

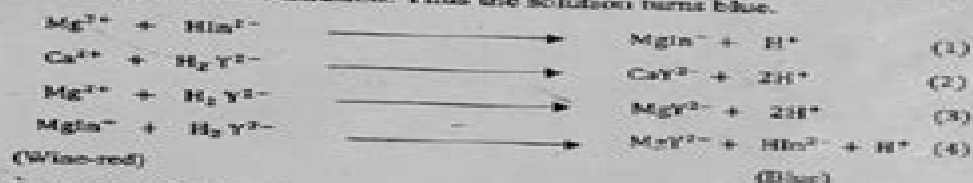
ESTIMATION OF HARDNESS OF WATER USING EDTA SOLUTION

12

AIM: To estimate the temporary and permanent hardness of given water using EDTA solution

PRINCIPLE AND THEORY: The cations responsible for hardness of water are Ca^{2+} and Mg^{2+} . The Chlorides and Sulphates of Ca^{2+} and Mg^{2+} are responsible for permanent hardness and bicarbonates of Ca^{2+} and Mg^{2+} are responsible for temporary hardness. EDTA forms stable complexes of Ca-EDTA/Mg-EDTA with hardness causing ions Ca^{2+} and Mg^{2+} present in the hard water at $\sim \text{pH } 10$. Eriochrome Black-T (EBT) is used as an indicator to know the completion of the reaction.

When a small amount of EBT indicator solution is added to a hard water sample at $\sim \text{pH } 10$, it reacts with Mg^{2+} ions present in hard water to produce wine-red colour due to formation of MgIn^- complex (Equation 1). As EDTA (H_2Y^{2-}) is added, free Ca^{2+} ions present in hard water are first complexed to form CaY^{2-} (Equation 2), which is more stable complex. Then free Mg^{2+} ion react with EDTA to give Mg-EDTA complex (Equation 3), which is less stable than Ca-EDTA but more stable than MgIn^- complex. Later, the EDTA displaces the EBT from the weak MgIn^- complex to form stable Mg-EDTA complex (MgY^{2-}) simultaneously liberating the indicator in the free form (Equation 4), which makes the end-point of the titration. Thus the solution turns blue.



PROCEDURE: It consists of 3 parts:

PART-I:- Preparation of Standard hard water: Weigh accurately 1 g of pure and dry CaCO_3 and transfer it into a 1000 ml standard flask. Dissolve the substance in the minimum quantity of dil. HCl (due to which CaCO_3 is converted into CaCl_2 which is water soluble). Makeup the solution upto the mark with distilled water and shake the solution thoroughly.

CaCO_3 equivalents hardness of standard hard water = 1 g/litre = 1000 ppm

PART-II:- Standardisation of EDTA Solution: Pipette out 20 ml of standard hard water into a clean conical flask and add 5 ml of buffer solution of $\text{pH} = 10$. Add 3-6 drops of EBT indicator and titrate the solution against EDTA solution in the burette until the wine-red colour of the solution changes to blue. Repeat the titration to get atleast two consecutive concordant titre values. Let the titre value be V_1 ml of EDTA. V_1 ml of EDTA corresponds to 1000 ppm.

PART-III:- Estimation of hardness of given water (sample):

(a) **Estimation of total hardness:** Pipette out 20 ml of given water sample into a clean conical flask and add 5 ml of buffer solution of $\text{pH} = 10$ followed by 3-6 drops of EBT indicator. Titrate the solution against EDTA solution in the burette until the wine-red colour of the solution changes to blue. Repeat the titration to get atleast two consecutive concordant titre values. Let the titre value be V_2 ml of EDTA. V_2 ml of EDTA corresponds to total hardness (X) ppm. Therefore total hardness = (X) ppm.

(b) **Estimation of Permanent hardness:** Take the given water sample upto the mark into a clean 250 ml standard flask and transfer it into a 500 ml beaker. Boil the water until the volume is decreased to 100 ml (During the process the bicarbonates are decomposed to insoluble CaCO_3 / MgCO_3). Cool the water and filter it into a 250 ml standard flask and make it upto the mark with distilled water and shake the flask thoroughly. Pipette out 20 ml of this water into a clean conical flask and add 5 ml of buffer solution of $\text{pH} = 10$ followed by 3-6 drops of EBT indicator. Titrate the solution against EDTA solution in the burette until the wine-red colour of the solution changes to blue. Repeat the titration to get atleast two consecutive concordant titre values. Let the titre value be V_3 ml of EDTA. V_3 ml of EDTA corresponds to permanent hardness (Y) ppm. Therefore permanent hardness = (Y) ppm and Temporary hardness = (Z) ppm Where $Z = (X - Y)$.

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Each experiment in this manual was selected to match topics in the textbook and includes an introduction a procedure a page of pre lab exercises about the concepts the lab illustrates and a report form Some have a scenario that places the experiment in a real world context In addition each experiment has a link to a set of references and helpful online resources

Integrated Experimental Chemistry: Laboratory experiments ,1978 **Chemistry Lab Experiments** David S. Page, **Laboratory Experiments in Chemistry** Newton Henry Black,2017-10-15 Excerpt from Laboratory Experiments in Chemistry To Accompany Black and Conant s Practical Chemistry This book has been arranged to accompany black and conant s New Practical Chemistry The directions are framed primarily to meet the needs of students who are studying the subject for the first time These experiments are the result of the author s long experience as a teacher of beginners in chemistry Laboratory work in any science is fundamental and the study of a textbook merely extends and organizes the information that the student gets in the laboratory The experiments which the student does with his own hands Should make the fundamental principles of the science real and concrete to him It is also essential for him to perform certain experiments which will indicate how these facts and principles are utilized at home and in the commercial and industrial life of the community The directions are at first very full and detailed but they are gradually abbreviated in order to leave more and more to the student s own initiative and imagination It is hoped that they are so clearly stated and illustrated that the teacher will be largely freed from the necessity of repeating the details of manipulation Frequent questions in italics have been inserted in the directions to focus the attention Of the student on the important facts to be observed One of the aims of all laboratory work is to arouse the stu dent s enthusiasm for finding things out by experiment To encourage this spirit additional experiments which are marked Optional have been included These may well be used to give elasticity and variety to the laboratory work as well as to emphasize the close connection between chemistry in the school laboratory and chemistry in the household in the factory or on the farm The introductory paragraphs are intended to give the setting of the experiment and to indicate its significance These may well be amplified by the teacher in the oral discussion preceding each experiment It is expected that the instructor will select those experiments which meet the needs of his class Probably an average class of beginners in chemistry can in one school year perform success fully not more than forty of these experiments It is far better to have a small number carefully done well written up and thoroughly understood than to rush through many carelessly About the Publisher Forgotten Books publishes hundreds of thousands of rare and classic books

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Table of Contents Pkg Acp Chemistry Lab Experiments For Chem 125a

1. Understanding the eBook Pkg Acp Chemistry Lab Experiments For Chem 125a
 - The Rise of Digital Reading Pkg Acp Chemistry Lab Experiments For Chem 125a
 - Advantages of eBooks Over Traditional Books
2. Identifying Pkg Acp Chemistry Lab Experiments For Chem 125a
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Pkg Acp Chemistry Lab Experiments For Chem 125a
 - User-Friendly Interface
4. Exploring eBook Recommendations from Pkg Acp Chemistry Lab Experiments For Chem 125a
 - Personalized Recommendations
 - Pkg Acp Chemistry Lab Experiments For Chem 125a User Reviews and Ratings
 - Pkg Acp Chemistry Lab Experiments For Chem 125a and Bestseller Lists
5. Accessing Pkg Acp Chemistry Lab Experiments For Chem 125a Free and Paid eBooks
 - Pkg Acp Chemistry Lab Experiments For Chem 125a Public Domain eBooks
 - Pkg Acp Chemistry Lab Experiments For Chem 125a eBook Subscription Services
 - Pkg Acp Chemistry Lab Experiments For Chem 125a Budget-Friendly Options
6. Navigating Pkg Acp Chemistry Lab Experiments For Chem 125a eBook Formats
 - ePub, PDF, MOBI, and More
 - Pkg Acp Chemistry Lab Experiments For Chem 125a Compatibility with Devices
 - Pkg Acp Chemistry Lab Experiments For Chem 125a Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Pkg Acp Chemistry Lab Experiments For Chem 125a
 - Highlighting and Note-Taking Pkg Acp Chemistry Lab Experiments For Chem 125a
 - Interactive Elements Pkg Acp Chemistry Lab Experiments For Chem 125a
8. Staying Engaged with Pkg Acp Chemistry Lab Experiments For Chem 125a

- Joining Online Reading Communities
- Participating in Virtual Book Clubs
- Following Authors and Publishers Pkg Acp Chemistry Lab Experiments For Chem 125a
- 9. Balancing eBooks and Physical Books Pkg Acp Chemistry Lab Experiments For Chem 125a
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Pkg Acp Chemistry Lab Experiments For Chem 125a
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Pkg Acp Chemistry Lab Experiments For Chem 125a
 - Setting Reading Goals Pkg Acp Chemistry Lab Experiments For Chem 125a
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Pkg Acp Chemistry Lab Experiments For Chem 125a
 - Fact-Checking eBook Content of Pkg Acp Chemistry Lab Experiments For Chem 125a
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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