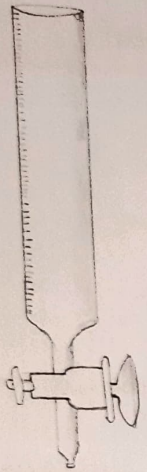
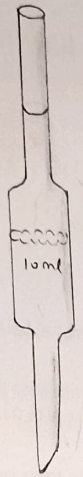
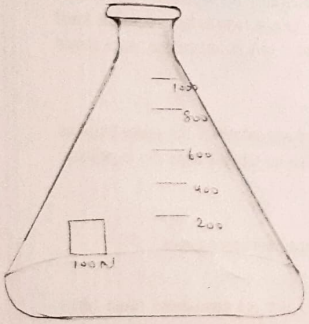


Burette



Volumetric pipette



Conical flask

Indicator Bottle

Expt. No. _____ Date _____

Page No. 1.

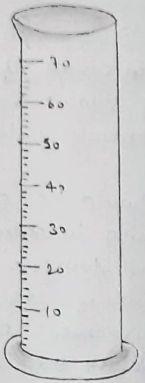
Instructions for students to work in chemistry laboratory.

Every student should keep the following in mind while working in chemistry lab -

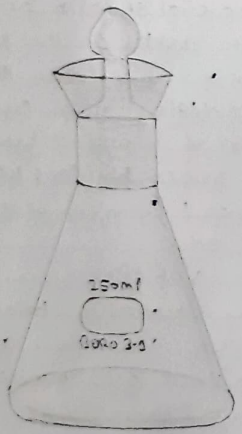
1. It should be compulsory to wear laboratory coat while working in chemistry lab.
2. Do not touch any instrument without prior permission of the laboratory staff.
3. Always work on your seat number only.
4. Check all the glass wares before use, Never use uncleaned ordinary & cracked glass ware for any reaction.
5. Dispose off all the waste material in their proper place.
6. Replace your titration solution bottles on the side bench at proper position from where you have taken these reagent bottle in the beginning after completing your experiments.
7. Do not disturb the sequence of reagent bottles. Keep every reagent bottle at its proper position; Never keep reagent bottle on your bench / Common bench. Keep them on wooden shelves only.
8. 'Off' your gas burner after completing your experiment.
9. If a student has broken any apparatus, bring this fact immediately in the notice of laboratory staff.
10. Do not take apparatus from other seat number without permission.
11. Bring wash bottle, funnel & volumetric flask for preparing standard solution before starting weighing.

Teacher's Signature _____

Glass Rod



Measuring Cylinder



Iodometric flask

Graduated pipette

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Page No. 9.

12. Never taste a chemical unless directed to do so.
13. Never mix water into concentrated acid. Always mix acid into water.
14. Before leaving the laboratory, wash your hands well with soap.

Our vision

We would contribute to human development through academic pursuits & be a trend setter in the field of Technical and management education.

Our mission

To establish world-class high quality learning environment by way of developing value-based education system, powered by brilliant professionals & leaders in the field of engineering & management.

Program outcomes-

PO-1: Engineering knowledge :- Apply the knowledge of mathematics, science, engineering fundamentals & an engineering specialization to the solution of complex engineering problems.

PO-2: Problem analysis :- Identify, formulate, review research literature and analyse complex engineering

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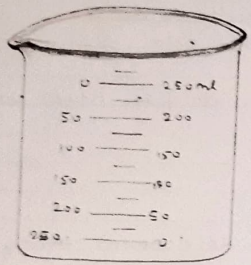
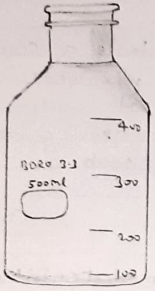


Beaker



Reagent bottle

Funnel

Dropper

problems reaching substantiated conclusions using first principles of mathematics natural sciences & engineering sciences.

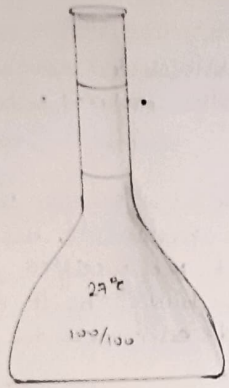
PO-3 : Design / Development of Solution Design solutions for complex engineering problems & design system components or process that meet the specified needs with appropriate consideration for the public health & safety, and the cultural, societal and environmental consideration.

PO-4 : Conduct investigations of Complex problems :- Use research-based knowledge & research methods including design of experiments, analysis and interpretation of data & synthesis of the information to present valid conclusion.

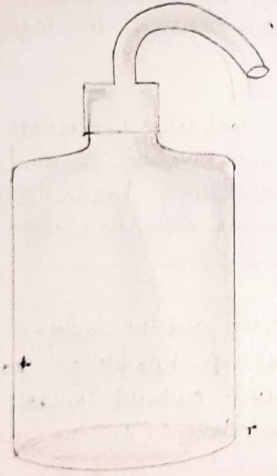
PO-5: Modern tool uses : Create select and apply appropriate, technique, resources and modern engg. & IT tools including predictions and modelling to complex engineering activities with an understanding of the limitations.

PO-6 : The engineer and the Society : Apply reasoning informed by the contextual knowledge to assess Societal, health, safety, legal and cultural issues and the consequent responsibilities relevent to the professional engineering practice.

Teacher's Signature



Volumetric Flask



Wash Bottle

Date

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PO-7 - Environment and sustain ability :- Understand the impact of the professional engineering solution in societal and environmental contexts, and deconstrate the knowledge of, and need for sustainable developments.

PO-8 : Ethics :- Apply ethical principle and commit to proffesional ethics & responsibilities & norms of the engineering practice.

PO-9 Individual and team work :- Function effectively as an individual & as a member or leader in diverse teams, and in multi-disciplinery settings.

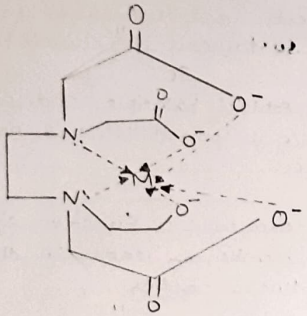
PO-10 : Communication : Communicate effectively on complex engineering activities with the engineering community and with Society at large, such as, being able to comprehend and water write effective reports & design documentation make effective presentation, and give and reciere clear instructions.

PO-11 : Project management & finance :- Demonstrate knowledge and understanding of the engineering & management principles & apply these to one's own work, as a member & leader in a term to manage project & in multidisciplinary environments.

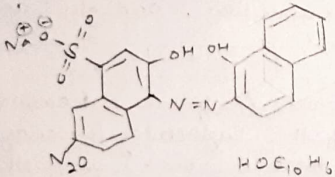
PO-12 Life-long learning :- Recognize the need for, & have the preparation & ability to engage in independent & life-long learning in the broadest context of technological change.

Teacher's Signature _____

EDTA



EBT



$HOC_{10}H_5N=NC_{10}H_4(OH)(NO_2)SO_3Na$

Eriochrome Black-T (Unionized = blue ; ionized = wine red)

IUPAC Name => Sodium 2-[1-Hydroxy naphthyl azo]-6-nitro-2 naphthol-4-sulfonate

Date 21/02/2025

Expt. No. 1 Page No. 5.

Object :- To determine the hardness of water by EDTA method.

Requirement :- Glass wears → Burette, pipette, conical flask, glass, funnel, reagent, bottle etc.

Chemical → Standard hard water, EDTA Solution, EBT, Buffer solution, hard water sample, boil water sample. NH_4Cl, Amonia solution

Principle of EDTA Titration :- EDTA (Ethylene diamine-tetra acidic acid) which is very used in analytical purposes on account of its powerful complex.

$$(HCOOCH_2C(4))_2N-CH_2-CH_2-N-(CH_2-COOH)_2$$

EDTA forms complex with Ca^{+2} and Mg^{+2} such complexes have general formal

$$M^{+2} + H_2Z^{-2} \longrightarrow MZ^{-2} + 2H^+$$

(i) Preparation of standard hard water :- 1 gm of dry $CaCO_3$ is dissolved in dilute HCl then evaporated to dryness on the water bath. Each ml of this solution contain 1 mg of $CaCO_3$

(ii) Preparation of EDTA solution :- 0.01 M EDTA solution is prepared by dissolving 3.7 g of its disodium salt in 1 unit of distilled water.

Teacher's Signature

(iii) Preparation of EBT Solution :- It is prepared by dissolving 0.5 g of EBT in 100 ml of alcohol.

(iv) Preparation of Buffer solution :- 70 gm of the NH_4Cl is dissolved in 570 ml of NH_3 and solution is diluted.

Procedure →

Standardization of EDTA Solution :-

(1) Pipette out 10 ml of standard hard water sample into a conical flask.
(2) Add 2 ml of buffer solution (pH ≈ 10) & 2-3 drops of EBT indicator.
(3) Titrate the solution against EDTA Solution until the colour changes from wine red to clear blue.

Total hardness :-

(4) Repeat the above procedure with hard sample water.

Permanent Hardness :-

(5) Take 100ml of Hard water sample & boil it gently in 25 0ml
(6) ~~Solut~~ Filter the solution into a 100 ml solution with distilled water.
(7) Pipette out 10 ml of water sample into a conical flask.
(8) Add 2 ml of buffer solution & 2-3 drops of EBT indicator
(9) Titrate it against EDTA Solution. Until the wine red colour changes to clear blue at end points.

Calculation

1. Standardization of EDTA
2. 1 gm of $CaCO_3$ is dissolve in 1L of distilled water
3. 1 ml of std hard water contains 1 mg of $CaCO_3$

10 ml of std Hard water = 11.7 ml of EDTA

10 mg $CaCO_3$ of $CaCO_3$ = 11.7 ml of EDTA

1 ml of EDTA = $\frac{10}{11.7}$ mg $CaCO_3$

→ Total hardness of water

10 ml of hard water = 6.2 ml of EDTA

1 ml of hard water = $\frac{6.2}{10} \times \frac{10}{11.7}$ mg of $CaCO_3$

1 ml of hard water = 0.5294 mg of $CaCO_3$

Now for 1 l of hard water = 529.48 mg of $CaCO_3$

→ Permanent hardness of water –

10 ml of boiled water = 4.2 ml of EDTA

1 ml of boiled water = $\frac{4.2}{10} \times \frac{10}{11.7}$ mg of $CaCO_3$

= 0.3589 mg of $CaCO_3$.

Now for litre of boiled water = 358.97 mg of $CaCO_3$.

Date _____

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Observation Table :-

For standard Hard water –

S.No.	Volume of Standard hard water (ml) $CaCO_3$	Volume of EDTA (ml)			Concordant reading (V) ml
		Initial	Final	Difference	
1.	10 ml	0.0	11.7	11.7	11.7
2.	10 ml	11.7	23.4	11.7	

For hard water sample →

S.No.	Volume of $CaCO_3$ (ml)	Volume of EDTA			Concordant reading (V) ml
		Initial	Final	Difference	
1.	10 ml	0.0	5.3	5.3	6.2
2.	10 ml	5.3	11.5	6.2	

For boiled water sample →

S.No.	Volume of $CaCO_3$ (ml)	Volume of EDTA			Concordant reading
		Initial	Final	Diff.	
1.	10 ml	0.0	4.2	4.2	4.2
2.	10 ml	4.2	8.4	4.2	

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Now

Temporary hardness of water

= Total − permanent hardness

= 529.48 − 358.97

Temporary hardness = 170.51 mg/l

Expt. No. _____ Date _____ Page No. 2

Results The hardness of given water sample:-

1. Total hardness = 529.48 mg/l
2. Permanent hardness = 358.97 mg/l
3. Temporary hardness = 170.51 mg/l

Precautions:-

1. Use 1-2 drops of indicator
2. Wash all the apparatus with distilled water
3. All solution should be Freshly prepare.

Indistrial Application

(i) All type of hardness can be determined by using the method.
(ii) Various method can be employed.
(iii) Quality of water can be assessed by knowing its hardness.
(iv) To minimize precipitation of soap.
(v) To avoid fabric being washed
(vi) To avoid ppt of dyes.
(vii) To avoid sludge & scales.

P.O.	a	b	c	d	e	f	g	h	i	j	k	l
Mapping			✓					✓		✓		

Teacher's Signature

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Viva Question

Q1 What are the difference between hard water & soft water

Ans In hard water lather doesn't form easily & soft water forms lather easily.

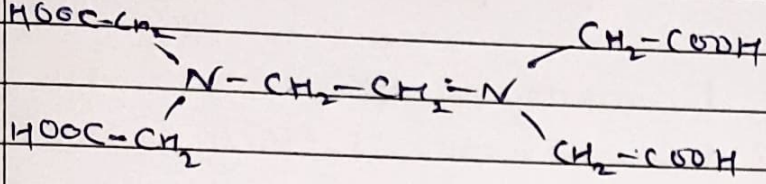
Q2 What is complexometric titration?

Ans Types of volumetric analysis where a complex is formed between a metal ion & a complex agent.

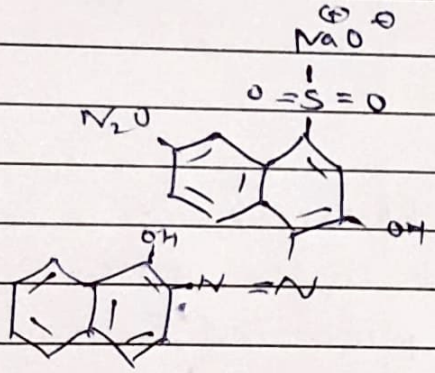
Q3 Draw structure of EDTA & EBT

Ans

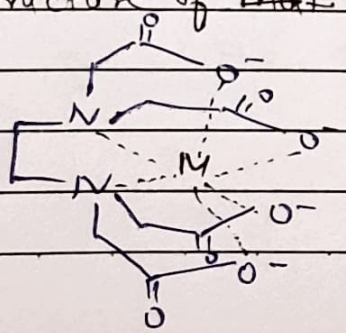
EDTA ⇒



EBT



Q4 Draw the structure of ~~mat~~ EDTA metal complex



Teacher's Signature _____

Q5. What is buffer solution?
Ans A buffer is a solution that can resist pH change upon the addition of an acidic or basic compounds.

Q6 Why disodium salt of EDTA is used?
Ans The disodium salt of EDTA is the most commonly used form of this versatile organic complexing agent.

Q7 What colour changes is observed at the end point.?
Ans At the end point Mg^{+2} will be released from the EBT indicator and the complexed with EDTA, causing the colour change from red to blue.

Q8 Write principle & chemical involved in this titration?
Ans EDTA which is very ~~p~~ used in analytical purposes on account of its powerful complex. EDTA forms complex with Ca^{+2} or Mg^{+2} such complex have general form.

Q9 Why hardness is expressed in terms of $CaCO_3$ equivalent.
Ans Hardness in water refers to the concentration of dissolved mineral primarily and magnesium ions.

Q10 Which salts are responsible for permanent hardness?
Ans The presence of soluble salts of calcium & magnesium.

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