

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}C , and the quantity itself is $6.02214199(47) \times 10^{23}$.¹

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.

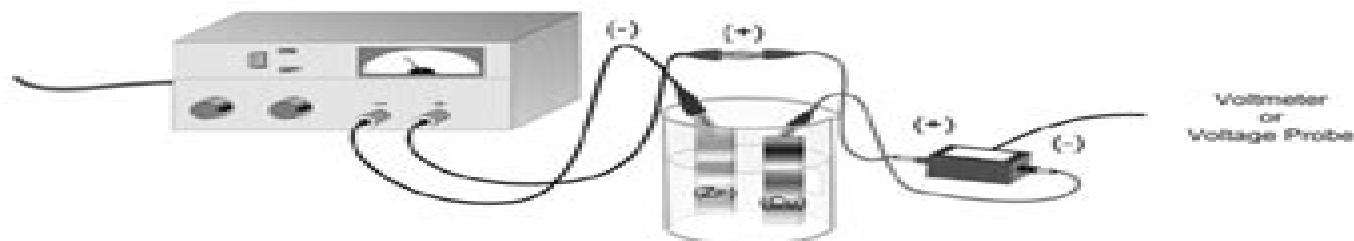


Figure 1

¹ CRC Handbook of Chemistry and Physics, 82nd edition, p. 1-7.

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Paul Foglino, Princeton Review (Firm)



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Chemical, Biochemical, and Engineering Thermodynamics Stanley I. Sandler, 2017-04-24 In this newly revised 5th Edition of Chemical and Engineering Thermodynamics Sandler presents a modern applied approach to chemical thermodynamics and provides sufficient detail to develop a solid understanding of the key principles in the field The text confronts current information on environmental and safety issues and how chemical engineering principles apply in biochemical engineering bio technology polymers and solid state processing This book is appropriate for the undergraduate and graduate level courses

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academics and practitioners the information has been molded and made relevant to both present and future research pursuits *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 As 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 NASA Thesaurus, 1998 Contains the authorized subject terms by which the documents in the NASA STI Database are indexed and retrieved Scientific and Technical Aerospace Reports, 1991 **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 **Electroplating** Darwin Sebayang, Sulaiman Hasan, 2012-04-11 This book emphasizes on new applications of electroplating with consideration for environmental aspect and experimental design Written by experienced expert from various countries the authors come from academia and electroplating industrial players Here a very detailed explanation to the new application of the electroplating is followed by a solution of the environmental issue caused by the electroplating process and concluded by experimental design for optimization of electro deposition processes Coverage included 1 Preparation NiO catalyst on FeCrAl Substrate Using Various Technique at Higher Oxidation Process 2 Electrochemical properties of carbon supported metal nanoparticle prepared by electroplating methods 3 Fabrication of InGaN Based Vertical Light Emitting Diodes Using Electroplating 4 Integration Of Electrografted Layers for the Metallization of Deep Through Silicon Vias 5 Biomass adsorbent for removal of toxic metal ions from electroplating industry wastewater 6 Resistant fungal biodiversity of electroplating effluent and their metal tolerance index 7 Experimental design and response surface analysis as available tools for statistical modeling and optimization of electrodeposition processes *Energy: a Continuing Bibliography with Indexes*, 1975 **A Handbook Of Chemical Thermodynamics** Dinesh Sharma, 2005 Divided Into 6 Chapters Zeroth Law Of Thermodynamics Ionic Equilibria And Biochemical Reactions First Law Of Thermodynamics Electrochemical Equilibrium Second And Third Law Of Thermodynamics And Quantum Theory **Thesaurus of Engineering and Scientific Terms** Engineers Joint Council, 1967

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