

# 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.

# Measurements Using Electrochemical Cells And Electroplating

**JG Myers**



## **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

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narratives and insightful discussions encourage readers to delve deeper into the fascinating world of chemical energetics. Whether you're a student or a seasoned researcher, this book offers a comprehensive and engaging resource to deepen your understanding of chemical thermodynamics and unlock the mysteries of the energetic heart of chemistry.

*PHARMACEUTICAL ANALYSIS* Mrs. Sandhya. Kota, Ms. Araf Mahefuzabibi H, Dr. Rohit Singh, Dr. S. Kambhoja, Dr. Priti Rajendra Kale, The past several decades have seen a tremendous change in the area of pharmaceutical analysis, mostly due to the growing complexity of the difficulties we seek to solve, the integration of interdisciplinary methods, and the development of analytical techniques. This book, *Pharmaceutical Analysis*, aims to provide a thorough review that takes into account the complex character of the state-of-the-art studies in this area. It is intended to provide experts, researchers, and students with the fundamental abilities and information required to successfully and properly traverse the challenging field of pharmaceutical analysis. The effort was motivated by the understanding that thorough analysis procedures are essential to generating accurate and significant information. In a time where data is easily accessible and plentiful, the difficulty is not just gathering information but also arranging, analyzing, and assessing it critically in order to make significant judgments. By giving readers a comprehensive grasp of both qualitative and quantitative analytical methodologies within the context of pharmaceutical analysis, this book seeks to close the knowledge gap between theoretical principles and actual execution. Each chapter has been painstakingly written to cover a broad spectrum of subjects, ranging from the sophisticated techniques used in pharmaceutical analysis to the basic concepts of analytical chemistry. Current concerns include the use of cutting-edge technology in drug research, the morality of data collecting, and the value of multidisciplinary methods, which have received special attention. This book shows how to use a variety of analytical approaches to different parts of pharmaceutical analysis via case studies and real-world examples. Putting this book together has been a joyful and difficult journey. It has included a thorough analysis of the literature, professional contacts, and the synthesis of many viewpoints. Through the joint efforts of researchers, academics, and practitioners, the information has been molded and made relevant to both present and future research pursuits.

*NASA Thesaurus*, 1982. Contains the authorized subject terms by which the documents in the NASA STI Database are indexed and retrieved.

*Cracking the AP Chemistry, 2002-2003 Edition* Paul Foglino, Princeton Review (Firm), 2002-01-29. The Princeton Review realizes that acing the AP Chemistry exam is very different from getting straight A's in school. The Princeton Review doesn't try to teach students everything there is to know about chemistry; only the techniques they'll need to score higher on the exam. There's a big difference. In *Cracking the AP Chemistry*, TPR will teach test takers how to think like the test makers and score higher by reviewing key chemistry concepts. Earn more points by becoming familiar with the format of the test. Safeguard against traps that can lower scores. Perfect skills with review questions in each chapter. This book includes 2 full-length simulated AP Chemistry exams. All of The Princeton Review practice test questions are like the ones test takers will see on the actual exam, and every solution is fully explained.

*Electrochemistry* Susan

Marie Szegedi,2000 *5 Steps to a 5 AP Chemistry, 2014-2015 Edition* Richard H. Langley,John Moore,2013-07-10 A PERFECT PLAN for the PERFECT SCORE STEP 1 Set up your study plan with three customized study schedules STEP 2 Determine your readiness with an AP style diagnostic exam STEP 3 Develop the strategies that will give you the edge on test day STEP 4 Review the terms and concepts you need to score high STEP 5 Build your confidence with full length practice exams **NASA Thesaurus Alphabetical Update** ,1971 **Chemistry** Gary S. Thorpe,2001 CliffsAP study guides help you gain an edge on Advanced Placement exams Review exercises realistic practice exams and effective test taking strategies are the key to calmer nerves and higher APa scores CliffsAP Chemistry is for students who are enrolled in AP Chemistry or who are preparing for the Advanced Placement Examination in Chemistry Inside you ll find hints for answering the essay and multiple choice sections a clear explanation of the exam format reviews of all 22 required labs a look at how exams are graded and more Realistic full length practice exam Answers to commonly asked questions about the AP Chemistry exam Study strategies to help you prepare Thorough review of the key topics that are sure to be on the test Sample laboratory write ups The AP Chemistry exam is coming up Your thorough understanding of months and months of college level chemistry coursework is about to be evaluated in a 3 hour examination CliffsAP Chemistry includes the following material to you do the very best job possible on the big test Gravimetrics Electronic structure of atoms Covalent bonding and ionic bonding Acids and bases Reduction and oxidation Organic chemistry and nuclear chemistry Writing and predicting chemical reactions This comprehensive guide offers a thorough review of key concepts and detailed answer explanations It s all you need to do your best and get the college credits you deserve a Advanced Placement Program and AP are registered trademarks of the College Board which was not involved in the production of and does not endorse this product **Chemical Engineering Catalog** ,1925 British Chemical and Physiological Abstracts ,1930 British Chemical Abstracts ,1927 The Industrial Arts Index ,1930 Energy Research Abstracts ,1977 Semiannual with semiannual and annual indexes References to all scientific and technical literature coming from DOE its laboratories energy centers and contractors Includes all works deriving from DOE other related government sponsored information and foreign nonnuclear information Arranged under 39 categories e g Biomedical sciences basic studies Biomedical sciences applied studies Health and safety and Fusion energy Entry gives bibliographical information and abstract Corporate author subject report number indexes **Electrochemical Technology** ,1967 *British Abstracts* ,1927 **Chemical Abstracts** ,1991 **Standard Handbook for Electrical Engineers** ,1908 **The Fundamental Theory of Electrical Engineering** Arthur Lemuel Albert,1930 Physical Chemistry, SI Version Robert A. Albery,1980

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