

# Measurements Using Electrochemical Cells and Electroplating

The basic counting unit in chemistry, the mole, has a special name, *Avogadro's number*, in honor of the Italian scientist Amadeo Avogadro (1776-1856). The commonly accepted definition of Avogadro's number is the number of atoms in exactly 12 g of the isotope  $^{12}\text{C}$ , and the quantity itself is  $6.02214199(47) \times 10^{23}$ .<sup>1</sup> A bit of information about Avogadro seems appropriate. His full name was Lorenzo Romano Amedeo Carlo Avogadro (almost a mole of letters in his name). He was a practicing lawyer until 1806 when he began his new career teaching physics and math at the University of Turin, where he was later promoted to the chair of physical chemistry. In 1811, Avogadro published a paper in the *Journal de Physique*, entitled "Essay on a Manner of Determining the Relative Masses of the Elementary Molecules of Bodies, and the Proportions in Which They Enter into These Compounds," which pretty much says it all. This paper includes the statement that has come to be regarded as Avogadro's Hypothesis:

The first hypothesis to present itself in this connection, and apparently even the only admissible one, is the supposition that the number of integral molecules in any gases is always the same for equal volumes, or always proportional to the volumes. Indeed, if we were to suppose that the number of molecules contained in a given volume were different for different gases, it would scarcely be possible to conceive that the law regulating the distance of molecules could give in all cases relations as simple as those which the facts just detailed compel us to acknowledge between the volumes and the number of molecules.

In this experiment, you will confirm Avogadro's number by conducting an electrochemical process called *electrolysis*. In electrolysis, an external power supply is used to drive an otherwise *nonspontaneous* reaction. You will use a copper strip and a zinc strip as the electrodes, placed in a beaker of sulfuric acid. You will make the cell electrolytic by using the copper strip as the anode and the zinc strip as the cathode. By determining the average current used in the reaction, along with the knowledge that all of the copper ions formed are the  $2^+$  cations, you will calculate the number of atoms in one mole of copper and compare this value with Avogadro's number.

## OBJECTIVES

In this experiment, you will

- Prepare an electrochemical cell to oxidize a copper electrode.
- Measure the amount of copper that was deposited in the electroplating process and determine the average current used.
- Calculate a value for Avogadro's number and compare it to the accepted value.
- Calculate the value of a Faraday.

## MATERIALS

Lab Quest

Current probe

Battery pack with 2 D batteries

2 wires with banana plug

3 wires with alligator clips

1 M  $\text{H}_2\text{SO}_4$  solution

steel wool or sandpaper

balance

distilled water

copper strip (anode) (+)\*

zinc strip (cathode) (-)\*

**\* Remember the acronym "EPA"—An Electrolytic (nonspontaneous) cell has a Positive Anode.**

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**JS Bruner**



## **Measurements Using Electrochemical Cells And Electroplating:**

*AP Chemistry For Dummies* Peter J. Mikulecky, Michelle Rose Gilman, Kate Brutlag, 2008-11-13 A practical and hands on guide for learning the practical science of AP chemistry and preparing for the AP chem exam Gearing up for the AP Chemistry exam AP Chemistry For Dummies is packed with all the resources and help you need to do your very best Focused on the chemistry concepts and problems the College Board wants you to know this AP Chemistry study guide gives you winning test taking tips multiple choice strategies and topic guidelines as well as great advice on optimizing your study time and hitting the top of your game on test day This user friendly guide helps you prepare without perspiration by developing a pre test plan organizing your study time and getting the most out of your AP course You ll get help understanding atomic structure and bonding grasping atomic geometry understanding how colliding particles produce states and so much more To provide students with hands on experience AP chemistry courses include extensive labwork as part of the standard curriculum This is why the book dedicates a chapter to providing a brief review of common laboratory equipment and techniques and another to a complete survey of recommended AP chemistry experiments Two full length practice exams help you build your confidence get comfortable with test formats identify your strengths and weaknesses and focus your studies You ll discover how to Create and follow a pretest plan Understand everything you must know about the exam Develop a multiple choice strategy Figure out displacement combustion and acid base reactions Get familiar with stoichiometry Describe patterns and predict properties Get a handle on organic chemistry nomenclature Know your way around laboratory concepts tasks equipment and safety Analyze laboratory data Use practice exams to maximize your score Additionally you ll have a chance to brush up on the math skills that will help you on the exam learn the critical types of chemistry problems and become familiar with the annoying exceptions to chemistry rules Get your own copy of AP Chemistry For Dummies to build your confidence and test taking know how so you can ace that exam

## **Chemical Thermodynamics** Siddharth

Venkatesh, 2025-02-20 Chemical Thermodynamics The Essentials offers a comprehensive and accessible exploration of the fundamental principles and practical applications of thermodynamics in chemical systems Designed for students researchers and professionals this book delves into the energetic underpinnings of chemical reactions and processes Covering basic principles to advanced topics like phase equilibria and chemical kinetics each chapter provides clear explanations illustrative examples and practical applications The book adopts a rigorous approach to ensure a solid understanding of the subject matter systematically presenting complex concepts and emphasizing a strong theoretical foundation Practical relevance is highlighted through applications in chemical engineering environmental science and materials science Thought provoking exercises accompany each chapter fostering critical thinking and practical problem solving Helpful pedagogical tools such as chapter summaries key terms and glossaries aid comprehension and serve as valuable references Beyond being a textbook Chemical Thermodynamics The Essentials aims to inspire curiosity and exploration in the field of thermodynamics Engaging

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**Microelectromechanical Systems**, 2007      **Characterization and Metrology for ULSI Technology: 2003** David G. Seiler, 2003-10-08 The worldwide semiconductor community faces increasingly difficult challenges as it moves into the manufacturing of chips with feature sizes approaching 100 nm and beyond The magnitude of these challenges demands special attention from the metrology and analytical measurements community New paradigms must be found Adequate research and development for new metrology concepts are urgently needed Topics include integrated circuit history challenges and overviews front end lithography interconnect and back end and critical analytical techniques Characterization and metrology are key enablers for developing new semiconductor technology and in improving manufacturing This book summarizes major issues and gives critical reviews of important measurement techniques that are crucial to continue the advances in semiconductor technology It covers major aspects of process technology and most characterization techniques for silicon research including development manufacturing and diagnostics The editors believe that this book of collected papers provides a concise and effective portrayal of industry characterization needs and the way they are being addressed by

industry academia and government to continue the dramatic progress in semiconductor technology Hopefully it will also provide a basis for stimulating advances in metrology and new ideas for research and development

**Electrochemical Technology** ,1967      Universal Dictionary of the English Language ,1896      **JJAP** ,2009      **Journal** American Chemical Society,2004      **Plating and Surface Finishing** ,2008      **Energy Research Abstracts** ,1983      **NASA Thesaurus: Hierarchial listing** ,1985      **Japanese Journal of Applied Physics** ,2002

The Enigmatic Realm of **Measurements Using Electrochemical Cells And Electroplating**: Unleashing the Language is Inner Magic

In a fast-paced digital era where connections and knowledge intertwine, the enigmatic realm of language reveals its inherent magic. Its capacity to stir emotions, ignite contemplation, and catalyze profound transformations is nothing short of extraordinary. Within the captivating pages of **Measurements Using Electrochemical Cells And Electroplating** a literary masterpiece penned with a renowned author, readers set about a transformative journey, unlocking the secrets and untapped potential embedded within each word. In this evaluation, we shall explore the book's core themes, assess its distinct writing style, and delve into its lasting affect the hearts and minds of those that partake in its reading experience.

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