

# Calculations in Analytical Chemistry

## The Mole

The mole is the SI unit for amount of substance. It corresponds to the amount of a chemical substance that contains the same number of particles present in 12 grams of C-12 which is equivalent to Avogadro's number, that is,  $N_A = 6.022 \times 10^{23}$ .

The molar mass is given as the mass of a compound in grams per mole of that substance. It is calculated by adding the molar masses of all the component elements in the compound. Take glucose for example:

| Element    | Molar mass per element | Number of atoms | Mass      |
|------------|------------------------|-----------------|-----------|
| C          | 12 g/mol               | 6               | 72 g/mol  |
| H          | 1 g/mol                | 12              | 12 g/mol  |
| O          | 16 g/mol               | 6               | 96 g/mol  |
| Molar Mass |                        |                 | 180 g/mol |

## Mole and Millimole Calculations

The millimole is simply 1/1000 of a mole. It is sometimes used in calculations because of its convenience.

Example (Skoog, et al., 2014):

1. Find the number of moles and millimoles of benzoic acid (122.1 g/mol) that are contained in 2.00 g of pure acid.

If we use HBz to represent benzoic acid:

$$HBz_{mol} = 2.00 \text{ g}_{HBz} \times \frac{1 \text{ mol}_{HBz}}{122.1 \text{ g}_{HBz}} = 0.0164 \text{ mol}_{HBz}$$

To obtain the number of millimoles, the millimolar mass of benzoic acid will be used:

$$HBz_{mol} = 2.00 \text{ g}_{HBz} \times \frac{1 \text{ mmol}_{HBz}}{0.1221 \text{ g}_{HBz}} = 16.4 \text{ mmol}_{HBz}$$

2. What is the mass in grams of  $\text{Na}^+$  (22.99 g/mol) in 25.0 g of  $\text{Na}_2\text{SO}_4$  (142.0 g/mol)?

$$\begin{aligned} \text{mass}_{\text{Na}^+} &= 25.0 \text{ g}_{\text{Na}_2\text{SO}_4} \times \frac{1 \text{ mol}_{\text{Na}_2\text{SO}_4}}{142.0 \text{ g}_{\text{Na}_2\text{SO}_4}} \times \frac{2 \text{ mol}_{\text{Na}^+}}{1 \text{ mol}_{\text{Na}_2\text{SO}_4}} \times \frac{22.99 \text{ g}_{\text{Na}^+}}{1 \text{ mol}_{\text{Na}^+}} \\ \text{mass}_{\text{Na}^+} &= 8.10 \text{ g}_{\text{Na}^+} \end{aligned}$$

# Analytical Chemistry 3

**Annelies Wilder-Smith**



### **Analytical Chemistry 3:**

Analytical Chemistry—3 P. Gh. Zugrăvescu, 2013-10-22 Analytical Chemistry 3 provides information pertinent to the development of analytical chemistry This book discusses the significant role of analytical chemistry in the progress of the chemical industry Organized into nine chapters this book begins with an overview of the contribution of analytical chemistry in the development as well as in process control of the industrial chemistry This text then presents a brief history concerning the development of analytical chemistry in Romania Other chapters consider the general problem of utilizing gradients in chromatography This book discusses as well the developments in the determination of some common anions and describes the separation of anions of the same species The final chapter deals with the classification of enrichment methods according to the type of sample for which they are to be used This book is a valuable resource for chemists analytical chemists and pharmaceutical chemists Teachers scientists researchers and specialists in Romanian school of chemistry will also find this book useful

**Chemometrics in Analytical Chemistry 3** 3. International conference on chemometrics in analytical chemistry, 1986

**Analytical Chemistry** Juliette Lantz, Renée Cole, The POGIL Project, 2014-12-31 An essential guide to inquiry approach instrumental analysis Analytical Chemistry offers an essential guide to inquiry approach instrumental analysis collection The book focuses on more in depth coverage and information about an inquiry approach This authoritative guide reviews the basic principles and techniques Topics covered include method of standard the microscopic view of electrochemistry calculating cell potentials the Berri Lambert atomic and molecular absorption processes vibrational modes mass spectra interpretation and much more

**Treatise on Analytical Chemistry** Philip J. Elving, Izaak Maurits Kolthoff, Fred H. Stross, 1977

Treatise on Analytical Chemistry, 1967

**New Advances in Analytical Chemistry** Atta-ur Rahman, 2002-04-11 New Advances in Analytical Chemistry Volume 3 presents recent developments in various spectroscopic techniques such as NMR spectroscopy and mass spectroscopy in the form of comprehensive reviews written by leading authorities in the field With new and updated information the book is invaluable to both research students and postdoctoral workers who wish to keep abreast of frontiers in analytical techniques Each chapter provides a broad overall account of recent developments so that the readers can stay current not only with the authors own contributions but also with contributions of other eminent scientists working in this area

Analytical Chemistry Ira S. Krull, 2012-11-07 The current text deals with several very important topics of modern Analytical Chemistry such as analytical method validation in biotechnology today principal component analysis kinetic methods of analysis using potentiometric and spectrophotometric detectors the current status of Analytical Chemistry and where it may move in the future peptide and amino acid separations and identification and several other related topics in this growing and increasingly important area of Chemistry in general Analytical Chemistry has come to assume an incredibly important role in most if not all areas of scientific research today from the current Mars lander rover to underwater explorations to forensic science to DNA characterization for dedicated

medicine treatments to climate change and others just as important areas of modern scientific research and development Its usage in modern omics R

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*Analytical Nanochemistry* Abbas Afkhami,Tayyeb Madrakian,Mazaher Ahmadi,2023-05-10 Analytical Nanochemistry provides readers with a comprehensive review of the application of nanomaterial in analytical chemistry It explains the fundamental concepts involved in utilizing nanomaterials including their classification synthesis functionalization characterization methods separation and isolation techniques as well as toxicity It also covers fundamental information on different aspects of analytical procedures and method development Furthermore it emphasizes micro and nano enabled analytical devices and instruments as well as nanotools for nanoanalysis The book opens with a section on fundamentals Section 1 then continues with a section on the role of nanomaterials in analytical procedures Section 2 including sample preparation separation and detection The third section Section 3 includes chapters on micro and nano enabled devices as most miniaturized microsystems include nanofeatures The book concludes with a fourth section Section 4 on future perspectives covering nanoanalysis bioanalysis toxic risks and limitations of both technology and commercialization This book serves as a valuable resource for students instructors and researchers in analytical chemistry nanomaterials and nanotechnology investigating the use of nanotechnology in their analytical procedures Covers the synthesis methods functionalization process and characterization methods of nanomaterials Uses numerous visual elements to illustrate key points including flowcharts process diagrams photographs and visual schemes Presents fundamental concepts and updated hot topics such as

miniaturization in analytical chemistry nanotools for nano analysis micro total analysis systems and lab on a chip

*Handbook of Green Analytical Chemistry* Miguel de la Guardia, Salvador Garrigues, 2012-02-23 The emerging field of green analytical chemistry is concerned with the development of analytical procedures that minimize consumption of hazardous reagents and solvents and maximize safety for operators and the environment In recent years there have been significant developments in methodological and technological tools to prevent and reduce the deleterious effects of analytical activities key strategies include recycling replacement reduction and detoxification of reagents and solvents The Handbook of Green Analytical Chemistry provides a comprehensive overview of the present state and recent developments in green chemical analysis A series of detailed chapters written by international specialists in the field discuss the fundamental principles of green analytical chemistry and present a catalogue of tools for developing environmentally friendly analytical techniques Topics covered include Concepts Fundamental principles education laboratory experiments and publication in green analytical chemistry The Analytical Process Green sampling techniques and sample preparation direct analysis of samples green methods for capillary electrophoresis chromatography atomic spectroscopy solid phase molecular spectroscopy derivative molecular spectroscopy and electroanalytical methods Strategies Energy saving automation miniaturization and photocatalytic treatment of laboratory wastes Fields of Application Green bioanalytical chemistry biodiagnostics environmental analysis and industrial analysis This advanced handbook is a practical resource for experienced analytical chemists who are interested in implementing green approaches in their work     *Sensors, Chemical and*

*Biochemical Sensors* Joachim Hesse, J. N. Zemel, 2008-11-20 Sensors is the first self contained series to deal with the whole area of sensors It describes general aspects technical and physical fundamentals construction function applications and developments of the various types of sensors This is the second of two volumes focusing on chemical and biochemical sensors It includes a detailed description of biosensors which often make use of transducer properties of the basic sensors and usually have additional biological components This volume provides a unique overview of the applications the possibilities and limitations of sensors in comparison with conventional instrumentation in analytical chemistry Specific facets of applications are presented by specialists from different fields including environmental biotechnological medical or chemical process control This book is an indispensable reference work for both specialists and newcomers researchers and developers

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**Foundations of Analytical Chemistry** Miguel Valcárcel Cases,Ángela I. López-Lorente,Ma Ángeles López-Jiménez,2017-08-29 This book offers a completely new approach to learning and teaching the fundamentals of analytical chemistry It summarizes 250 basic concepts of the field on the basis of slides Each of the nine chapters offers the following features Introduction Summary General scheme Teaching objectives Text containing the explanation of each slide Recommended and commented bibliography Questions to be answered Slides A distinct feature of this novel book is its focus on the fundamental concepts and essential principles of analytical chemistry which sets it apart from other books presenting descriptive overviews of methods and techniques     *Sample Preparation for Trace Element Analysis* Zoltan Mester,Ralph E. Sturgeon,2003-12-16 Following the collection of a sample every analytical chemist will agree that its subsequent preservation and processing are of paramount importance The availability of high performance analytical instrumentation has not diminished this need for careful selection of appropriate pretreatment methodologies intelligently designed to synergistically elicit optimum function from these powerful measurement tools *Sample Preparation for Trace Element Analysis* is a modern comprehensive treatise providing an account of the state of the art on the subject matter The book has been conceived and designed to satisfy the varied needs of the practicing analytical chemist It is a multi author work reflecting the diverse expertise arising from its highly qualified contributors The first five chapters deal with general issues related to the determination of trace metals in varied matrices such as sampling contamination control reference materials calibration and detection techniques The second part of the book deals with extraction and sampling technologies totaling 15 chapters providing theoretical and practical hints for the users on how to perform specific extractions Subsequent chapters

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