volume of solution in litre}}$$

$$\text{Normality (N)} = \frac{w \times 1000\text{mL}}{E \times V(\text{mL})}$$

Mass of potassium permanganate (w) = 3.16 g

Equivalent mass of potassium permanganate (E) = 31.6

Volume of solution (V) = 500 mL

$$\text{Normality (N)} = \frac{3.16 \times 1000}{31.6 \times 500}$$

$$= 0.2 \text{ N}$$

The normality of the solution = 0.2 N

2. Calculate the normality of the solution containing 9.8 g of crystalline ferrous ammonium sulphate (Equivalent mass = 392) in 250 mL of solution.

$$\text{Normality (N)} = \frac{\text{Number of gram equivalents of solute}}{\text{Volume of solution in litre}}$$

$$\text{Normality (N)} = \frac{w \times 1000\text{mL}}{E \times V(\text{mL})}$$

Mass of ferrous ammonium sulphate (w)= 9.8 g

Equivalent mass of ferrous sulphate (E) = 392

Volume of solution (V) = 250 mL

$$\text{Normality (N)} = \frac{9.8 \times 1000}{392 \times 250}$$

$$= 0.1 \text{ N}$$

The normality of the solution = 0.1 N

Properties of acids

1. Acids are sour in taste.
2. Acids turn blue litmus paper to red .

3. Acids have pH values less than 7.

4. Acids are corrosive in nature.

5. Acids react with bases to give salt and water.

6. Aqueous solutions of acids are electrolytes.

7. Acids react with metals to give hydrogen gas.

Examples: HCl, H_2SO_4, HNO_3, etc.

Properties of bases

1. Bases are bitter in taste.
2. Bases turn red litmus paper to blue.
3. Bases have pH value greater than 7.
4. Bases are corrosive in nature.
5. Bases react with acids to give salt and water.
6. Bases are soapy to touch.
7. Bases give pink colour with phenolphthalein indicator.

Examples: KOH, NaOH, etc.

Lewis concept of acid and bases

According to the Lewis concept, substances that accept a pair of electrons are called Lewis acids.

Lewis acids are electron pair acceptors.

Examples: $AlCl_3$, BF_3

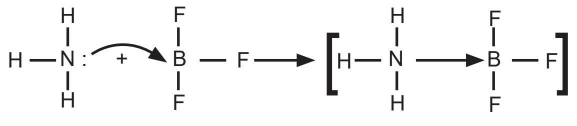
Lewis base:

According to the Lewis concept, substances that donate a pair of electrons are called Lewis bases.

Lewis bases are electron pair donors.

Examples: NH_3, Cl^-

Explanation:



Ammonia (Lewis base)
Boron Trifluoride (Lewis acid)

$$H_3N: + BF_3 \longrightarrow [H_3N \longrightarrow BF_3]$$

In the above reaction, nitrogen atom of ammonia donates its lone pair of electrons to boron atom of boron trifluoride. Hence, boron trifluoride is called a Lewis acid and ammonia a Lewis base.

Advantages of Lewis concept of acids and bases

1. It can explain the acidic nature of CO_2 and $AlCl_3$.

2. It can explain acid-base reactions in gaseous state and fused state.

3. It can explain the acidic nature of metal ions.

pH

The pH of a solution is defined as the negative logarithm to the base 10 of the hydrogen ion concentration.

$$pH = -\log_{10} [H^+]$$

p^{OH}

The p^{OH} of a solution is defined as the negative logarithm to the base 10 of the hydroxyl ion concentration.

$$p^{OH} = -\log_{10} [OH^-]$$

Indicator

An indicator is a substance which indicates the exact completion of a chemical reaction by changing its colour sharply at the end point.

Examples: Phenolphthalein, methyl red, methyl orange, etc.

Buffer solution

A solution which maintains a constant p^H even after the addition of a small amount of acid or base is called a buffer solution.

Types of buffer solution

1. Acidic buffer solution
2. Basic buffer solution

1. Acidic buffer Solution

A mixture of a weak acid and its salt with a strong base.

Example: A mixture of acetic acid and sodium acetate

$(CH_3COOH + CH_3COONa)$

2. Basic buffer solution

It is a mixture of a weak base and its salt with a strong acid.

Example: A mixture of ammonium hydroxide and ammonium chloride

$(NH_4OH + NH_4Cl)$

Industrial applications of pH

The control of pH plays a vital role in various industries.

1. Waste water treatment

In the waste water treatment process, the pH level should be maintained between 6.5 to 7.5. The acidity and alkalinity of water should be controlled at various stages of water treatment to prevent damage to the tank by the effluent.

2. Aquaculture

In aquaculture, the pH level of water should be maintained between 6.5 and 9. Otherwise, the aquatic life may be affected.

3. Pulp and Paper Industry

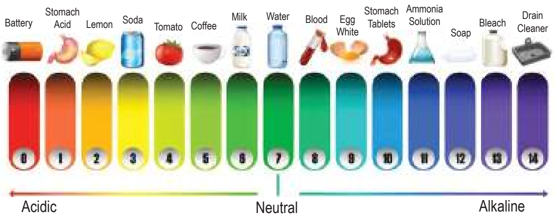
In the paper industry, the pH level should be maintained between 10 to 11 during the bleaching process. If the p^H level is not maintained, the paper may not achieve a white colour.

4. Pool and spa water

In swimming pools and spas, the p^H level should be maintained between 7.2 to 7.8. The failure to maintain this p^H range may result in eye and skin irritation.

5. Food and Beverage

In the food processing industry, the p^H level should be maintained between 5.6 to 6. Any change in this value affect the quality of the food.



6. Electroplating and Metal Finishing Industry

In the electroplating industry, maintaining the proper p^H level is essential for improving the quality of metal plating. For example, a p^H level of 3.5 to 4.2 is typically maintained in acid baths for nickel and copper plating.

7. Textile industry

The failure to maintain the appropriate p^H level will affect the colour, dyeing process, finishing and overall quality of the fabric.

8. Sugar industry

In sugar industries, if the pH of sugar molasses is not maintained around 7, the sugar gets tarnished and the yield is also reduced.

REINFORCEMENT

In this lesson, following topics were discussed

- Solution, solute, solvent
- Methods of expressing the concentration of solution
- Lewis concept of acids and bases and its advantages
- pH and pOH
- Indicator
- Buffer solution – types – examples
- Application of pH in industries

ACTIVITY

- Prepare one molar solution of NaOH in 500 mL of water
- Prepare an acid buffer of acetic acid and ammonium acetate and study the buffer action
- Identify the working range of phenolphthalein using strong base
- Draw pH curve for the above titration

QUESTIONS

PART – A

1. Define solution.
2. What is a solute?
3. What is a solvent?
4. What do you mean by concentration of a solution?
5. What is a dilute solution?
6. What is a concentrated solution?
7. Name the methods of expressing concentration of a solution.
8. Define molarity.
9. Define molality.
10. Define normality.
11. Define pH.
12. Define pOH.
13. What is an indicator? Give examples.

PART – B

1. List out the properties of acids and bases.
2. Explain Lewis concept of acids and bases with an example. Mention its advantages.
3. What is a buffer solution? How are they classified? Give examples.
4. Highlight the applications of pH in industries.
5. 100 grams of sucrose (Molecular mass = 342) is dissolved in 1000 g of water. What is the molality of the solution?
6. What is the molality of a solution containing 18 g of glucose (Molecular mass = 180) in 2 Kg of water?
7. Calculate the molarity of a solution containing 49 g of sulphuric acid (Molecular mass = 98) dissolved in 250 mL of the solution.
8. Calculate the molarity of a solution containing 37.5 g of sodium hydroxide

   (Molecular mass = 40) dissolved in 500 mL of the solution.
9. What is the normality of a solution containing 27 g of sodium carbonate

   (Equivalent mass = 53) in 5 litres of water?
10. What is the normality of a solution containing 1.575 g of oxalic acid (Equivalent mass = 63) in 250 mL of water?

Future reference links:

https://www.youtube.com/watch?v=eQWmobEbgf0&list=PL1b9Ht9ISqIFsIiqREfRjehR-2WAs3qCW4&index=4

https://www.youtube.com/watch?v=MudEc9Fbd2M&list=PL1b9Ht9ISqIFsIiqREfRjehR-2WAs3qCW4&index=3

https://youtu.be/V5Mq_cL9Bck

https://youtu.be/OwlK3M2HNgs

SURFACE CHEMISTRY

UNIT 2

Colloids – Definition – True solution and Colloidal solution – Differences – Lyophilic and Lyophobic colloids (Definitions only) – Properties – Tyndall effect – Brownian movement – Industrial applications of colloids – Smoke Precipitation by Cottrell's method, Purification of water – Catalyst – Definition – Positive catalyst – Negative catalyst – Definition – Types of catalysis – Homogeneous and Heterogeneous catalysis – examples – Characteristics of a catalyst – Industrial applications of catalysts.

Introduction

An aqueous solution of salt or sugar is homogeneous and it contains the solute as single ions or molecules, respectively. This solution is called a true solution. The diameter of the ions or molecules ranges from 1 Å to 10 Å **[1 Å = 10^{-8} cm]**; whereas in a suspension of sand stirred in water, the diameter of the dispersed particles will be more than 2000 Å. The particles which are larger than a molecule or ion of true solution and smaller than the suspended particle are said to be colloids and such solutions are called **colloidal or sol.**

True solution < colloids < suspension

Molecular size

(1 Å – 10 Å) (10 Å – 2000 Å)

(More than 2000 Å)

A colloid is like glue like, diffuses very slowly in solution and cannot pass through animal or vegetable membranes.

Examples: glue, albumin, etc.,

A colloid is heterogeneous system in which one substance is dispersed (dispersed phase analogous to solute) as very fine particles in another substance called dispersion medium (analogous to solvent)

Colloids have many industrial applications. Even our body can easily absorb food and medicine in a colloidal form.

True solution

A true solution is a homogeneous mixture of two or more substances.

Example: Sugar solution (Solute – Sugar; Solvent – Water)

Colloids

It is a heterogeneous mixture of two immiscible phases (Dispersed phase and dispersion medium).

Examples: Smoke, ink, etc.

Differences between true solution and colloids

S. No.	Property	True solution	Colloids
1	Nature	Homogeneous system	Heterogeneous system
2	Diameter of the particle	Ranges from 1 Å to 10 Å	Ranges from 10 Å to 2000 Å
3	Filtration	Cannot be filtered	Can be filtered
4	Osmotic pressure	Low	High

5	Tyndall effect	Does not show	Shows Tyndall effect.
6	Brownian movement	Does not exhibit	Exhibits Brownian movement
7	Electrophoresis	Does not show	Shows electrophoresis
8	Coagulation	Cannot be coagulated	Can be coagulated
Example		Sugar solution	Soap solution

Classification of colloids

Colloids are classified on the basis of following criteria:

i. Physical state of dispersed phase and dispersion medium

ii. Nature of interaction between dispersed phase and dispersion medium

iii. Type of particles of the dispersed phase

Depending upon the nature of interaction between the dispersed phase and dispersion medium, colloids are classified into two types namely

a. Lyophilic (Solvent attracting) colloids

b. Lyophobic (Solvent repelling) colloids

A. Lyophilic colloids

'Lyophilic' means liquid-loving. Colloids in which a dispersed phase has more affinity for dispersion medium are called lyophilic colloids. They are directly formed by mixing substances like gum, gelatine, starch, rubber etc., in a suitable medium.

B. Lyophobic colloids

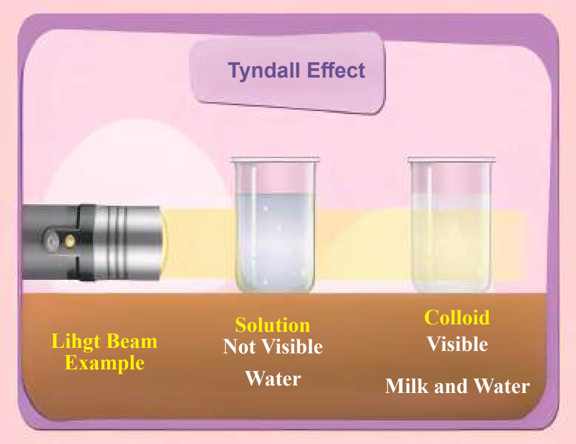
'Lyophobic' means solvent-hating. Colloids in which a dispersed phase has very little affinity for dispersion medium are called lyophobic colloids. Substances like metal sulphides when simply mixed with their dispersion medium do not form the colloid. These colloids can be prepared by special methods only.

Properties of colloids

1. Tyndall effect (Optical property)

When a beam of light is passed through a true solution and is observed at right angles to the direction of the beam, path of the light is not clear. If a beam of light is passed through a colloid placed in a darkroom, the path of light is visible. This is due to the scattering of light by the colloidal particles.

The phenomenon of scattering of light by the colloidal particles is known as "Tyndall effect".



Tyndall effect in nature

Example

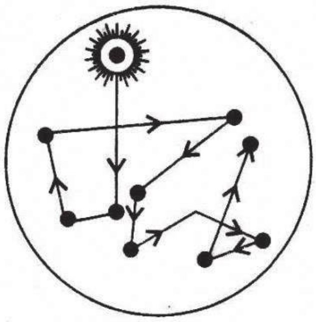
The sky appears blue in colour due to the scattering of blue ray in the sunlight by the colloidal particles present in the atmosphere.

2. Brownian movement

(Mechanical property)

When colloidal solutions are viewed under a powerful ultra-microscope, the colloidal particles appear to be in a state of continuous zig-zag motion. This motion was first observed by the British botanist Robert Brown and is known as Brownian movement. This is due to the collision between colloidal particles.

The Brownian movement depends on temperature and the viscosity of the solution. The motion becomes rapid at high temperature and in less viscous medium.



Brownian movement

Industrial applications of colloids

1. Smoke precipitation

Smoke is a negatively charged colloid, consisting of carbon particles dispersed in air. It is passed through a highly positively charged metallic knob placed in a chamber. On coming in contact with knob, carbon particles lose their charge and get settled down. They are scrapped mechanically. The precipitator is called Cottrell's electrostatic precipitator.

2. Purification of drinking water

The water obtained from natural sources often contains colloidal impurities. Alum is added to such water to coagulate the colloidal impurities and water is fit for drinking purposes after filtration.

Catalyst

A catalyst is a substance that changes the rate of a chemical reaction. It is classified into two types, namely

a. Positive catalyst

b. Negative catalyst

Positive catalyst

It is the substance that increases the rate of a chemical reaction.

Examples

- Iron acts as positive catalyst in the manufacture of ammonia by Haber's process

$$3H_2 + N_2 \xrightarrow{Fe} 2NH_3$$

- Nickel acts as positive catalyst in the hydrogenation of oils

$$Oil + H_2 \xrightarrow{Ni} Fat$$

Negative catalyst

It is the substance that decreases the rate of a chemical reaction.

Examples

- Glycerol is a negative catalyst in the decomposition of hydrogen peroxide

$$2H_2O_2 \xrightarrow{Glycerol} 2H_2O + O_2$$

- Ethanol is a negative catalyst in the oxidation of chloroform.

$$CHCl_3 + (O) \xrightarrow{Ethanol} COCl_2 + HCl$$

Types of Catalysis

Catalysis reactions are classified into two types, namely

A. Homogeneous catalysis

B. Heterogeneous catalysis

A. Homogeneous catalysis

In this reaction, the reactants and the catalyst are in the same physical state.

Examples

- Nitric oxide is a catalyst in the oxidation of SO_2 to SO_3

$$2SO_{2(g)} + O_{2(g)} \xrightarrow{NO_{(g)}} SO_{3(g)}$$

- Hydrolysis of ester catalyzed by mineral acid

$$CH_3COOC_2H_{5(l)} + H_2O_{(l)} \xrightarrow{HCl_{(l)}} CH_3COOH + C_2H_5OH$$

Heterogeneous catalysis

In this reaction, the reactants and the catalyst are in different physical state.

Examples

- Iron is a catalyst in the manufacture of ammonia by Haber's process

$$3H_2(g) + N_2(g) \xrightarrow{Fe(s)} 2NH_3$$

- Raney nickel is a catalyst in the hydrogenation of **oil.**

$$Oil + H_2 \xrightarrow{Ni} Fat$$

Characteristics of a catalyst

A catalyst has the following characteristics.

- A catalyst alters the rate of a chemical reaction without undergoing any change in mass and its composition.
- It is regenerated at the completion of the reaction.
- A little amount the substance is sufficient to catalyse the reaction.
- It does not change the relative amount of reactants and the products.
- It does not initiate a chemical reaction.
- In an equilibrium reaction it increases the rate of both forward and backward reactions equally.
- It only reduces the time required for the attainment of equilibrium.
- Catalytic activity is specific in nature.
- A catalyst is more active at a particular temperature called optimum temperature.

Industrial applications of catalyst

The industrial applications of catalyst are listed below.

S. No.	Industrial Process	Catalyst
1	Manufacture of ammonia by Haber's process	Iron
2	Manufacture of nitric acid by Ostwald process	Platinum
3	Manufacture of methanol from water gas	Zinc oxide/Chromium oxide
4	Fermentation of starch to ethanol	Diastase and maltase
5	Manufacture of vinyl chloride	Cuprous chloride
6	Manufacture of sulphuric acid by contact process	V_2O_5
7	Manufacture of hydrogen from water gas	Iron oxide
8	Hydrogenation of oil	Raney nickel
9	Hydrolysis of ester	Mineral acid
10	Dehydration of alcohols	Phosphorus pentoxide

REINFORCEMENT

In this lesson, following topics were discussed

- Difference between true solution and colloidal solution
- Types of colloids
- Properties of colloids
- Industrial application of colloids
- Characteristics of Catalyst
- Industrial application of catalyst

ACTIVITY

- See the day to day colloidal materials like milk, ink, ice cream etc.,
- Milk can be coagulated by adding few drops of lemon juice.
- Observe the Tyndall effect that causes blue colour of sky
- Watch scattering light in cinema theatres from the projector room.
- Watch the preparation of mayonnaise, a colloid, in YOUTUBE.
- Observe the churning of butter milk to coagulate butter.

QUESTIONS

PART – A

1. What is a true solution? Give an example.
2. Define colloid/sol. Give an example.
3. What are lyophilic colloids? Give an example.
4. What are lyophobic colloids? Give an example.
5. What is Tyndall effect?
6. What is Brownian movement?
7. Define catalyst.
8. What is a positive catalyst? Give an example.
9. What is a negative catalyst? Give an example.

PART – B

1. Write the differences between a true solution and a colloid.
2. Write a short note on property of colloids.
3. Explain the industrial applications of colloids.
4. Explain homogeneous catalysis and heterogeneous catalysis with examples.
5. Mention the characteristics of a catalyst.
6. Highlight the industrial applications of catalysts.

Future reference links

https://www.youtube.com/watch?v=hzDFCUKos4U&list=PL1b9Ht9ISqIFsIiqREfRjehR-2WAs3qCW4&index=6

https://www.youtube.com/watch?v=oCp6-pu3xuM&list=PL1b9Ht9ISqIFsIiqREfRjehR-2WAs3qCW4&index=7

https://www.youtube.com/watch?v=IS0aqaVX1h4&list=PL1b9Ht9ISqIFsIiqREfRjehR-2WAs3qcW4&index=12

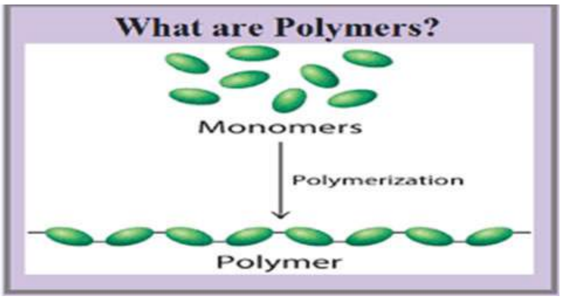
https://youtu.be/cuEHseI31kY https://youtu.be/s3yWnM2Y-rw

CHEMISTRY OF ENGINEERING MATERIALS

UNIT 3

Plastics – types – Types of Polymerization – Addition and condensation polymerization – Thermoplastics and Thermoset plastics – Differences – Mechanical properties of plastics – Advantages of plastics over traditional materials – Natural polymer – Rubber – Extraction of rubber from latex - defects of natural rubber – Vulcanization – Compounding of rubber – Ingredients and their functions.

Polymers



A polymer (Greek: poly – many; mers – units or parts) is a macromolecule which is formed by linking together a large number of small molecules called monomers.

The number of repeating monomer units in a polymer is called degree of polymerization.

Polymerization

Polymerization is process of converting monomers (small, low molecular weight organic molecules) into polymers (long, high molecular weight organic molecules) either by addition reaction or by condensation reaction.

There are two types of polymerization.

a. Addition polymerization

b. Condensation polymerization

A. Addition polymerization

In this type of polymerization, polymers are formed by simple addition reaction between same molecules containing double or triple bonds without the elimination of simple molecules.

Example: Formation of polythene

It is obtained by the polymerization of ethylene.

$$\underset{\substack{\text{(Ethylene)}\\ \text{(Monomer)}}}{nCH_2=CH_2} \xrightarrow{\text{Polymerizaiton}} \underset{\substack{\text{(Polyethylene)}\\ \text{(Polymer)}}}{+\!\!\left[CH_2-CH_2\right]_n}$$

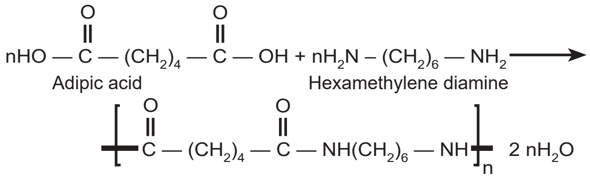
Polythene is used in making toys, pet bottles, carry bags, etc.

B. Condensation polymerization

In this type of polymerization, polymers are formed by the combination of monomers (having bi- or poly- functional groups) with the elimination of simple molecules such as H_2O, H_2S, HCl, etc.

Example: Formation of Nylon 6,6

It is formed by the condensation reaction between adipic acid and hexamethylene diamine



$$nHO-\overset{O}{\overset{\|}{C}}-(CH_2)_4-\overset{O}{\overset{\|}{C}}-OH + nH_2N-(CH_2)_6-NH_2 \longrightarrow \left[\overset{O}{\overset{\|}{C}}-(CH_2)_4-\overset{O}{\overset{\|}{C}}-NH(CH_2)_6-NH\right]_n \; 2\,nH_2O$$

Nylon 6,6

Nylon 6,6, is used in making ropes, fishing nets, boats, etc.

Plastics

Plastics are high molecular weight organic materials which can be moulded into any desired form when subjected to heat and pressure in the presence of a catalyst.

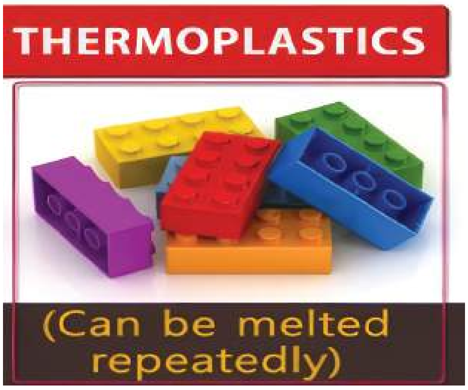
Types of plastics

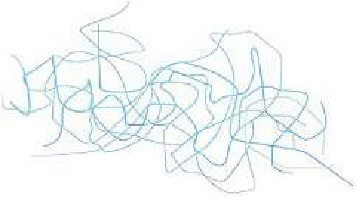
Plastics are classified into two types based on the type of resin used in its preparation.

a. Thermoplastics

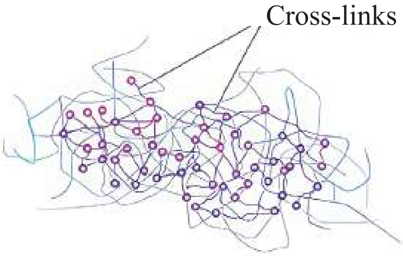
b. Thermoset plastics

A resin is a binder, which holds the different constituents together.





Thermoplastic



Thermoset

A. Thermoplastics

Thermoplastics are the resins which softens on heating and becomes hard on cooling.

Examples

PVC, Nylon, Polythene, etc.

Applications of Nylon as airbag in cars and parachute

B. Thermoset plastics

Thermosetting plastics are the resins which harden on heating during moulding and they cannot be softened again.

Examples

Bakelite (Phenol-formaldehyde resin), Urea formaldehyde, etc.

Differences between thermoplastics and thermoset plastics:

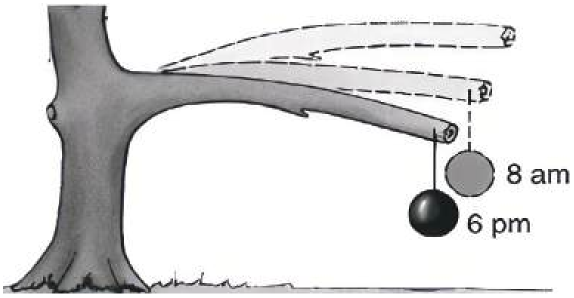
The differences between the two types of plastics arise mainly due to the difference in their chemical structure.

S. No.	Property	Thermoplastics	Thermoset plastics
1	Type of bonding between adjacent polymer chains	The polymer chains are held together by weak force called Vander Waal's force of attraction	The polymer chains are linked by strong chemical bonds (covalent bonds)
2	Action of heat	They soften on heating and harden on cooling	They do not soften on heating
3	Solubility	They are soluble in organic solvents	They are insoluble in organic solvents
4	Expansion due to heating	They expand very much on heating	Their expansion is only marginal due to heat
5	Type of polymerization	They are formed by addition polymerization	They are formed by condensation polymerization
6	Type of moulding	They are formed by injection moulding	They are formed by compression moulding
7	Scrap recovery	They can be reclaimed from wastes	They cannot be reclaimed from wastes
Examples		PVC, Nylon	Bakelite, Urea-formaldehyde

Mechanical properties of plastics

1. Creep

When a plastic part is subjected to a load for a longer period of time, it undergoes deformation in shape which is called creep. It is due to the displacement of molecules in a polymer structure. For this reason, plastics cannot be used as load bearing materials.



2. Strength to weight ratio

Plastics have good strength to weight ratio when compared to the light weight metals like aluminium, magnesium, etc. Hence, they are used in making rockets.

3. Thermal stability

Plastics either soften or degrade at high temperatures. Hence, they cannot be used at high temperatures.

4. Softening temperature – Glass transition temperature

Softening temperature refers to the particular temperature at which a plastic change from elastic stage to fluid stage. Glass transition temperature is a threshold temperature below which the plastic is hard and glassy and above which the plastic becomes rubbery.

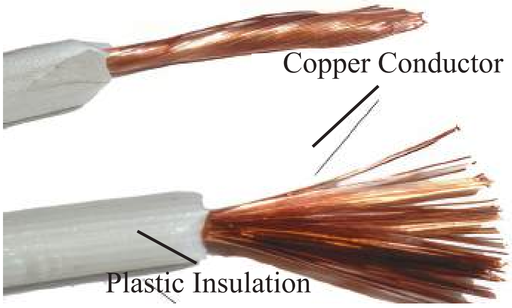
5. Optical properties

Some plastics are transparent showing optical properties similar to glass.

Examples: Eyeglasses, automobile headlight assemblies, etc.

6. Electrical properties

Many plastics are electrical insulators and hence they are mainly used for electrical insulation purposes.



7. Impact strength

Plastics have better impact strength when compared to glass. Hence, they are reinforced with glass fibres.

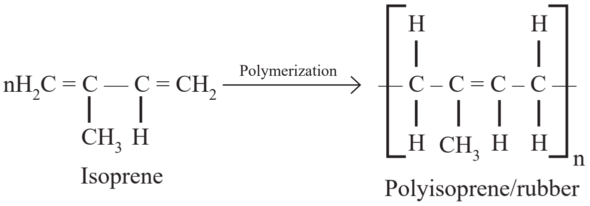
Advantages of plastics over traditional materials

In recent years, plastics have attained great importance in every walk of our life due to their advantages over other traditional materials like wood, metals, glass, etc. Their advantages are given below.

1. They are light in weight
2. They have high strength to weight ratio than metals
3. They are easily workable
4. They have high corrosion and abrasion resistance
5. They have low fabrication and maintenance cost
6. They can be made transparent
7. They possess very low thermal and electrical conductance
8. They can be used in combination with metal.

Natural Polymer – Rubber

Natural rubber is polyisoprene, which occurs in the latex of rubber tree.



$$nH_2C=\underset{\underset{CH_3}{|}}{C}-\underset{\underset{H}{|}}{C}=CH_2 \xrightarrow{\text{Polymerization}} \left[-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-\underset{\underset{CH_3}{|}}{C}=\underset{\underset{H}{|}}{C}-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-\right]_n$$

Extraction of rubber from latex

The latex is a milky white liquid containing about 30% to 45% rubber.

The rubber is extracted from latex as follows.

1. The latex is diluted with water and allowed to stand for some time.
2. The impurities settle down and the clear liquid is separated.
3. The clear liquid is coagulated by the addition of acetic acid or formic acid and the rubber is precipitated.
4. The precipitated rubber is collected and passed through rollers to get sheets of rubber.
5. Rubber sheets are dried in air or smoke. Thus, the natural rubber is obtained.

Defects of natural rubber

The raw rubber has the following defects.

- It becomes soft at high temperature
- It becomes brittle at low temperature
- It has low tensile strength
- It has lower elasticity
- It has large water absorption tendency
- It has little durability
- It swells up in oils and organic solvents
- It readily undergoes air oxidation

Compounding of rubber – Ingredients and their functions

The addition of certain ingredients to raw rubber in order to attain the desired properties is called compounding of rubber.

1. Vulcanizing agents

When rubber is heated with sulphur, its tensile strength, elasticity and hardness are increased.

2. Accelerators

They are added to increase the rate of vulcanization.

Example: 2- mercaptoethanol

3. Softeners and plasticizers

They are added to give the rubber greater firmness and adhesion.

Example: Vegetable oils

4. Anti-oxidants

They are added to retard the oxidation of rubber.

Example: Beta-napthol

5. Fillers

They are added to increase the bulk and reduce the cost.

Example: Gypsum

6. Pigments

They are added to give desired colour to rubber.

Example: TiO_2 – White;

Lead chromate – Yellow

7. Reinforcing agents

They are added to give strength and stiffness to rubber.

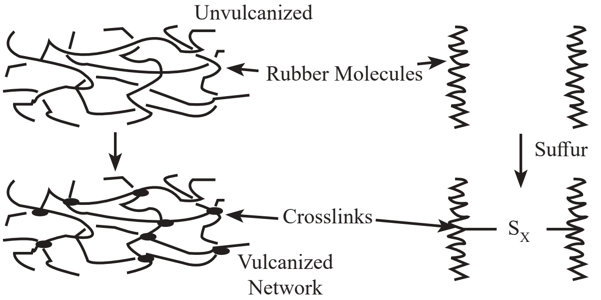
Example: Zinc oxide

Vulcanization of rubber

Vulcanization is a process of heating natural rubber with sulphur to 140° C.

Sulphur enters into the double bonds of polymer chains forming crosslinks between the polymer chains and gives the structure toughness.

For flexible tyre rubber, sulphur content is 2 – 5 % and for tougher rubber like ebonite, content of sulphur is 32%.



Properties of vulcanized rubber

Vulcanized rubber has the following properties.

1. It is hard and non-sticky at high temperature
2. It has high tensile strength
3. It has high elasticity
4. It has low water absorption tendency
5. It is a better electrical insulator
6. It is resistant to organic solvents and oils
7. It has higher resistance to oxidation.

Tyres and Football are made of vulcanized rubber

REINFORCEMENT

In this lesson, following topics were discussed

- Polymerization and types of polymerization
- Plastics and types of plastic
- Mechanical properties of plastics
- Advantages of plastics over traditional materials
- Rubber and its extraction from latex
- Defects of natural rubber
- Compounding of rubber
- Vulcanization of rubber

ACTIVITY

- Make a poster presentation on biomedical applications of plastics
- Arrange for a field trip to study the extraction of rubber from latex
- Study the harmful effects of burning plastics and make a newsletter
- Enumerate the practical application of recycling of rubber in daily life
- Collect the samples of plastic waste in the community and segregate into different types

QUESTIONS

PART – A

1. Define polymer.
2. Define polymerization.
3. What are the two types of polymerization?
4. How are plastics classified?
5. What is glass transition temperature?
6. Define rubber.
7. What is compounding of rubber?
8. Define vulcanization.

PART – B

1. Explain addition polymerization with an example.
2. Explain condensation polymerization with an example.
3. Define plastics. What are the two types of plastics? Explain.
4. Highlight the differences between thermoplastics and thermosetting plastics.
5. Write the mechanical properties of plastics.
6. What are the advantages of plastics over the traditional materials?
7. How is natural rubber extracted from latex?
8. List the defects of natural rubber.
9. What is compounding of rubber? Mention the ingredients and their functions.
10. Write a note on vulcanization of rubber.

Future reference links

https://www.youtube.com/watch?v=bOsivSylohc&list=PL1b9Ht9ISqIEmoksyUA5WRuhWgB5V5&index=16
https://www.youtube.com/watch?v=KKH1LJxi8VM&list=PL1b9HtpISqIEmoksyUA5Ab5WRuhWgB5V5&index=17
https://youtu.be/Z5BjX1YYIr0
https://youtu.be/cN3U4AALIS0
https://youtu.be/sFjGQxUTVJE
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ELECTRO CHEMISTRY

UNIT 4

Electronic concept of oxidation and reduction – electrolytes – classification – strong, weak and non-electrolyte – examples – electrolysis – definition – Mechanism – Industrial applications of Electrolysis – Chrome plating – Primary Battery – Secondary Battery – Definition – examples & construction of Li-ion Battery – Corrosion (Definition) – Types of Corrosion – Differential aeration theory only – Factors Influencing Rate of Corrosion. – Methods of Prevention of Corrosion (Qualitative).

Introduction

Electrochemistry is the study of production of electricity from energy released during spontaneous chemical reactions and the use of electrical energy to perform non spontaneous chemical reactions. The subject is of importance both for theoretical and practical considerations. A large number of metals, sodium, chlorine, fluorine, and many more chemicals are produced by electrochemical methods. Batteries and fuel cells convert chemical energy in to electrical energy. They are used on a large scale in various instruments and devices. The reactions carried out electrochemically can be energy efficient and less polluting. Therefore, study of electrochemistry is important for creating new technologies that are eco-friendly. The transmission of sensory signals through cells to brain and vice versa have electrochemical origin.

Electronic concept of oxidation and reduction

Oxidation: Loss of electron(s)

Reduction: Gain of electron(s)

Oxidation

Oxidation is defined as a process of removal of electron from an atom.

Example

$$Na \longrightarrow Na^{+} + e^{-}$$

Here, Na loses one electron and changes in to Na^{+} ion. So, when an atom loses an electron, it gets oxidized.

Reduction

Reduction is defined as a process of gain of electron by an atom.

Example

$$Cl + e^{-} \longrightarrow Cl^{-}$$

Here, Cl gains one electron and changes into Cl^{-} ion. So, when an atom gains an electron, it gets reduced.

Electrolytes

Substances which conduct electric current in solution or in molten state are called electrolytes.

Examples: NaCl solution, HCl solution, etc.

Classification of electrolytes

Electrolytes are divided into two types.

a. Strong electrolytes

b. Weak electrolytes

a. Strong electrolytes

The substances that are completely ionized into ions are called strong electrolytes.

Examples: NaCl solution, HCl solution

b. Weak electrolytes

The substances that are partially ionized into ions are called weak electrolytes.

Examples: Acetic acid, ammonium hydroxide

Non – electrolytes

The substances which do not conduct electric current in solution or in molten state are called non-electrolytes.

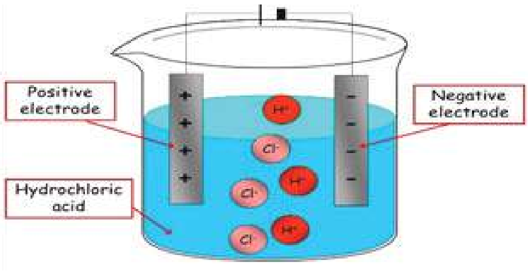
Examples: Glucose, urea

Electrolysis

Electrolysis is the process of decomposition of an electrolyte by the passage of electric current.

Mechanism of electrolysis

Example: Electrolysis of HCl solution.



When an electric current is passed through HCl solution taken in an electrolytic cell, it decomposes to H_2 and Cl_2.

Reactions

Ionization

$$HCl \longrightarrow H^+ + Cl^-$$

At cathode (Reduction)

H^+ ions are attracted towards cathode and are reduced to H_2 gas

$$2\,H^+ + 2\,e^- \longrightarrow H_{2\,(g)}$$

At anode (Oxidation)

Cl^- ions are attracted towards anode and are oxidized to Cl_2 gas.

$$2\,Cl^- \longrightarrow Cl_{2\,(g)} + 2\,e^-$$

Total cell reaction

$$2\,H^+ + 2\,Cl^- \longrightarrow H_{2\,(g)} + Cl_{2\,(g)}$$

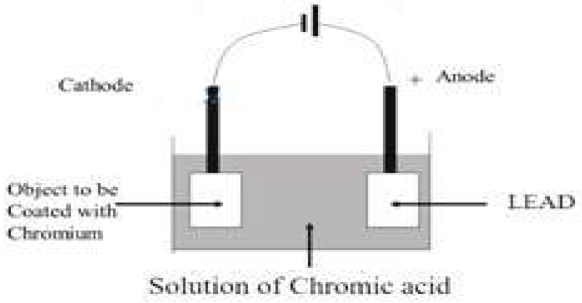
Industrial application of electrolysis

The process of electrolysis is applied in many fields. It is required for the extraction and purification of metals. It is used as one of the commercial processes to produce hydrogen gas. It is also used to prevent the corrosion of metals.

Chrome plating

Chromium metal is critical in the manufacture of stainless steel, which hardens and toughens steel and increases its resistance to corrosion particularly at high temperatures.

Chrome plating is a process of applying a thin layer of chromium on the metal surface using the principle of electrolysis.



Anode: Lead plate

Cathode: Nickel coated iron article

Electrolyte: Chromic acid + Sulphuric acid

In this process, a nickel coated iron article to be plated with chromium is made cathode. Lead plate is used as anode. A mixture of chromic acid and 1% sulphuric acid is used as an electrolyte. When electric current (DC) is passed through the electrolyte, chromium gets deposited at the cathode.

Chrome plating is extensively used for decorative purposes.

Batteries

A battery is a device which converts chemical energy into electrical energy. The batteries are very vital for the modern electronic world. Li-ion batteries are used in mobile phones, dry cell in flash lights etc.

Classification of batteries

Batteries are classified into primary batteries (non-rechargeable) and secondary batteries (rechargeable).

Primary Batteries

The batteries which cannot be recharged are called as primary batteries

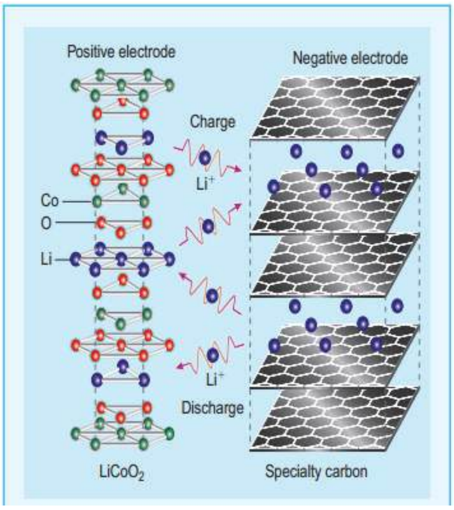
Examples: Dry cell, alkaline batteries

Secondary batteries

The batteries which can be recharged are called secondary batteries,

Examples: Lead acid batteries, Li-ion batteries

Construction of Li-ion battery



Anode : Porous graphite

Cathode : Transition metal oxide - CoO_2

Electrolyte : Lithium salt (Lithium hexafluoro phosphate) in an organic solvent.

At anode (Oxidation)

$$Li_{(s)} \longrightarrow Li^{+}_{(aq)} + e^{-}$$

At cathode (Reduction)

$$Li^{+} + CoO_2 + e^{-} \longrightarrow LiCoO_2$$

Over all reaction

$$Li_{(s)} + CoO_2 \longrightarrow LiCoO_{2(s)}$$

Both electrodes allow lithium ions to move in and out of their structures.

During discharge, the lithium ions produced at the anode moves towards the cathode through an aqueous electrolyte.

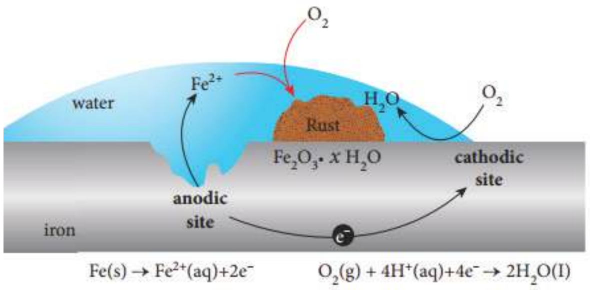
Corrosion

When a metal like iron is exposed to air and moisture, it gets rusted. It is due to the oxidation of metal by oxygen in presence of moisture. This redox reaction which causes the deterioration of metal is called corrosion.

Differential aeration theory of corrosion

This theory is based on the fact that when a metal is exposed to varying concentration of air (Oxygen) or an electrolyte, concentration cell is formed.

The metallic area which is exposed to less amount of oxygen act as anode and undergoes corrosion. The metallic area which is exposed to greater amount of oxygen act as cathode. Corrosion of metal occurs due to difference in concentration of air or electrolyte. Hence, this theory is called differential aeration theory.



Electrode reactions

At anode (Oxidation)

$$Fe \longrightarrow Fe^{2+} + 2e^-$$

At anode (Reduction)

$$4\,H^+ + O_2 + 4\,e^- \longrightarrow 2\,H_2O$$

Factors influencing rate of corrosion

1. Reactivity of metal: If a metal is more electro positive, then it undergoes corrosion more readily.
2. Strain in metal surface: Corrosion takes place readily at cuts and bends area of metal
3. Presence of impurities: If impurities are present in the metal then the metal will undergo corrosion more readily
4. Presence of moisture: Increase of moisture in the environment generally increases the rate of corrosion
5. Temperature: The rate of corrosion increases with the increase in temperature
6. pH: Lower the pH, greater is the rate of corrosion
7. Cathodic and anodic areas: If the cathodic area is more than the anodic area, corrosion takes place rapidly.

Methods of prevention of corrosion

Corrosion prevention can be achieved by the following methods.

1. Galvanization

Rusting of iron can be prevented by coating iron with zinc metal. Zinc is stronger reducing agent than iron and hence it can be more easily corroded than iron. i.e., instead of iron, zinc is oxidized when it is exposed to air creating a protective coating on the metal surface.

2. Alloying

It is the method of improving the properties of a metal by mixing the metal with another metal or non-metal. When iron is mixed with chromium and nickel, stainless steel is obtained. It does not rust at all.

3. Painting

Rusting of iron can be easily prevented by coating the surface with paint which protects iron from air and moisture.

4. Greasing (Oiling)

When some grease oil is applied to the surface of an iron object then air and moisture cannot come in contact with it and hence rusting is prevented.

5. Cathodic protection

In this technique, the metal to be protected need not be covered with a protecting material. Instead, metals like Mg or Zn which is corroded more easily than iron can be used as a sacrificial anode and the iron acts as a cathode. So, the iron is protected but Mg or Zn is corroded.

6. Passivation

The metal is treated with strong oxidizing agent such as Conc. HNO_3. As a result, a protective oxide layer is formed on the surface of the metal.

7. Anodizing

Anodizing is the process of coating of aluminium oxide on the surface of aluminium metal. The anodized aluminium is used in aircrafts, window frames, machine parts, etc.

REINFORCEMENT

In this lesson, following topics were discussed

- Electronic concept of oxidation and reduction
- Electrolytes and non-electrolytes
- Electrolysis and its application
- Corrosion – differential aeration theory
- Factors influencing rate of corrosion
- Methods of prevention of corrosion (Qualitative)

ACTIVITY

- Take a glass jar and fill it with copper sulphate solution (Electrolyte). Connect the plate of copper to the positive terminal (anode) of the battery and iron nail to the negative terminal (cathode) of the battery. Now dip these two electrodes in copper sulphate solution. Switch ON the battery. What do you observe after a couple of days?
- Study the application of gold plating in jewellry and collect the literature about the role of electroplating in Indian economy through e-survey.

QUESTIONS

PART – A

1. What are electrolytes?
2. What are strong electrolytes? Give an example.
3. What are weak electrolytes? Give an example.
4. What are non-electrolytes? Give an example.
5. Define electrolysis.
6. What is chrome plating?
7. Define battery.
8. What are primary batteries? Give examples.
9. What are secondary batteries? Give examples.
10. Define corrosion.

PART – B

1. Explain the electronic concept of oxidation and reduction.
2. How are electrolytes classified? Give examples.
3. Explain the mechanism of electrolysis with an example.
4. Explain the industrial application of electrolysis
5. Explain the process of chrome plating.
6. Explain the construction of Li-ion battery.
7. Explain the mechanism of corrosion by differential aeration theory.
8. Explain the various factors influencing the rate of corrosion.
9. Write a note on the methods employed for prevention of corrosion.

Future reference links

https://wwwyoutube.com/watch?y=zaOR7oo7qAq&list=PL1b9Ht9ISqIFsliqREfRjehR2WAs3qCW4&index=14

http://www.youtube.com/watch?y=ibFyc1aja24&list=PL1b9Ht9ISqIFsIiqREfRjehR2WAs3qCW4&index=15

https://youtu.be/Wu3DlY9W0Dw

https://youtu.be/WmtaMq36jaE

https://youtu.be/zUlbHMDCosI

https://youtu.be/HlGITf-rhCE

https://youtu.be/sJy9YC-RsS8

https://youtu.be/aXg1W3XvP28

ENVIRONMENTAL CHEMISTRY

UNIT 5

Air pollution – Definition – Air pollutants (SO_2, H_2S, HF, CO and Dust) – Sources and Harmful effects – Formation of Acid Rain – Harmful effects – Green House Effect – Causes – Ozone layer depletion and its harmful defects – Global warming – Harmful effects – Control of Air Pollution – Solid Waste – Definition – Problems – Types of Solid Waste – Methods of Disposal – Land fill and Incineration – Recycling – Definition – Examples – Advantages of Recycling (Basic ideas) – Green Chemistry – Definition – Goals of Green Chemistry.

Introduction

Pollution has been a problem since the appearance of our earliest ancestors. Along with the amazing technological advancement, the industrial revolution of the mid-19th century added new sources of materials to air and water pollution. By the middle of the 20th century, the effects of these changes were felt in countries around the world. Evidence from Greece shows that the problems of polluted air outdoors were being documented at least 2400 years ago.

Pollution

Pollution is the process of discharging unwanted harmful materials into the environment by inhuman activities that causes huge damage to the life and properties of humans, plants and animals.

Environment includes air, water and land. The harmful substances that causes damage are called **pollutants**. They are discharged from various industries, automobiles, microorganism, volcanic eruptions, forest fire, strong winds.

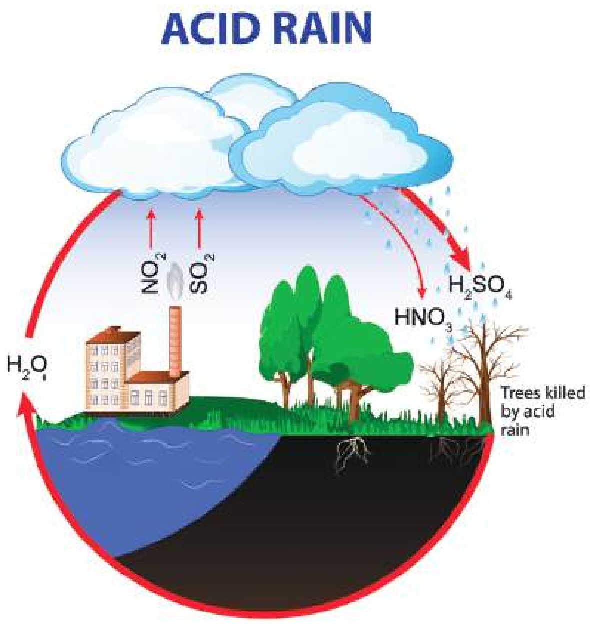
Air pollution

Air pollution is caused by the discharge of solid, liquid particles and certain gases in excess into the atmosphere by inhuman activities. These particles and gases can come from car and truck exhausts, factories, dust, pollen, mold spores, volcanoes and wildfires.

Major air pollutants, sources and their harmful effects

S. No.	Air pollutant	Source	Harmful effects
1	Sulphur dioxide (SO_2)	Sulphuric acid plants, petrochemical, cement, paper industries, etc.	Respiratory diseases, eye irritation, throat infection, etc.
2	Hydrogen Sulphide (H_2S)	Petroleum refineries and sewage treatment plants	Headache, paralysis, irritability, coma, convulsions, etc.
3	Hydrogen Fluoride (HF)	Fertilizer industry, aluminium industry	Respiratory diseases, eye irritation, tooth disorders, fluorosis in animals, etc.
4	Carbon monoxide (CO)	Auto exhaust, combustion of fossil fuels	Headache, toxicity, lung disorder, dizziness, etc.
5	Dust	Mines, Cement, glass, ceramic industries, etc.	Respiratory diseases, affects lung.

Acid rain



Industries pollute the atmosphere with oxides of nitrogen and sulphur which in turn get dissolved in rainwater as nitric acid and sulphuric acid. The rain water containing these acids is called acid rain.

$$2\,SO_2 + O_2 + 2\,H_2O \longrightarrow 2\,H_2SO_4$$
(Sulphuric acid)

$$4\,NO_2 + O_2 + 2\,H_2O \longrightarrow 4\,HNO_3$$
(Nitric acid)

Harmful effects of acid rain

1. It makes the soil more acidic and reduces the fertility of the soil.
2. It has an adverse impact on terrestrial ecosystem.
3. It reduces the population of aquatic species.
4. It affects humans nervous, respiratory and digestive system.
5. It causes stone leprosy in historical monuments like Taj Mahal.
6. It increases the rate of corrosion of metal.
7. Acid rain damages automobiles coatings and oil based paint.

Ozone layer

The ozone layer in the upper atmosphere acts as a protective layer which prevents the entry of harmful UV radiation into earth's surface.

Ozone layer depletion

The decrease in the concentration of ozone molecule by the action of gases like chlorine, nitric oxide and atomic oxygen is called ozone layer depletion.

The pollutants like Chlorofluorocarbon (CFC), Freon-12 get accumulated in the atmosphere. The UV radiation decomposes CFC into chlorine and the chlorine converts ozone into oxygen in a chain reaction. As a result, the ozone layer gets depleted.

Harmful effects of ozone layer depletion

Harmful UV radiation enters earth surface due to ozone layer depletion.

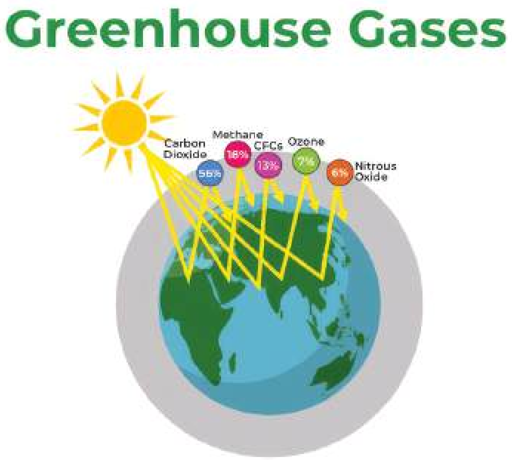
1. It changes the earth's wind pattern, climate and rainfall.
2. It affects human life.
3. It leads to lung cancer, cataract and DNA mutation.
4. It leads to breast cancer and blood cancer.
5. It causes sun burns and skin cancer.

Green-House effect

Several radiations like UV, visible and infra-red rays from the sunlight reaches the earth surface and produce heat energy. Some of the heat absorbed by the earth's surface is radiated back into the space. The greenhouse gases in earth's atmosphere act like a glass window, trap the heat and reradiate it to the earth. Hence, the temperature of the earth increases.

The warming up of the earth's surface due to the blanketing effect of CO_2 in the atmosphere is called greenhouse effect. The greenhouse gases are CFC, methane, $CO_{2,}$ water vapour, etc.

Green House gases	Industrial sources
Carbon dioxide	Fossil fuel burning, forest fire, etc.
Methane	Volcanic eruption, bio –mass burning, etc.
Chlorofluor-carbon (CFC)	Air conditioners, refrigerators, etc.
Water vapour	Humidity in air
Nitrous oxide	Deforestation, fossil fuel burning,etc.



Global warming

The warming up of earth's surface due to green house effect is called global warming.

Harmful effects of global warming

1. It causes the melting of glaciers and ice bergs.
2. It increases the sea level and affects the coastal life.
3. The temperature of the earth is increased due to the evaporation of surface water.
4. It causes cyclone, hurricane and floods.
5. It causes diseases like malaria, cholera.
6. It affects the food production.
7. It causes climatic changes.

Control of air pollution

"Prevention is better than cure". Similarly, it is better to control the air pollutants at the source itself.

Air pollution can be controlled by the following ways.

1. The exhaust gases from automobiles can be minimized by using catalytic convertor.
2. Installation of tall chimneys to reduce the pollution at the ground level.
3. Smoke can be removed by Cottrell's electrostatic precipitator. (Cottrell precipitator)
4. The concept of recycle and reuse not only conserves resources but also reduces air pollution.
5. Dust particles can be removed by the use of bag filters and dust separators.
6. Carbon monoxide can be removed by complete combustion at high temperature.
7. Growing of trees reduces more pollution. Plants take carbon dioxide during photo synthesis and releases oxygen to environment. Hence, more trees should be planted.

Solid Waste

The materials which are no longer useful for human beings and are thus thrown away are called solid waste.

Problems caused by solid waste

1. Pollutes air, land and ground water.
2. Air becomes unclean with foul smell.
3. Break out of diseases at an alarming rate.
4. Affects the fertility of the soil.
5. Causes climatic changes.

Types of solid waste

S. No	Types	Examples
1	Commercial garbage	Bricks, cement, sand, etc.
2	Agricultural waste	Herbicides, pesticides, crop residue, animal and poultry waste, etc.
3	Plastic waste	Plastic toys, cosmetics, food packaging, etc.
4	Medicinal waste	Blood stained cotton, dressing linen, syringes, waste medicines, etc.
5	Domestic waste	Food waste, plastics, broken bottle, metallic containers, kitchen waste, etc.
6	Municipal garbage	Food waste, plastics, metals, etc.
7	Industrial waste	Metal scrap, plastic waste, etc.
8	e - waste	Waste electronic materials like computer, laptops, television, etc.,

Methods of disposal of solid wastes

The two methods widely used for the disposal of solid wastes are landfills and incineration

A. Landfills

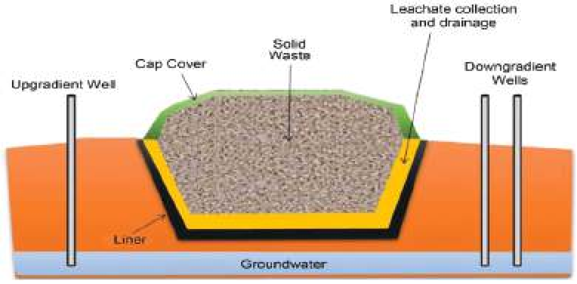
Landfills is a far away area from the residential areas where the solid wastes are disposed. In this method, waste is buried underground and covered with soil.

A landfill consists of the following layers.

a. Bottom liner

b. Leachate system

c. Cover



a. Bottom liner

Bottom liner is the area where the waste is placed. Then, it is covered with a layer of sand.

b. Leachate system

Leachate system collects water, that is formed due to the contracting of wastes.

c. Cover

Final covering is placed on the landfill when it is closed. The covering seals the waste from air and reduces the amount of water getting into the landfill.

A properly designed and well managed land fill can be a hygienic and relatively inexpensive method of disposing of waste materials.

B. Incineration

Thermal destruction of solid waste is called incineration. In this method, solid wastes are burnt at high temperatures. In results in the emission of flue gases such as CO, N_2, etc. The flue gases are formed by the combustion of organic materials present in the solid waste. The main advantage of incineration is that the heat generated during the process can be used for the generation of electricity.

Recycling

Recycling is a process of converting used materials into new useful and valuable products.

Examples of recycling

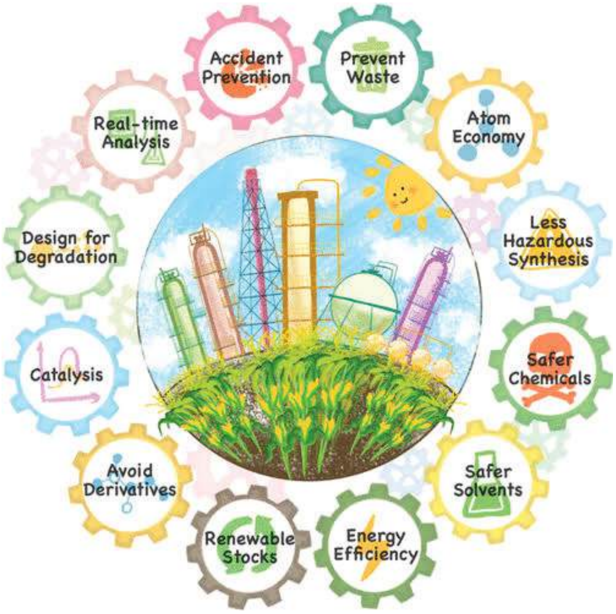
1. Used paper can be converted into new paper, like paper plate making.
2. Used glass containers can be converted into new glass containers.
3. Used aluminium containers can be converted into new containers.
4. Metal scraps can be converted into new materials.

Advantages of recycling

1. It helps in the conservation of natural resources.
2. Recycling prevents pollution.
3. It makes the air clean and free from foul smell.
4. Conservation of raw materials for future generation
5. It saves lot of energy.
6. Reduces manufacturing cost.
7. Provides additional employment opportunities.

Green Chemistry

Green chemistry is the design of chemical processes and products that reduce or eliminate the use or generation of hazardous substances.



Goals of green chemistry

Preventing waste is better than treating or cleaning up waste after it is created. Some guidelines may be given while choosing the reactants, products and designing the processes to achieve the goals of green chemistry.

$$\underset{\text{Reactants}}{A + B} \xrightarrow{\text{Process}} \underset{\text{Product}}{C + D}$$

1. To develop modern technology of high efficient energy management.
2. To design for methods to manufacture eco-friendly bio degradable products.
3. To develop processes using renewable materials.
4. To perform the process in a safe and controlled way.
5. To adopt new techniques for maximum conversion of reactants to products.
6. To avoid the usage of toxic chemicals wherever possible.
7. To adopt a technology to make use of the non-conventional energy sources.

REINFORCEMENT

In this lesson, following topics were discussed

- Acid rain, greenhouse effect, global warming
- Harmful effects and methods to control the air pollution.
- Various types of solid wastes and their problems.
- Need for the solid waste management and methods of Solid waste management
- Recycling, examples of recycling and its advantages
- Green chemistry and goals of green chemistry.

ACTIVITY

- Visit a garbage dumping of your town and study the solid waste management procedure.
- Study the methods adopted for the purification of drinking water in our municipality water distribution station.
- Visit a vegetable of your town and study the effect of solid waste management systems.
- Adopt the procedure for segregation of waste in your college campus and create awareness for minimum solid waste among your friends.
- Conduct programme in your community on solid waste management and help the society to achieve the goals of green chemistry.

QUESTIONS

PART – A

1. Define air pollution.
2. List the common air pollutants.
3. Mention the gases responsible for acid rain.
4. Give any two examples for green house gases.

5. What is the importance of ozone layer?
6. What is the cause of ozone layer depletion?
7. What is global warming?
8. Define solid waste.
9. Mention any two problems of solid waste.
10. What are the two methods of disposal of solid waste?
11. What is incineration?
12. What is recycling?
13. Mention any two advantages of recycling.
14. Define green chemistry.

PART – B

1. What are the major air pollutants? Mention their sources and harmful effects.
2. What is acid rain? Mention its harmful effects.
3. Write a note on green house effect.
4. What is the cause of ozone layer depletion? Mention its harmful defects.
5. What is global warming? List its harmful effects.
6. Explain the different ways of control of air pollution.
7. Mention the problems caused by solid waste.
8. What are the different types of solid wastes? Give examples.
9. Explain the methods of disposal of solid waste.
10. Write a note on recycling.
11. Define green chemistry. Mention the goals of green chemistry.

Future reference links

https://www.youtube.com/watch?v=yGXINHfUUzQ&list=PL1b9Ht9ISqIEmoksyU-A5Ab5WRuhWgB5V5&index=1

https:www.youtube.com/watch?v=Uc3YsodLcco&list=PL1b9Ht9ISqIEmoksyU-A5Ab5WRuhWgB5V5&index

https://www.youtube.com/watch?v=sMeUGwpvLtk&list=PL1b9Ht9ISqIEmoksyU-A5Ab5WRuhWqB5V5&index=3

https://www.youtube.com/watch?v=KHIOXta9Q4U&list=PL1b9Ht9ISqIEmoksyU-A5Ab5WRuhWgB5V5&index=4

https://www.youtube.com/watch?v=STnKAI5kWQ0

https://youtu.be/dmgLESI4GGU

https://youtu.be/iaDBE4-OlJs

https://youtu.be/pC1u6rJkyzA

BASIC CHEMISTRY – I

MODEL QUESTION PAPER – I

CAT – I - THEORY

Time: TWO hours Maximum marks: 30

PART A

(Marks 8 × 2 =16)

N.B. – (1) Answer any 8 questions only

(2) All questions carry equal marks

1. What do you mean by concentration of a solution?
2. Name the types of buffer solutions with an examples.
3. Define pH of a solutions.
4. Define molarity?
5. Give two examples for acid base indicator.
6. What are colloids?
7. What are lyophilic and lyophobic colloids?
8. What is a positive catalyst? Give example.
9. What is Tyndall effect?
10. What is the role of a catalyst in an equilibrium reaction?

PART B

(Marks 2 × 7 =14)

N.B. – (1) Answer ALL questions, choosing any two divisions from each questions.

(2) All questions carry equal marks

I a) List the application of pH in industries.

b) Write the characteristics of a catalyst.

c) Calculate the molality of a solution containing 5g of glucose (molecular mass = 90) dissolved in 500g of solvent.

BASIC CHEMISTRY – I

MODEL QUESTION PAPER – II

CAT – I - THEORY

Time: TWO hours Maximum marks: 30

PART A

(Marks 8 × 2 =16)

N.B. – (1) Answer any 8 questions only

(2) All questions carry equal marks

1. What is an indicator? Give an example.
2. What are buffer solutions? Give an example.
3. Define pOH of a solutions.
4. Define normality?
5. Write the Lewis concept of acid and bases.
6. What is a catalyst?
7. Give two examples each for lyophilic and lyophobic colloids?
8. Write any two characteristics of a catalyst.
9. What is Brownian movement?
10. Mention any two example for industrial application of catalyst.

PART B

(Marks 2 × 7 =14)

N.B. – (1) Answer ALL questions, choosing any two divisions from each questions.

(2) All questions carry equal marks

I. a) Calculate the molarity of a solution containing 4g of sodium hydroxide (molecular mass= 40) dissolved in a solution of 2 litres.

b) Distinguish between true solution and colloidal solution.

c) Highlight the industrial application of colloids.

BASIC CHEMISTRY – I

MODEL QUESTION PAPER – I

CAT – III - THEORY

Time: TWO hours Maximum marks: 30

PART A

(Marks 8 × 2 =16)

N.B. – (1) Answer any 8 questions only

(2) All questions carry equal marks

1. What is vulcanization?
2. What is natural rubber?
3. Give two examples each for thermoplastics and thermoset plastics.
4. Define the electronic concept of oxidation and reduction.
5. What is the purpose of electroplating?
6. What is chrome plating?
7. What is greenhouse effect?
8. Mention the harmful effects of global warming.
9. How is acid rain formed?
10. What is recycling?

PART B

(Marks 2 × 7 =14)

N.B. – (1) Answer ALL questions, choosing any two divisions from each questions.

(2) All questions carry equal marks

I a) Distinguish between thermoplastics and thermoset plastics.

b) Describe the construction and working of Li-ion battery.

c) Name any four common air pollutants and list their harmful effects.

BASIC CHEMISTRY – I
MODEL QUESTION PAPER – II
CAT – III - THEORY

Time: TWO hours Maximum marks: 30

PART A

(Marks 8 × 2 =16)

N.B. – (1) Answer any 8 questions only

(2) All questions carry equal marks

1. What are plastics?
2. List the defect of natural rubber.
3. What is condensation polymerization?
4. What are electrolytes? How are they classified?
5. What is electrolysis?
6. What is creep?
7. Give two examples for e-wastes.
8. List any two harmful effect of depletion of ozone layer.
9. What is incineration?
10. What is green chemistry?

PART B

(Marks 2 × 7 =14)

N.B. – (1) Answer ALL questions, choosing any two divisions from each questions.

(2) All questions carry equal marks

I a) Write a short note on compounding of rubber.

b) Explain the process of chrome plating.

c) Write the advantages of recycling.

OBSERVATIONS

TITRATION – I

STANDARDISATION OF SODIUM HYDROXIDE SOLUTION

Sodium hydroxide Vs Oxalic acid

Trial No.	Volume of sodium hydroxide solution (V_1 mL)	Burette Reading		Volume of oxalic acid solution consumed (V_2 mL)	Indicator
		Initial (mL)	Final (mL)		
1	20	0			
2	20	0			Phenolphthalein
3					
Concordant value =		mL			

Calculations

Volume of sodium hydroxide solution (V_1) = mL

Normality of sodium hydroxide solution (N_1) = ? N

Volume of oxalic acid solution (V_2) = mL

Normality of oxalic acid solution (N_2) = N

According to the Law of Volumetric Analysis,

$$V_1 \times N_1 = V_2 \times N_2$$

$$N_1 = \frac{V_2 \times N_2}{V_1}$$

$$= \frac{x}{N}$$

The normality of sodium hydroxide solution = N

EXPT. NO.: 1 **DATE:**

ESTIMATION OF SULPHURIC ACID

Aim:

To estimate the amount of sulphuric acid present in 200 mL of the given solution using a standard solution of oxalic acid of normality 0.1N and an approximately decinormal solution of sodium hydroxide.

Apparatus Required

Burette (50 mL), pipette (20 mL), conical flask, funnel, porcelain tile, etc.

Principle

- This titration is based on the principle of neutralization of an acid with a base.

$$H_2C_2O_4 + 2\,NaOH \longrightarrow Na_2C_2O_4 + 2\,H_2O$$

$$H_2SO_4 + 2\,NaOH \longrightarrow Na_2SO_4 + 2\,H_2O$$

- In Titration – I, the normality of sodium hydroxide solution is determined by titrating it against standard oxalic acid solution.
- In Titration – II, the normality of sulphuric acid solution is determined by titrating it against standardized sodium hydroxide solution.

Short Procedure

DESCRIPTION	TITRATION I	TITRATION II
Burette solution	Oxalic acid solution	Sulphuric acid solution
Pipette solution	Sodium hydroxide solution	Sodium hydroxide solution
Indicator	Phenolphthalein	Phenolphthalein
End point	Just disappearance of pink colour	Just disappearance of pink colour
Equivalent mass of sulphuric acid = 49		

TITRATION – II

ESTIMATION OF SULPHURIC ACID

Sodium hydroxide Vs Sulphuric acid

Trial No.	Volume of sodium hydroxide solution (V_3 mL)	Burette Reading		Volume of sulphuric acid solution consumed (V_4 mL)	Indicator
		Initial (mL)	Final (mL)		
1	20	0			Phenolphthalein
2	20	0			
3					
				Concordant value = mL	

Calculations

Volume of sodium hydroxide solution (V_3) = mL

Normality of sodium hydroxide solution (N_3) = N

Volume of sulphuric acid solution (V_4) = mL

Normality of sulphuric acid solution (N_4) = ? N

According to the Law of Volumetric Analysis,

$$V_3 \text{ x } N_3 = V_4 \text{ x } N_4$$

$$N_4 = \frac{V_3 \text{ x } N_3}{V_4}$$

$$= \frac{\quad \text{x} \quad}{\quad}$$

$$= \quad \text{N}$$

The normality of sulphuric acid solution = N

The amount of sulphuric acid present in 200 mL of the given solution

$$= \frac{\text{Normality x Equivalent mass x Volume}}{1000}$$

$$= \frac{\quad \text{x} \quad\quad \text{x} \quad}{1000}$$

$$= \quad \text{g}$$

PROCEDURE

TITRATION – I

STANDARDISATION OF SODIUM HYDROXIDE SOLUTION

The burette is washed with water and rinsed with oxalic acid solution. It is then filled with the same oxalic acid solution. The pipette is washed with water and rinsed with sodium hydroxide solution. 20 mL of sodium hydroxide is pipetted out into a clean conical flask and a drop of phenolphthalein indicator is added to it. The solution turns pink in colour. It is then titrated against oxalic acid solution taken in the burette. The end point is the just disappearance of pink colour. The titration is repeated for concordant values. From the titre value, the normality of sodium hydroxide is calculated.

TITRATION – II

ESTIMATION OF SULPHURIC ACID

The burette is washed with water and is rinsed with sulphuric acid solution. It is then filled with the same sulphuric acid solution. 20 mL of sodium hydroxide solution is pipetted out into a clean conical flask and a drop of phenolphthalein indicator is added to it. The solution turns pink in colour. It is then titrated against sulphuric acid solution taken in the burette. The end point is the just disappearance of pink colour. The titration is repeated for concordant values. From the titre value, the normality of sulphuric acid solution and then the amount of sulphuric acid present in 200 mL of the given solution is calculated.

RESULT

1. The normality of sodium hydroxide solution = N
2. The normality of sulphuric acid solution = N
3. The amount of sulphuric acid present in 200 mL of the given solution } = g

OBSERVATIONS

S. No.	Volume of sodium hydroxide added (mL)	pH measured

EXPT.NO.: 2 ` **DATE:**

ESTIMATION OF A STRONG ACID BY pH METRY

Aim :

To estimate the amount of the given hydrochloric acid solution present in 250 mL of the given solution by titrating it against standard sodium hydroxide solution (0.1 N) using pH meter.

Apparatus Required :

pH Meter, its accessories and beaker.

Principle :

A pH meter is an electronic instrument used to measure the pH of a liquid. A pH meter consists of a glass electrode connected to an electronic meter that measures and displays the pH reading.

When a base is added to an acid solution, the hydrogen ion concentration of the solution decreases and hence, the pH of the solution increases slowly. But, at the vicinity of the end point, the rate of change of pH of the solution is very fast. A graph of volume of base added and the pH of the solution, is plotted. From the sharp peak in the curve, end point of the titration can be determined and then the strength of hydrochloric acid can be calculated.

Procedure :

The pH meter should be switched on 15 minutes before the start of the experiment for a warm up. The pH meter is calibrated by immersing the electrode in a buffer solution of known pH value (usually 4.0/9.0).

20 mL of the hydrochloric acid solution (V_2) is taken out into a 100 mL beaker. Then, the pH of the solution is measured by immersing the glass electrode in it. The standard sodium hydroxide is taken in a burette and 1.0 mL is added gradually to the acid solution in the beaker. The value of pH shown by the pH meter is noted. After each addition of 1.0 mL, the solution is stirred thoroughly and the corresponding pH is measured. The titration is continued till beyond the neutralization point as indicated by a rapid change in pH. A graph of volume of sodium hydroxide (X – axis) and pH (Y – axis) is plotted. From the graph, the mid-point of the steep slope is determined which gives the volume of sodium hydroxide(V_1) required to neutralize the volume of hydrochloric acid taken (end-point). Then, the normality of the given hydrochloric acid solution and the amount of hydrochloric acid present in 250 mL of the given solution is calculated. (Equivalent mass of hydrochloric acid = 36.5).

Calculations :

Volume of sodium hydroxide solution (V_1) = mL

Normality of sodium hydroxide solution (N_1) = N

Volume of hydrochloric acid solution (V_2) = mL

Normality of hydrochloric acid solution (N_2) = ? N

According to the Law of Volumetric Analysis,

$$V_1 \text{ x } N_1 = V_2 \text{ x } N_2$$

$$N_2 = \frac{V_1 \text{ x } N_1}{V_2}$$

$$= \frac{\qquad \text{x} \qquad}{\qquad}$$

$$= \qquad N$$

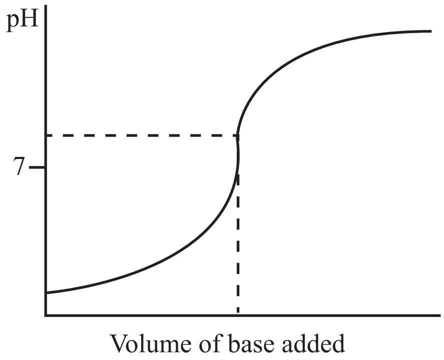
The normality of hydrochloric acid solution $= \qquad N$

The amount of hydrochloric acid present in 250 mL of the given solution $\Big\}$ $= \dfrac{\text{Normality x Equivalent mass x Volume}}{1000}$

$$= \frac{\qquad \text{x} \qquad\qquad \text{x} \qquad}{1000}$$

$$= \qquad g$$

Graph :



Result :

1. The normality of the given hydrochloric acid solution $= \qquad N$
2. The amount of hydrochloric acid present in 250 mL of the given solution $\Big\}$ $= \qquad g$

EXPT.NO.: 3 **DATE:**

PREPARATION OF LYOPHILIC AND LYOPHOBIC COLLOIDS

Aim :

To prepare (a) lyophilic colloids and (b) lyophobic colloids.

Apparatus Required :

Beaker, glass rod, tripod stand, funnel, wire gauze, pestle and mortar, etc.

Theory :

In a true solution, solute particles mix homogeneously with the molecules of the solvent and thus form a single phase. However, a colloidal solution is a heterogeneous system in which very fine particles of one substance disperse in another substance called dispersion medium.

In lyophilic colloids, since the particles of dispersed phase have more affinity for the particles of dispersion medium, these colloids are more stable as compared to lyophobic colloids. The two factors responsible for the stability of colloids are charge and the solvation of the colloidal particles by the solvent. Stability of lyophilic colloids is primarily due to the solvation of colloidal particles by the solvent whereas lyophobic colloids are stabilized by the charge on the colloidal particles.

Procedure :

A. PREPARATION OF LYOPHILIC COLLOID – STARCH COLLOID

0.5 to 1.0 g of starch is taken in a mortar and a few drops of distilled water is added. With the help of the pestle, starch is crushed into a paste. In the next step, 100 mL of distilled water is taken in a 250 mL beaker and boiled. As soon as the water starts boiling, starch paste is added with stirring. The mixture is boiled for 10 minutes After boiling, the mixture is cooled. The solution is filtered and the lyophilic starch sol is obtained.

Record your observations

B. PREPARATION OF LYOPHOBIC COLLOID – FERRIC HYDROXIDE COLLOID

100 mL of distilled water is taken in a 250 mL beaker and boiled. 2 g of ferric chloride is added to the boiling water with stirring. In the next step, 100 mL of distilled water is boiled in a 250 mL beaker. 10 mL of prepared ferric chloride solution is added drop by drop to the boiling water with stirring. Heating is continued till a brown or deep red ferric hydroxide sol is obtained.

Record your observations

EXPT.NO.: 4 **DATE:**

PREPARATION OF THERMOSETTING RESIN – UREA FORMALDEH1YDE RESIN

Aim:

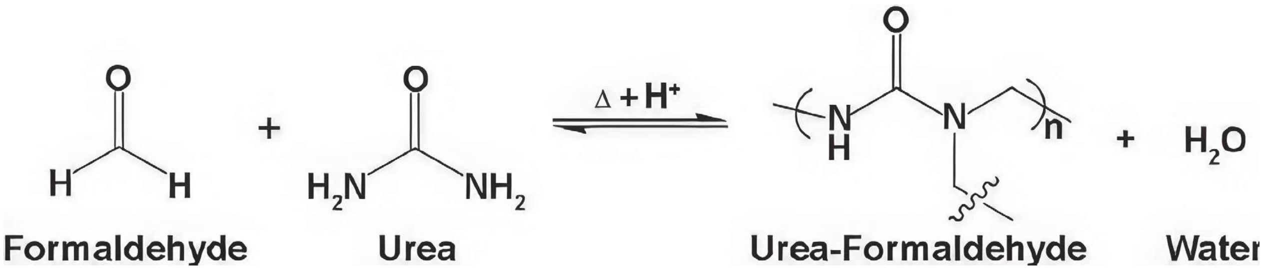
To prepare the crystals of thermosetting resin – urea formaldehyde resin and to determine the amount obtained.

Apparatus And Chemicals Required :

Beaker, measuring cylinder, glass rod, chemical balance, weight box, urea, 40% formaldehyde solution, concentrated sulphuric acid, etc.

Procedure :

- 20 mL of 40 % formaldehyde solution (formalin) is taken in a 100 mL beaker.
- 2.5 g of urea is added with constant stirring till a saturated solution is obtained.
- Few drops of concentrated sulphuric acid is added with constant stirring.
- A clear white solid crystals of urea formaldehyde resin appeared.
- The resin is washed with water and dried in the folds of filter paper.
- The amount of the obtained product is determined and reported.



Precautions :

- Urea should be weighed carefully and accurately.
- Concentrated sulphuric acid should be added drop wise with the help of glass rod along the walls of the beaker.
- Beaker and glass rod should be clean.
- Contents should not be heated above 50^0C, otherwise it will stick with the walls of the beaker.

Industrial Importance of Urea Formaldehyde :

- Used as a cation exchanger in water treatment.
- Used as a binder for glass fibers and plywood.
- Used in paper industry.
- Used for laminating purpose.
- Used in radio cabinets, switches, buttons, cups, picnic ware etc.

Result :

The amount of white crystals of urea formaldehyde = g

OBSERVATIONS

TITRATION – I

STANDARDISATION OF POTASSIUM PERMANGANATE SOLUTION

Ferrous sulphate Vs Potassium permanganate

Trial No.	Volume of ferrous sulphate solution (V_1 mL)	Burette Reading		Volume of potassium permanganate solution consumed (V_2 mL)	Indicator
		Initial (mL)	Final (mL)		
1	20	0			Self (Potassium permanganate solution)
2	20	0			
3					

Concordant value = mL

Calculations:

Volume of ferrous sulphate solution (V_1) = mL

Normality of ferrous sulphate solution (N_1) = N

Volume of potassium permanganate solution (V_2) = mL

Normality of potassium permanganate solution (N_2) = ? N

According to the Law of Volumetric Analysis,

$$V_1 \times N_1 = V_2 \times N_2$$

$$N_2 = \frac{V_1 \times N_1}{V_2}$$

$$= \frac{\quad \times \quad}{\quad}$$

$$= \quad \text{N}$$

The normality of potassium permanganate solution = N

EXPT.NO.: 5 **DATE:**

ESTIMATION OF FERROUS AMMONIUM SULPHATE (MOHR'S SALT)

Aim :

To estimate the amount of ferrous ammonium sulphate (Mohr's salt) present in one litre of the given solution using a standard solution of ferrous sulphate of normality 0.1 N and an approximately decinormal solution of potassium permanganate.

Apparatus Required :

Burette (50 mL), pipette (20 mL), conical flask, funnel, porcelain tile, etc.

Principle :

- The estimation is based on oxidation - reduction reaction. The oxidizing agent potassium permanganate oxidizes ferrous ion into ferric ion in the acidic medium.
- $2\,KMnO_4 + 10\,FeSO_4 + 8\,H_2SO_4 \longrightarrow K_2SO_4 + 2\,MnSO_4 + 5\,Fe_2(SO_4)_3 + 8\,H_2O$
- In Titration – I, the normality of potassium permanganate solution is determined by titrating it against standard ferrous sulphate solution.
- In Titration – II, the normality of ferrous ammonium sulphate solution is determined by titrating it against standardized potassium permanganate solution.

Short Procedure :

DESCRIPTION	TITRATION I	TITRATION II
Burette solution	Potassium permanganate solution	Potassium permanganate solution
Pipette solution	Ferrous sulphate solution	Ferrous ammonium sulphate solution
Reagent added	20 mL of 2 N dilute sulphuric acid	20 mL of 2 N dilute sulphuric acid
Indicator	Self (Potassium permanganate solution)	Self (Potassium permanganate solution)
End point	Appearance of permanent pale pink colour	Appearance of permanent pale pink colour

Equivalent mass of ferrous ammonium sulphate (Mohr's salt) = 392

TITRATION – II

ESTIMATION OF FERROUS AMMONIUM SULPHATE

Ferrous ammonium sulphate Vs Potassium permanganate

Trial No.	Volume of ferrous ammonium sulphate solution (V_3 mL)	Burette Reading		Volume of potassium permanganate solution consumed (V_4 mL)	Indicator
		Initial (mL)	Final (mL)		
1	20	0			Self (Potassium permanganate solution)
2	20	0			
3					

Concordant value = mL

Calculations:

Volume of ferrous ammonium sulphate solution (V_3) = mL

Normality of ferrous ammonium sulphate solution (N_3) = ? N

Volume of potassium permanganate solution (V_4) = mL

Normality of potassium permanganate solution (N_4) = N

According to the Law of Volumetric Analysis,

$$V_3 \text{ x } N_3 = V_4 \text{ x } N_4$$

$$N_3 = \frac{V_4 \text{ x } N_4}{V_3}$$

$$= \frac{\qquad \text{x} \qquad}{\qquad\qquad}$$

$$= \qquad \text{N}$$

The normality of ferrous ammonium sulphate solution = N

The amount of ferrous ammonium sulphate present in one litre (1000 mL)of the given solution $\Big\}$

$$= \frac{\text{Normality x Equivalent mass x Volume}}{1000}$$

$$= \frac{\qquad \text{x} \qquad\qquad \text{x} \qquad}{1000}$$

$$= \qquad \text{grams}$$

PROCEDURE

TITRATION – I

STANDARDISATION OF POTASSIUM PERMANGANATE SOLUTION

The burette is washed with water and rinsed with potassium permanganate solution. It is then filled with the potassium permanganate solution. The pipette is washed with water and rinsed with ferrous sulphate solution. 20 mL of ferrous sulphate solution is pipetted out into a clean conical flask and 20 mL of 2 N dilute sulphuric acid (one test tube full) is added. The solution remains colourless. It is then titrated against potassium permanganate solution taken in the burette. The end point is the appearance of permanent pale pink colour. The titration is repeated for concordant values. From the titre value, the normality of potassium permanganate solution is calculated.

TITRATION – II

ESTIMATION OF FERROUS AMMONIUM SULPHATE (MOHR'S SALT)

The burette is filled with potassium permanganate solution. The pipette is washed with water and rinsed with ferrous ammonium sulphate solution. 20 mL of ferrous ammonium sulphate (Mohr's salt) is pipetted out into clean conical flask and 20 mL of 2 N dilute sulphuric acid (one test tube full) is added. The solution remains colourless. It is then titrated against potassium permanganate solution taken in the burette. The end point is the appearance of permanent pale pink colour. The titration is repeated for concordant values. From the titre value, the normality of ferrous ammonium sulphate solution and then the amount of ferrous ammonium sulphate present in one litre (1000 mL) of the given solution is calculated.

RESULT

1. The normality of potassium permanganate solution = N
2. The normality of ferrous ammonium sulphate solution = N
3. The amount of ferrous ammonium sulphate present in one litre of the given solution } = g

OBSERVATIONS

TITRATION – I

STANDARDISATION OF POTASSIUM PERMANGANATE (A) SOLUTION

Ferrous ammonium sulphate Vs Potassium permanganate (A)

Trial No.	Volume of ferrous ammonium sulphate solution (V_1 mL)	Burette Reading		Volume of potassium permanganate (A) solution consumed (V_2 mL)	Indicator
		Initial (mL)	Final (mL)		
1	20	0			Self
2	20	0			
3					

Concordant value = mL

Calculations:

Volume of ferrous ammonium sulphate solution (V_1) = mL

Normality of ferrous ammonium sulphate solution (N_1) = N

Volume of potassium permanganate (A) solution (V_2) = mL

Normality of potassium permanganate (A) solution (N_2) = ? N

According to the Law of Volumetric Analysis,

$$V_1 \times N_1 = V_2 \times N_2$$

$$N_2 = \frac{V_1 \times N_1}{V_2}$$

$$= \frac{\quad x \quad}{\qquad}$$

$$= \qquad N$$

The normality of potassium permanganate (A) solution = N

COMPARISON OF STRENGTHS OF TWO POTASSIUM PERMANGANATE SOLUTIONS

Experiment No: 6 **Date:**

Aim :

To compare the normalities of potassium permanganate solutions supplied in bottles A and B and to estimate the amount of potassium permanganate present in 500 mL of the given stronger solution using a standard solution of ferrous ammonium sulphate of normality 0.1 N.

Apparatus Required :

Burette (50 mL), pipette (20 mL), conical flask, funnel, porcelain tile, etc.

Principle :

- The estimation is based on oxidation - reduction reaction. The oxidizing agent potassium permanganate oxidizes ferrous ion into ferric ion in the acidic medium.
- In Titration – I, the normality of potassium permanganate (A) solution is determined by titrating it against standard ferrous ammonium sulphate solution.
- In Titration – II, the normality of potassium permanganate (B) solution is determined by titrating it against standard ferrous ammonium sulphate solution.

Short Procedure :

S. NO.	CONTENTS	TITRTION - I	TITRTION - II
1	Burette solution	Potassium Permanganate (A) solution	Potassium Permanganate (B) solution
2	Pipette solution	Ferrous ammonium sulphate solution	Ferrous ammonium sulphate solution
3	Reagents added	20 mL of 2 N dilute sulphuric acid	20 mL of 2 N dilute sulphuric acid
4	Indicator	Self (Potassium permanganate solution)	Self (Potassium permanganate solution)
5	End point	Appearance of permanent pale pink colour	Appearance of permanent pale pink colour

Equivalent mass of potassium permanganate = 31.6

TITRATION – II

STANDARDISATION OF POTASSIUM PERMANGANATE (B) SOLUTION

Ferrous ammonium sulphate Vs Potassium permanganate (B)

Trial No.	Volume of ferrous ammonium sulphate solution (V_1 mL)	Burette Reading		Volume of potassium permanganate (B) solution consumed (V_2 mL)	Indicator
		Initial (mL)	Final (mL)		
1	20	0			Self (Potassium permanganate solution)
2	20	0			
3					
				Concordant value = mL	

Calculations:

Volume of ferrous ammonium sulphate solution (V_3) = mL

Normality of ferrous ammonium sulphate solution (N_3) = N

Volume of potassium permanganate (B) solution (V_4) = mL

Normality of potassium permanganate (B) solution (N_4) = ? N

According to the Law of Volumetric Analysis,

$$V_3 \times N_3 = V_4 \times N_4$$

$$N_4 = \frac{V_3 \times N_3}{V_4}$$

$$= \frac{\quad \times \quad}{\qquad}$$

$$= \qquad N$$

The normality of potassium permanganate (B) solution = N

$KMnO_4$ ( ) solution is stronger than $KMnO_4$ ( ) solution

The amount of potassium permanganate present in 500 mL of the given stronger solution } $= \frac{\text{Normality x Equivalent mass x Volume}}{1000}$

$$= \frac{\quad \times \quad \times \quad}{\qquad}$$

$$= \qquad g$$

PROCEDURE

TITRATION – I

STANDARDISATION OF POTASSIUM PERMANGANATE (A) SOLUTION

The burette is washed with water and rinsed with potassium permanganate (A) solution. It is then filled with the potassium permanganate (A) solution. The pipette is washed with water and rinsed with the ferrous ammonium sulphate solution. 20 mL of ferrous ammonium sulphate solution is pipetted out into a clean conical flask and 20 mL of 2 N dilute sulphuric acid is added. The solution remains colourless. It is then titrated against potassium permanganate (A) solution taken in the burette. The end point is the appearance of permanent pale pink colour. The titration is repeated for concordance. From the titre value, the normality of potassium permanganate (A) solution is calculated.

TITRATION – II

STANDARDISATION OF POTASSIUM PERMANGANATE (B) SOLUTION

The burette is washed with water and rinsed with potassium permanganate (B) solution. It is then filled with the potassium permanganate (B) solution. The pipette is washed with water and rinsed with the ferrous ammonium sulphate solution. 20 mL of ferrous ammonium sulphate solution is pipetted out into a clean conical flask and 20 mL of 2 N dilute sulphuric acid is added. The solution remains colourless. It is then titrated against potassium permanganate (B) solution taken in the burette. The end point is the appearance of permanent pale pink colour. The titration is repeated for concordance. From the titre value, the normality of potassium permanganate (B) solution is calculated. The normalities of two potassium permanganate solutions are compared and then the amount of potassium permanganate present in 500 mL of the given stronger solution is calculated.

RESULT

1. The normality of potassium permanganate (A) solution = N
2. The normality of potassium permanganate (B) solution = N
3. $KMnO_4$ ( ) solution is stronger than $KMnO_4$ ( ) solution
4. The amount of potassium permanganate present in 500 mL of the given stronger solution } = g

EXPT.NO.: 7 **DATE:**

CRYSTALLIZATION OF COPPER SULPHATE AND IDENTIFICATION OF IONS

Aim :

To prepare crystalline copper sulphate and confirmation of ions.

Procedure :

About 5 g of cupric carbonate or cupric chloride is taken in a conical flask and dilute sulphuric acid is added with constant stirring. The appearance of the blue colour indicates the formation of cupric sulphate. The solution is concentrated and crystallized using water. The yield is weighed after drying. Then the confirmatory tests for copper and sulpate ions were carried out.

TESTS FOR COPPER ION :

S. NO.	EXPERIMENT	OBSERVATION	INFERENCE
1	To a portion of a salt solution few drops of dilute hydrochloric acid is added and then hydrogen sulphide gas is passed through the solution	A black precipitate is obtained	Presence of Copper is confirmed
2	To a portion of a salt solution few drops of potassium ferrocyanide solution is added.	A brown precipitate is obtained	Presence of Copper is confirmed
3	To a portion of a salt solution ammonium hydroxide solution is added.	A blue precipitate soluble in excess of ammonium hydroxide is obtained	Presence of Copper is confirmed

TEST FOR SULPHATE ION

S. NO.	EXPERIMENT	OBSERVATION	INFERENCE
1	To a portion of a salt solution few drops of barium chloride solution is added	A white precipitate is obtained	Presence of Sulphate is confirmed
2	To a portion of a salt solution few drops of lead acetate solution is added	A white precipitate is obtained	Presence of Sulphate is confirmed

Result :

The yield of copper sulphate = g

The cation present in the crystal =

The anion present in the crystal =

EXPT.NO.: 8 **DATE:**

DECOLOURATION OF CLAYEY WATER USING SAND FILTER BED

Aim :

To decolourise coloured water associated with suspended impurities

Apparatus And Materials Required :

Plastic water bottle, container to collect the water, fine sand, charcoal, gravel, and pebbles

Procedure :

A pet jar water bottle is taken and the bottom of it is cut with a knife and kept in the inverted position. The neck portion of the bottle is stuffed with cotton and four different layer of pebbles, gravel, powdered charcoal and fine sand is arranged. Then, the dirty coloured water is poured on the top of the filtered bed.

Inference :

- Gravel or pebble filter out larger sediments
- Charcoal removes contaminated impurities and coloured materials
- Sand filter out fine suspended impurities
- Clear water comes out at the bottom of the filter bed

REFERNCE

https://www.youtube.com/watch?v=vQgJp6HIKRs&ab_channel=DOTEDiplomaE-lectures

https://www.youtube.com/watch?v=0mB7_bBZ7So&ab_channel=DOTEDiplomaE-lectures

BASIC CHEMISTRY – I

MODEL QUESTION PAPER – I

CAT – II - PRACTICAL

Time: TWO hours Maximum marks: 20

N.B. – (1) Answer any ONE of the following questions only

(2) All questions carry equal marks

1. Estimate the amount of sulphuric acid present in 500 mL of the given solution. You are provided with a standard solution of oxalic acid of normality 0.0985 N and a link solution of sodium hydroxide.
2. Estimate the amount of strong acid present in the given solution by pH metry. You are provided with a standard solution of sodium hydroxide of normality 0.05 N.
3. Prepare samples of lyophilic and lyophobic colloids and record your observation.
4. Prepare the crystals of thermosetting urea-formaldehyde resin using urea and formalin solution. Report the yield and mention the industrial uses.

BASIC CHEMISTRY – I

MODEL QUESTION PAPER – I

CAT – IV - PRACTICAL

Time: TWO hours Maximum marks: 20

N.B. – (1) Answer any ONE of the following questions only

(2) All questions carry equal marks

1. Estimate the amount of ferrous ammonium sulphate present in 100 mL of the given solution. You are provided with a standard solution of ferrous sulphate of normality 0.1005 N and a link solution of potassium permanganate.
2. Compare the strength of two given potassium permanganate solution A and B and estimate the amount of potassium permanganate present in 200 mL of the stronger solution. You are provided with a standard solution of ferrous ammonium sulphate of normality 0.0965 N.
3. Prepare crystals of copper sulphate from copper carbonate and confirm the copper and sulphate ions present by any two tests each.
4. Prepare a pilot sample sand bed model and decolourise the given sample of clayey water and record your observation.

GUIDELINES FOR EVALUATION OF PRACTICALS

1. For practical lab, only practical observation manual is sufficient and no record note book is required.
2. Practical observation manual may be verified by the squad/ concerned authority.
3. All 8 experiment should be completed and observation are recorded.
4. Two tests viz. CAT-2 and CAT-4 should be conducted for the purpose of evaluation.
5. CAT-2 should be conducted for first four experiments, all the experiments must be placed for the CAT-2 test and one for each student. Similarly, CAT-4 for the remaining four experiments.
6. Classwork observation manual is mandatory for all test and 5 marks are awarded for observation manual.
7. The assessment is for 20 marks for each test as given below

The internal test is conducted for 45 marks and is converted into 15 marks for calculation.

Observation note book - 5 marks

Internal test – 15 marks

Total – 20 marks

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a. For experiments no. 1, 5, and 6

Observation note book	5
Internal Examination	
Titration I	15
Titration II	15
Calculation	10
Result	5

b. For experiment no. 2

Observation notebook	5
Internal Examination	
Definition of pH	2
Model graph	3
Observation	15
Plotting the data in graph	15
Result and calculation	10

c. For experiment no. 3

Observation notebook	5
Internal Examination	
Definition of lyophilic and lyophobic colloids	5
Preparation of lyophilic colloids	15
Preparation of lyophobic colloids	15
Result and yield	10

d. For experiment no.4

Observation notebook	5
Internal Examination	
Definition of thermoplastics and thermosetting plastics	5
Preparation of urea-formaldehyde resin	15
Industrial importance	15
Result and yield	10

e. For experiment no.7

Observation notebook	5
Internal Examination	
Preparation of copper sulphate from copper carbonate	10
Test for cupric ion (Two only)	15
Test for sulphate ion (Two only)	15
Report and yield	5

f. For experiment no. 8

Observation notebook	5
Internal Examination	
Collection of materials like fine sand, charcoal, gravel pepples ect.	15
Preparation of sand bed model	15
Observation	10
Result	5

FIRST AID FOR ACCIDENTS IN CHEMISTRY LABORATORIES

ACCIDENT		FIRST AID TREATMENT
1.FIRE (a) Inflammable gases, liquids on fire.	i	Pour water carefully. Except when sodium, potassium, oil, spirit ison fire
	ii	Throw large quantities of sand if sodium, etc. is on fire.
	iii	Throw a mixture of sand and sodium bicarbonate if oil or spirit ison fire.
	iv	If any liquid or flask has caught fire, cover the mouth of the vesselwith a damp cloth or duster
	v	Cover with a piece of blanket or thick cloth or card- board.
(b) Burning of clothes.	i	Lay the person on the floor, burning parts of cloth upwards and cover with a blanket. Never throw water on the person; otherwiseit will cause serious boils on the body.
2. Cuts		Remove the visible glass pieces, etc. if any from the affected part. Stop bleeding by one of the following methods By applying pressure at the place of injury. By washing with alum or $FeCl_3$ solution. By applying a little spirit or Dettol on the skin and coverwith a piece of leucoplast
3. BURNS (a) By dry heat (i.e., flame, steam, hot object, etc.)	1	Avoid handling the affected area as far as possible. Do not break the blisters. For minor burns apply burnol and sarson oil (mustard oil). Cover the affected part with lint or linen saturated with carron oil (a mixture of linseed oil and lime water in equal amounts) or with cold cream, etc. and bandage tightly
(b) By corrosive acids.	1	If conc. H_2SO_4 falls on skin, wipe itwith cotton. Wash with plenty of cold water, then with dilute $NaHCO_3$ solution (t in 88) and again with water. If burning persists wipe the skin with cotton wool and apply burnol and sarsonoil.
(c) By corrosive alkalis.		Wash immediately with excess of water, then with dilute aceticacid or lemon juice and apply burnol or sarson oil dressing
(d) By bromine.	i	Wash with petrol or alcohol and then rub glyerine. Finally smear with burnol.
	ii	Wash withdil.Na_2CO_3 solution (1:10); the with alcohol and picricacid and apply oil dressing

ACCIDENT		FIRST AID TREATMENT
4. EYE INJURIES a) By acid.		Wash with excess of water, then with 3% $NaHCO_3$ and then withexcess of water, forcibly opening the eyes. If necessary, drop castor oil (mobile oil) into the eyes, cover with cotton wool and bandage lightly
(b) By alkalis.		Wash well with 2% boric acid solution; the fest as in (a).
(c) By bromine or chlorine vapour.		Wash with dil. $NaHCO_3$ solution and then bring near the eyes acloth or sponge soaked in alcohol or alcohol +ether mixture. Donot allow the liquid to enter the eyes
(d) By foreign particles.		Wash it by sprinkling water into the eyes. Open the eye carefullyand remove the particle by means of cotton wool or clean handkerchief. Wash again with water. Then put a drop olive or castor oil in the eyes and keep closed
5. DAMAGE TOCLOTHES (a) By acids.	1	Apply $(NH_4)_2CO3$ solution or dilute ammonia and wash well withwater
(b) By alkalis.	2	Apply lemon juice or dil. acetic acid, wash well with plenty ofwater
6. POISONING (a) Strong acids.	1	Give plenty of water. Then give 2 tablespoons of lime water ormilk of magnesia.
(b) Caustic alkalis.	2	Give plenty of water. Then give orange or lemon juice.
(c) Salts of heavy metal or copper sulphate.	3	Give milk or white of an egg.
(d) Mercury salts.	4	Immediately give a tablespoon of common salt or zinc sulphate ina tumbler of warm water
e) Arsenic or antimony salt.	5	(i) Drink plenty of warm water and make vomiting. ii) Give large quantities of freshly precipitated ferric hydroxide (mix equal vols. of $FeCl_3$ and NH_4OH) or magnesium hydroxide or castor oil mixed with milk and white of egg. (iii) Keep the feet and abdomen warm by hot waters bottles and blankets.
7. **INHALATION** (a) Bromine or chlorine.		Inhale alcohol or ammonia vapour.
(b) Carbon monoxide.		Fresh air; inhale dilute oxygen.
(c) Nitrous fumes.		Plenty of fresh air; inhale steam
(d) Chloroform.		Fresh air; artificial respiration: apply hot and cold
(e) H_2S.		Artificial respiration; inhalation of ammonia. Apply warm andcold douches to head.

List of Apparatus Required

The following glassware's are required per batch of 30 students for the conduct of Basic Chemistry practical I in our Chemistry laboratory for the year 2023-24 as per the new syllabus

S. No.	Name of the Apparatus	Quantity
1	Burette	40
2	Pipette	40
3	Conical Flask	40
4	Beaker (250 mL)	40
5	Beaker (100 mL)	40
6	Reagent bottle	120
7	Porcelain tile	40
8	Burette stand	30
9	Watch glass	40
10	Glass rod	40
11	Stopper	5
12	Test tubes	150
13	Boiling tube	40
14	Test tube holder	30
15	Brush	30
16	Wash bottle	30
17	Funnel	30
18	Round bottom flask (2L)	5
19	Indicator bottle	10
20	Glass trough (5L)	5

List of Chemical Required

The following Chemicals are required per batch of 30 students for the conduct of Basic Chemistry practical I in our Chemistry laboratory for the year 2023-24 as per the new syllabus

S. No.	Name of the Apparatus	Quantity
1	Ferrous ammonium sulphate	1000g
2	Ferrous sulphate	1000g
3	Potassium permanganate	250g
4	Copper sulphate	100g
5	Oxalic acid	500g
6	Sodium hydroxide	1000g
7	Copper carbonate	500g
8	Lead acetate	250g
9	Urea	250g
10	Barium chloride	250g
11	Potassium ferro cyanide	250g
12	Yellow ammonium sulphide	500mL
13	Ammonium chloride	250g
14	Ammonium hydroxide	250mL
15	Phenolphthalein	100g
16	PH meter	4 units
17	Acetic acid	500mL
18	Formalin solution	500mL
19	Concentrated sulphuric acid	500mL
20	Concentrated hydrochloric acid	500mL

BASIC CHEMISTRY LABORATORY (DO'S & DON'T'S)

DO'S

1. Enter the lab with proper uniform.
2. Wear shoes inside the lab.
3. Bring waste cloth to the lab.
4. Keep your work table clean.
5. Handle chemicals carefully.
6. Wash all your apparatus before and after the use.
7. Switch off the lamp, when not in use.
8. Throw all the wastages into the dust bin.
9. Use blue flame for heating.
10. Use test tube holder for heating.
11. Pour running water to the wounds caused by heat or acids.
12. Memorise the procedure thoroughly.
13. Analyse the salt systematically.
14. Record the finding then and there.
15. Use tongs for handling china dish while heating.
16. Be disciplined inside the lab.
17. Complete the experiment within the specified hours.
18. Do the experiment as per the procedure. Never attempt the addition of unnecessary chemicals.
19. Then and there get the signature in the observation notebook.

DONT'S

1. Don't consult others inside the lab.
2. Don't throw the salt with raw hand ,use spatula.
3. Don't throw the waste materials in and around your place.
4. Don't handle the chemicals not concerning you.
5. Don't wash the apparatus when it is hot.

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