

## Chapter Assessment Nuclear Chemistry

This report presents the results from fiscal year (FY) 1999 technical studies conducted by Lawrence Livermore National Laboratory (LLNL) as part of the Hydrology and Radionuclide Migration Program (HRMP) and Underground Test Area (UGTA) work-for-others project. This report is the latest in a series of annual reports published by LLNL to document the migration of radionuclides and controls of radionuclide movement at the Nevada Test Site. The FY 1999 studies highlighted in this report are: (1) Chapter 1 provides the results from flow-through leaching of nuclear melt glasses at 25 C and near-neutral pH using dilute bicarbonate groundwaters. (2) Chapter 2 reports on a summary of the size and concentration of colloidal material in NTS groundwaters. (3) Chapter 3 discusses the collaboration between LLNL/ANCD (Analytical and Nuclear Chemistry Division) and the Center for Accelerator Mass Spectrometry (CAMS) to develop a technique for analyzing NTS groundwater for 99-Technicium (99Tc) using accelerator mass spectrometry (AMS). Since 99Tc is conservative like tritium in groundwater systems, and is not sorbed to geologic material, it has the potential for being an important tool for radionuclide migration studies. (4) Chapter 4 presents the results of secondary ion mass spectrometry measurements of the in-situ distribution of radionuclides in zeolitized tuffs from cores taken adjacent to nuclear test cavities and chimneys. In-situ measurements provide insight to the distribution of specific radionuclides on a micro-scale, mineralogical controls of radionuclide sorption, and identification of migration pathways (i.e., matrix diffusion, fractures). (5) Chapter 5 outlines new analytical techniques developed in LLNL/ANCD to study hydrologic problems at the NTS using inductively coupled plasma mass spectrometry (ICP-MS). With costs for thermal-ionization mass spectrometry (TIMS) increasing relative to sample preparation time and facility support, ICP-MS technology provides a means for rapidly measuring dilute concentrations of radionuclides with precision and abundance sensitivity comparable to TIMS. (6) Chapter 6 provides results of a characterization study of alluvium collected from the U-1a complex approximately 300 meters below ground surface in Yucca Flat. The purpose of this investigation was to provide information on particle size, mineralogical context, the proportion of primary and secondary minerals, and the texture of the reactive surface area that could be used to accurately model radionuclide interactions within Nevada Test Site alluvial basins (i.e., Frenchman Flat and Yucca Flat).

Operating at a high level of fuel efficiency, safety, proliferation-resistance, sustainability and cost, generation IV nuclear reactors promise enhanced features to an energy resource which is already seen as an outstanding source of reliable base load power. The performance and reliability of materials when subjected to the higher neutron doses and extremely corrosive higher temperature environments that will be found in generation IV nuclear reactors are essential areas of study, as key considerations for the successful development of generation IV reactors are suitable structural materials for both in-core and out-of-core applications. Structural Materials for Generation IV Nuclear Reactors explores the current state-of-the art in these areas. Part One reviews the materials, requirements and challenges in generation IV systems. Part Two presents the core materials with chapters on irradiation resistant austenitic steels, ODS/FM steels and refractory metals amongst others. Part Three looks at out-of-core materials. Structural Materials for Generation IV Nuclear Reactors is an essential reference text for professional scientists, engineers and postgraduate researchers involved in the development of generation IV nuclear reactors. Introduces the higher neutron doses and extremely corrosive higher temperature environments that will be found in generation IV nuclear reactors and implications for structural materials Contains chapters on the key core and out-of-core materials, from steels to advanced micro-laminates Written by an expert in that particular area Emphasises on contemporary applications and an intuitive problem-solving approach that helps students discover the exciting potential of chemical science. This book incorporates fresh

applications from the three major areas of modern research: materials, environmental chemistry, and biological science.

Proceedings of the NATO Advanced Research Workshop on 'Nuclear and Chemical Contamination in the Countries of the Former Soviet Union: Cleanup, Management and Prevention', Atlanta, Georgia, U.S.A., February 16-22, 1995

Radiations from Radioactive Substances

The Best Test Preparation for the Advanced Placement Examination, Chemistry

Nuclear Power and the Environment

Strengthening Forensic Science in the United States

Nuclear Physics

A Whole Year of Chemistry Sentence Starters

### ***The Chemistry of Nuclear Fuel Waste Disposal Presses inter Polytechnique***

***Dramatic progress has been made in all branches of physics since the National Research Council's 1986 decadal survey of the field. The Physics in a New Era series explores these advances and looks ahead to future goals. The series includes assessments of the major subfields and reports on several smaller subfields, and preparation has begun on an overview volume on the unity of physics, its relationships to other fields, and its contributions to national needs. Nuclear Physics is the latest volume of the series. The book describes current activity in understanding nuclear structure and symmetries, the behavior of matter at extreme densities, the role of nuclear physics in astrophysics and cosmology, and the instrumentation and facilities used by the field. It makes recommendations on the resources needed for experimental and theoretical advances in the coming decade.***

***Corrosion of nuclear materials, i.e. the interaction between these materials and their environments, is a major issue for plant safety as well as for operation and economic competitiveness. Understanding these corrosion mechanisms, the systems and materials they affect, and the methods to accurately measure their incidence is of critical importance to the nuclear industry. Combining assessment techniques and analytical models into this understanding allows operators to predict the service life of corrosion-affected nuclear plant materials, and to apply the most appropriate maintenance and mitigation options to ensure safe long term operation. This book critically reviews the fundamental corrosion mechanisms that affect nuclear power plants and facilities. Initial sections introduce the complex field of nuclear corrosion science, with detailed chapters on the different types of both aqueous and non aqueous corrosion mechanisms and the nuclear materials susceptible to attack from them. This is complemented by reviews of monitoring and control methodologies, as well as modelling and lifetime prediction approaches. Given that corrosion is an applied science, the final sections review corrosion issues across the range of current and next-generation nuclear reactors, and across such nuclear***

**applications as fuel reprocessing facilities, radioactive waste storage and geological disposal systems. With its distinguished editor and international team of expert contributors, Nuclear corrosion science and engineering is an invaluable reference for nuclear metallurgists, materials scientists and engineers, as well as nuclear facility operators, regulators and consultants, and researchers and academics in this field. Comprehensively reviews the fundamental corrosion mechanisms that affect nuclear power plants and facilities Chapters assess different types of both aqueous and non aqueous corrosion mechanisms and the nuclear materials susceptible to attack from them Considers monitoring and control methodologies, as well as modelling and lifetime prediction approaches Impressive in its overall size and scope, this five-volume reference work provides researchers with the tools to push them into the forefront of the latest research. The Handbook covers all of the chemical aspects of nuclear science starting from the physical basics and including such diverse areas as the chemistry of transactinides and exotic atoms as well as radioactive waste management and radiopharmaceutical chemistry relevant to nuclear medicine. The nuclear methods of the investigation of chemical structure also receive ample space and attention. The international team of authors consists of 77 world-renowned experts - nuclear chemists, radiopharmaceutical chemists and physicists - from Austria, Belgium, Germany, Great Britain, Hungary, Holland, Japan, Russia, Sweden, Switzerland and the United States. The Handbook is an invaluable reference for nuclear scientists, biologists, chemists, physicists, physicians practicing nuclear medicine, graduate students and teachers - virtually all who are involved in the chemical and radiopharmaceutical aspects of nuclear science. The Handbook also provides for further reading through its rich selection of references.**

**Applied Modeling and Computations in Nuclear Science**

**Contesting the Future of Nuclear Power**

**Half-life of Tritium**

**Molten Salt Reactors and Thorium Energy**

**AP Edition**

**Hydrologic Resources Management Program and Underground Test Area Project FY 2001-2002 Progress Report**

Principles of Nuclear Chemistry is an introductory text in nuclear chemistry and radiochemistry, aimed at undergraduates with little or no knowledge of physics. It covers the key aspects of modern nuclear chemistry and includes worked solutions to end of chapter questions. The text begins with basic theories in contemporary physics and uses these to introduce some fundamental mathematical techniques. It relates nuclear phenomena to key divisions of chemistry such as atomic structure, spectroscopy, equilibria and kinetics. It also gives an introduction to f-block chemistry and the nuclear power industry. This book is essential reading for those taking a first course in nuclear chemistry and is a useful companion to other volumes in physical and analytical chemistry. It will

also be of use to those new to working in nuclear chemistry or radiochemistry.

This book presents all the publicly available questions from the PISA surveys. Some of these questions were used in the PISA 2000, 2003 and 2006 surveys and others were used in developing and trying out the assessment.

Molten Salt Reactors is a comprehensive reference on the status of molten salt reactor (MSR) research and thorium fuel utilization. There is growing awareness that nuclear energy is needed to complement intermittent energy sources and to avoid pollution from fossil fuels. Light water reactors are complex, expensive, and vulnerable to core melt, steam explosions, and hydrogen explosions, so better technology is needed. MSR's could operate safely at nearly atmospheric pressure and high temperature, yielding efficient electrical power generation, desalination, actinide incineration, hydrogen production, and other industrial heat applications. Coverage includes: Motivation -- why are we interested? Technical issues -- reactor physics, thermal hydraulics, materials, environment, ... Generic designs -- thermal, fast, solid fuel, liquid fuel, ... Specific designs -- aimed at electrical power, actinide incineration, thorium utilization, ... Worldwide activities in 23 countries

Conclusions This book is a collaboration of 58 authors from 23 countries, written in cooperation with the International Thorium Molten Salt Forum. It can serve as a reference for engineers and scientists, and it can be used as a textbook for graduate students and advanced undergrads. Molten Salt Reactors is the only complete review of the technology currently available, making this an essential text for anyone reviewing the use of MSR's and thorium fuel, including students, nuclear researchers, industrial engineers, and policy makers. Written in cooperation with the International Thorium Molten-Salt Forum Covers MSR-specific issues, various reactor designs, and discusses issues such as the environmental impact, non-proliferation, and licensing Includes case studies and examples from experts across the globe

Understanding radionuclide behaviour in the natural environment is essential to the sustainable development of the nuclear industry and key to assessing potential environmental risks reliably. Minimising those risks is essential to enhancing public confidence in nuclear technology. Scientific knowledge in this field has developed greatly over the last decade. Radionuclide behaviour in the natural environment provides a comprehensive overview of the key processes and parameters affecting radionuclide mobility and migration. After an introductory chapter, part one explores radionuclide chemistry in the natural environment, including aquatic chemistry and the impact of natural organic matter and microorganisms. Part two discusses the migration and radioecological behavior of radionuclides. Topics include hydrogeology, sorption and colloidal reactions as well as in-situ investigations. Principles of modelling coupled geochemical, transport and radioecological properties are also discussed. Part three covers application issues: assessment of radionuclide behaviour in contaminated sites, taking Chernobyl as an example, estimation of radiological exposure to the population, performance assessment considerations related to deep geological repositories, and remediation concepts for contaminated sites. With its distinguished editors and international team of expert contributors, Radionuclide behaviour in the natural environment is an essential tool for all those interested or involved in nuclear energy, from researchers, designers and industrial operators to environmental scientists. It also provides a comprehensive guide for academics of all levels in this field. Provides a comprehensive overview of the key processes and parameters affecting radionuclide mobility and migration Explores radionuclide chemistry in the natural environment Discusses the migration and radioecological behaviour of radionuclides

The Chemistry of Nuclear Fuel Waste Disposal

Structural Materials for Generation IV Nuclear Reactors

Over 130 Quizzes That Will Test Student Understanding In Honors Chemistry, AP Chemistry, and

IB Chemistry

An Introduction to Chemistry

Fundamentals of Nuclear Science and Engineering Second Edition

A Path Forward

The principal goals of the study were to articulate the scientific rationale and objectives of the field and then to take a long-term strategic view of U.S. nuclear science and engineering in a global context for setting future directions for the field. Nuclear Physics: Exploring the Heart of Matter provides a long-term assessment of an outlook for nuclear physics. The first phase of the report articulates the scientific rationale and objectives of the field, while the second phase provides a global context for the field and its long-term priorities and proposes a framework for progress through 2020 and beyond. In the second phase of the study, also developing a framework for progress through 2020 and beyond, the committee carefully considered the balance between universities and government facilities in terms of research and workforce development and the need for international collaborations in leveraging future investments. Nuclear physics today is a diverse field, encompassing research that spans dimensions from a tiny fraction of the volume of the individual particles (neutrons and protons) in the atomic nucleus to the enormous scales of astrophysical objects in the cosmos. Nuclear Physics: Exploring the Heart of Matter explains the research objectives, which include the desire not only to better understand the nature of matter interacting at the nuclear level, but also to describe the state of the universe that existed at the big bang. This report explains how the universe can now be studied in the most advanced colliding-beam accelerators where strong forces are the dominant interactions, as well as the nature of neutrinos. Paleo workouts that are heavy on results--and low on equipment investment Paleo Workouts For Dummies offers a program of back-to-the-Stone-Age exercises with specially designed workouts that burn fat, fight disease, and increase energy. The workouts found in this step-by-step guide, promote sound activities with a strong emphasis on practicing and mastering fundamental/primitive human movements such as squats, hinges, pushes/pulls, sprints, crawls, and more. Paleo Workouts For Dummies caters to the anti-gym crowd who want a convenient program that can be used anywhere, anytime. In addition, vital details on healthy Paleolithic foods that maximize energy levels for the intense workout routines are covered. Companion workout videos can be accessed, for free, at Dummies.com The video content aids in mastering paleo moves and techniques covered in the book Offers a complete cardiovascular and strength workout By focusing on the primal movements that humans evolved to perform, Paleo Workouts For Dummies is for anyone following a paleo diet routine as well as those curious about how to maximize their paleo workouts. Drawing on the authors' extensive experience in the processing and disposal of nuclear waste, An Introduction to Nuclear Waste Immobilisation, Second Edition examines the global issues of nuclear waste from the natural level of radionuclides in the environment to the geological disposal of waste-forms and their long-term behavior. It covers all-important aspects of processing and immobilization, including nuclear decay, regulations, new technologies and methods. Significant focus is given to the analysis of the various

matrices used, especially cement and glass, with further discussion of other materials such as bitumen. The final chapter concentrates on the performance assessment of immobilizing materials and safety of disposal, providing a full range of the resources needed to understand and correctly immobilize nuclear waste. The fully revised second edition focuses on core technologies and has an integrated approach to immobilization and hazards. Each chapter focuses on a different matrix used in nuclear waste immobilization: cement, bitumen, glass and new materials. Keeps the most important issues surrounding nuclear waste - such as treatment schemes and technologies for disposal - at the forefront.

This Very Short Introduction traces the history and cultural impact of the elements of humankind, and examines why people have long sought to identify the substances around them. Looking beyond the Periodic Table, the author takes the reader on an engaging and entertaining tour: from the Greek philosophers who propounded a system with four elements - earth, air, fire, and water - to the modern-day scientists who are able to create their own.

An Introduction to the Concepts, Systems, and Applications of Nuclear Processes  
Hydrologic Resources Management Program and Underground Test Area FY 1999  
Progress Report

Sample Questions from OECD's PISA Assessments

Exploring the Heart of Matter

Technical and Institutional Options for the Future

A Critical Global Assessment of Atomic Energy

This book will broach the topics of applied nuclear science in general, and nuclear chemistry in particular where there is usually a modeling or computational component. Typically one finds several modelers presenting their work in the course of almost every symposium. It's imperative to bring all such theoretical and computational work in applied nuclear science under one umbrella and that's what this book aims to do. The nuclear scientists interested in modeling are lacking a broader forum for their research, as well as a vehicle to enable those learning related techniques. The editors intend to include several topics: radiation risk assessment, radiation transport, contaminant transport, radiation dosimetry, modeling of experiments, detection limits, nuclear data analysis and statistical aspects.

This volume carefully describes the nature of radioactivity and of nuclear power and discusses in detail the management of radioactive waste by the multi-barrier system, but also takes an unusual approach to assessing the risks. Using knowledge of the chemical properties of the various radionuclides in spent fuel, this book follows each of the important radionuclides as it travels through the many barriers placed in its path. It turns out that only two radionuclides are able to reach the biosphere, and they arrive at the earth's surface only after many thousands of years. A careful analysis of the critical points of the disposal plant emphasizes site rejection criteria and other stages at which particular care must be taken, demonstrating

how dangers can be anticipated and putting to rest the fear of nuclear fuel waste and its geological burial. This report contains highlights of FY 2001 and 2002 technical studies conducted by the Analytical and Nuclear Chemistry Division (ANCD) at Lawrence Livermore National Laboratory (LLNL) in support of the Hydrologic Resources Management Program (HRMP) and the Underground Test Area (UGTA) Project. These programs are administered by the U.S. Department of Energy, National Nuclear Security Administration, Nevada Site Office (NNSA/NSO) through the Defense Programs and Environmental Restoration Divisions, respectively. HRMP-sponsored work emphasizes the Defense Programs goal of responsible management of natural resources at the NTS, while UGTA-funded work focuses on defining the extent of radionuclide contamination in NTS groundwater resulting from underground nuclear testing. The report is organized on a topical basis, and contains eight chapters that reflect the range of technical work performed by LLNL-ANCD in support of HRMP and UGTA. Chapter 1 describes recent hot well sampling efforts at the NTS, and presents the results of chemical and isotopic analyses of groundwater samples from six near-field wells. These include the Cambric (UE-5n), Bilby (U-3cn PS No. 2), Bourbon (UE-7nS), Nash (UE-2ce), Tybo/Benham (ER-20-5 No. 3), and Almendro (U-19v PS No. 1ds) sites. The data generated by the hot well program is vital to the development and validation of contaminant transport models at the NTS. Chapter 2 discusses the results of xenon isotope measurements of groundwater samples from the six near-field wells described in Chapter 1. This work demonstrates that fission xenon is present in the water at levels that are readily measurable and highlights the significant differences in xenon concentrations and isotopic abundances at different sites. These differences provide insight into the early cooling history of nuclear test cavities, and may assist in predicting the distribution of the source term in the near-field environment. Chapter 3 is an investigation of the distribution and abundance of actinides in a nuclear test cavity and chimney. This work demonstrates that early-time processes can widely disperse actinides at low concentrations outside the melt glass, implying that melt glass dissolution may not be the sole mechanism for the release of actinides to groundwater. The study also provides evidence for the isotopic fractionation of plutonium under the extreme conditions accompanying nuclear explosions. In Chapter 4, X-ray absorption spectroscopy measurements were used to determine the redox state of Fe and U in nuclear melt glass samples from the NTS. Both elements were found to occur in mixed valence states ( $\text{Fe}^{\text{sup } 2+}/\text{Fe}^{\text{sup } 3+}$  and  $\text{U}^{\text{sup } 5+}/\text{U}^{\text{sup } 6+}$ ) in all samples. Comparison of the Fe and U redox states with published redox studies of synthetic glasses suggests that plutonium is predominantly in the  $\text{Pu}^{\text{sup } 4+}$  oxidation state in the melt glasses. In Chapter 5, alpha autoradiography is used in a NTS field study to investigate the spatial distribution and transport of actinides in soils, and to help identify the size distribution and morphology of the actinide particles. It was found that  $\{\alpha\}$ -emitting radionuclides have moved to at least 39 cm

depth in the soil profile, far deeper than expected. The methodology that was developed could easily be applied to other field locations where actinides are dispersed in the soil zone. Chapter 6 summarizes the development of a method for measuring environmental levels of  $^{241}\text{Am}$  on the multi-collector inductively coupled plasma mass spectrometer. The method detection limit of  $0.017 \text{ pCi/L}$  is about two times lower than the best analyses possible by alpha spectrometry. Chapter 7 describes a chlorine-36 study of vertical groundwater transport processes in Frenchman Flat. Mass balance calculations developed from a  $^{36}\text{Cl}$  mixing model at well ER-5-3 No. 2 are used to estimate vertical transport fluxes and average vertical flow velocities through the thick volcanic section underlying the basin. The study also documents the variations in  $^{36}\text{Cl}/\text{Cl}$  ratios within the three principal hydrostratigraphic units in Frenchman Flat. Chapter 8 discusses an ongoing stable isotope investigation of precipitation and recharge processes in central Nevada. Precipitation, spring water, and shallow infiltration samples have been collected at four locations on a biannual basis since 1999. The results show that winter precipitation accounts for  $>90\%$  of the recharge at these sites. Lysimeter data suggest that most of the evaporation occurring during recharge is due to water vapor loss through the soil zone during periods of slow infiltration. In addition to the topical investigations described above, LLNL-ANCD contributed to several other major collaborative technical products during FY 2001 and 2002.

This book, "A Whole Year of Chemistry Quizzes" was written to provide easy to use and grade quizzes to assess the comprehension of honors students, Advance Placement students (AP), and International Baccalaureate (IB) students. This book of quizzes guides the teacher and the student through what is required in a non-watered-down chemistry course that leads students towards test and college readiness. The outline of this book has a minimum of 4 quizzes per chapter that prepares students for the formative assessment associated at the end of all chapters. The 25 chapters include topics that are covered in the honors chemistry setting as well as specialty topics like thermodynamics, kinetics, rates of reactions that are seen in the Advance Placement classes. Included within this book are quizzes for the International Baccalaureate teacher that wishes to test students on environmental chemistry as well as biological and food chemistry. This is a book that was written to fill the void of valuable resources needed for novice and experienced teachers in institutions that continually push for more summative assessments, higher DOKs, and rapid feedback, while limiting preparation time. As a teacher for over 25 years, I know that any well outlined, structured, and comprehensive resource saves time in additional planning, searching, and preparing. Use this book to help you identify and test students on topics that are important to their comprehension and success with their final test. Chapter 1. Matter and change Chapter 2. measurement and calculations Chapter 3. Atoms: The building blocks of matter Chapter 4. Arrangement of electrons in

atoms  
Chapter 5. The periodic law  
Chapter 6. Chemical bonding  
Chapter 7. Chemical formulas and chemical compounds  
Chapter 8. Chemical equations and reactions  
Chapter 9. Stoichiometry  
Chapter 10. Physical characteristics of gases  
Chapter 11. Molecular composition of gases  
Chapter 12. Liquids and solids  
Chapter 13. Solutions  
Chapter 14. Ions in aqueous solution and colligative properties  
Chapter 15. Acids and bases  
Chapter 16. Acid-base titrations  
Chapter 17. Reaction energy and reaction kinetics  
Chapter 18. Chemical equilibrium  
Chapter 19. Oxidation-reduction reactions  
Chapter 20. Chemical thermodynamics  
Chapter 21. Carbon and hydrocarbons  
Chapter 22. Other organic compounds  
Chapter 23. Nuclear chemistry  
Chapter 24. Biological and Food chemistry  
Chapter 25. Environmental chemistry  
Nuclear Power

The Core of Matter, The Fuel of Stars

Handbook of Nuclear Chemistry

Biological Effects of Nonionizing Radiation

An Introduction to Nuclear Waste Immobilisation

A Whole Year Of Chemistry Sentence Starters

This book, "A Whole Year of Chemistry Sentence Starters," was written to provide easy to use and grade sentence starters to assess the comprehension of honors students, Advance Placement students (AP), and International Baccalaureate (IB) students. The sentence starters in this book guide the teacher and the student through what is required in a non-watered-down chemistry course that leads students towards test and college readiness. The outline of this book has 25 chapters, with each chapter having two pages of sentence starters. In total, the book contains 250 sentence starters, and include topics that are covered in the honors chemistry setting as well as special topics like thermodynamics, kinetics, rates of reactions that are seen in the Advanced Placement classes. Included within this book are quizzes for the International Baccalaureate teacher that wishes to test students on environmental chemistry as well as biological and food chemistry. This is a book that was written to fill the void of valuable resources needed for novice and experienced teachers in institutions that continually push for more summative assessments, higher DOKs, and rapid feedback while limiting preparation time. As a teacher for over 25 years, I know that any well outlined, structured, and comprehensive resource saves time in additional planning, searching, and preparing. Use this book to help you identify and test students on topics that are important to their comprehension and success with their final test, while providing a valuable resource for chemistry teachers.  
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Chapter 15. Acids and bases  
Chapter 16. Acid-base titrations  
Chapter 17. Reaction energy and reaction kinetics  
Chapter 18. Chemical equilibrium  
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Chapter 23. Nuclear chemistry  
Chapter 24. Biological and Food chemistry  
Chapter 25. Environmental chemistry

Originally published in 1983, this book presents both the technical and political information necessary to evaluate the emerging threat to world security posed by recent advances in uranium enrichment technology. Uranium enrichment has played a relatively quiet but

important role in the history of efforts by a number of nations to acquire nuclear weapons and by a number of others to prevent the proliferation of nuclear weapons. For many years the uranium enrichment industry was dominated by a single method, gaseous diffusion, which was technically complex, extremely capital-intensive, and highly inefficient in its use of energy. As long as this remained true, only the richest and most technically advanced nations could afford to pursue the enrichment route to weapon acquisition. But during the 1970s this situation changed dramatically. Several new and far more accessible enrichment techniques were developed, stimulated largely by the anticipation of a rapidly growing demand for enrichment services by the world-wide nuclear power industry. This proliferation of new techniques, coupled with the subsequent contraction of the commercial market for enriched uranium, has created a situation in which uranium enrichment technology might well become the most important contributor to further nuclear weapon proliferation. Some of the issues addressed in this book are: A technical analysis of the most important enrichment techniques in a form that is relevant to analysis of proliferation risks; A detailed projection of the world demand for uranium enrichment services; A summary and critique of present institutional non-proliferation arrangements in the world enrichment industry, and An identification of the states most likely to pursue the enrichment route to acquisition of nuclear weapons.

Scores of talented and dedicated people serve the forensic science community, performing vitally important work. However, they are often constrained by lack of adequate resources, sound policies, and national support. It is clear that change and advancements, both systematic and scientific, are needed in a number of forensic science disciplines to ensure the reliability of work, establish enforceable standards, and promote best practices with consistent application. *Strengthening Forensic Science in the United States: A Path Forward* provides a detailed plan for addressing these needs and suggests the creation of a new government entity, the National Institute of Forensic Science, to establish and enforce standards within the forensic science community. The benefits of improving and regulating the forensic science disciplines are clear: assisting law enforcement officials, enhancing homeland security, and reducing the risk of wrongful conviction and exoneration.

*Strengthening Forensic Science in the United States* gives a full account of what is needed to advance the forensic science disciplines, including upgrading of systems and organizational structures, better training, widespread adoption of uniform and enforceable best practices, and mandatory certification and accreditation programs. While this book provides an essential call-to-action for congress and policy makers, it also serves as a vital tool for law enforcement agencies, criminal prosecutors and attorneys, and forensic science educators.

The Collins College Outline for College Chemistry is a comprehensive guide to the fundamental concepts behind chemical reactions, bonding, equilibria, and thermodynamics, with topics ranging from simple chemical measurements and the basics of atoms and molecules to entropy, electrochemistry, and nuclear chemistry. Fully revised and updated by Dr. Steven Boone, *College Chemistry* includes practical "test yourself" sections with answers and complete explanations at the end of each chapter. Also included are essential vocabulary definitions and sample exercises, as well as detailed images, charts, and diagrams. The Collins College Outlines are a completely revised, in-depth series of study guides for all areas of study, including the Humanities, Social Sciences, Mathematics, Science, Language, History, and Business. Featuring the most up-to-date information, each book is written by a seasoned professor in the field and focuses on a simplified and general overview of the subject for college students and, where appropriate, Advanced Placement students. Each Collins College Outline is fully integrated with the major curriculum for its subject and is a perfect supplement for any standard textbook.

Chemistry 2e

PISA Take the Test Sample Questions from OECD's PISA Assessments

Nuclear Corrosion Science and Engineering  
A Handbook for Teachers and Students  
Nuclear Energy  
Principles of Nuclear Chemistry

This book is concerned with reviewing the political and social context for nuclear power generation, the nuclear power fuel cycles and their implications for the environment.

Nearly 20 million nuclear medicine procedures are carried out each year in the United States alone to diagnose and treat cancers, cardiovascular disease, and certain neurological disorders. Many of the advancements in nuclear medicine have been the result of research investments made during the past 50 years where these procedures are now a routine part of clinical care. Although nuclear medicine plays an important role in biomedical research and disease management, its promise is only beginning to be realized. *Advancing Nuclear Medicine Through Innovation* highlights the exciting emerging opportunities in nuclear medicine, which include assessing the efficacy of new drugs in development, individualizing treatment to the patient, and understanding the biology of human diseases. Health care and pharmaceutical professionals will be most interested in this book's examination of the challenges the field faces and its recommendations for ways to reduce these impediments.

The construction of nuclear power plants in the United States is stopping, as regulators, reactor manufacturers, and operators sort out a host of technical and institutional problems. This volume summarizes the status of nuclear power, analyzes the obstacles to resumption of construction of nuclear plants, and describes and evaluates the technological alternatives for safer, more economical reactors. Topics covered include Institutional issues--including regulatory practices at the federal and state levels, the growing trends toward greater competition in the generation of electricity, and nuclear and nonnuclear generation options. Critical evaluation of advanced reactors--covering attributes such as cost, construction time, safety, development status, and fuel cycles. Finally, three alternative federal research and development programs are presented.

A NEWER EDITION OF THIS TITLE IS AVAILABLE. SEE ISBN: 978-0-7386-0427-5  
Our savvy test experts show you the way to master the test and score higher. This new and fully expanded edition examines all AP Chemistry areas including in-depth coverage of solutions, stoichiometry, kinetics, and thermodynamics. The comprehensive review covers every possible exam topic: the structure of matter, the states of matter, chemical reactions, and descriptive chemistry. Features 6 full-length practice exams with all answers thoroughly explained. Follow up your study with REA's test-taking strategies, powerhouse drills and study schedule that get you ready for test day. DETAILS - Comprehensive, up-to-date subject review of every AP Chemistry topic used in the AP exam - Study schedule tailored to your needs - Packed with proven key exam tips, insights

and advice - 6 full-length practice exams. All exam answers are fully detailed with easy-to-follow, easy-to-grasp explanations.

TABLE OF CONTENTS

About Research & Education Association Preface About the Test Scoring Contacting the AP Program

AP CHEMISTRY COURSE REVIEW

CHAPTER 1 - THE STRUCTURE OF MATTER

A. ATOMIC PROPERTIES

1. The Atomic Theory and Evidence for the Atomic Theory
2. Chemical and Physical Approaches to Atomic Weight Determination
3. Atomic Number and Mass Number, Isotopes, Mass Spectroscopy
4. Electron Energy Levels
5. The Periodic Table and Periodic Relationships: Symbols, Radii, Ionization Energy, Electron Affinity, Oxidation States

B. BONDING

1. Types of Bonds
2. Effects of Bonding Forces on States, Structures, and Properties of Matter
3. Polarity and Electronegativity
4. Geometry of Ions, Molecules, and Coordination Complexes
5. Molecular Models

C. NUCLEAR CHEMISTRY, NUCLEAR EQUATIONS, HALF-LIVES, RADIOACTIVITY

CHAPTER 2 - STATES OF MATTER

A. GASES

1. Ideal Gas Laws
2. Kinetic Molecular Theory

B. LIQUIDS AND SOLIDS

1. Kinetic-Molecular View of Liquids and Solids
2. Phase Diagram
3. Changes of State, Critical Phenomena
4. Structure of Crystals

C. SOLUTIONS

1. Types of Solutions
2. Factors Affecting Solubility
3. Ways of Expressing Concentrations
4. Colligative Properties
5. Interionic Attractions

CHAPTER 3 - REACTIONS

A. TYPES

1. Forming and Cleaving Covalent Bonds
2. Precipitation
3. Oxidation and Reduction

B. STOICHIOMETRY

1. Recognizing the Presence of Ionic and Molecular Species
2. Balancing Chemical Equations
3. Weight and Volume Relationships

C. EQUILIBRIUM

1. Dynamic Equilibrium Both Physical and Chemical
2. The Relationship Between  $K_p$  and  $K_c$
3. Equilibrium Constants for Reactions in Solutions

D. KINETICS

1. Rate of Reaction
2. Reaction Order
3. Temperature Changes and Effect on Rate
4. Activation Energy
5. Mechanism of a Reaction

E. THERMODYNAMICS

1. State Functions
2. The First Law of Thermodynamics
3. The Second Law of Thermodynamics
4. Change in Free Energy

CHAPTER 4 - DESCRIPTIVE CHEMISTRY

1. Horizontal, Vertical, and Diagonal Relationships in the Periodic Table
2. Chemistry of the Main Groups and Transition Elements and Representatives of Each
3. Organic Chemistry
4. Structural Isomerism

PRACTICE EXAMS

AP CHEMISTRY EXAM I AP CHEMISTRY EXAM II AP CHEMISTRY EXAM III AP CHEMISTRY EXAM IV AP CHEMISTRY EXAM V AP CHEMISTRY EXAM VI

FORMULAS AND TABLES EXCERPT

About Research & Education Association

Research & Education Association (REA) is an organization of educators, scientists, and engineers specializing in various academic fields. Founded in 1959 with the purpose of disseminating the most recently developed scientific information to groups in industry, government, high schools, and universities, REA has since become a successful and highly respected publisher of study aids, test preps, handbooks, and reference works. REA's Test Preparation series includes study guides for all academic levels in almost all disciplines. Research & Education Association publishes test preps for students who have not yet completed high school, as well as high school students preparing to enter

college. Students from countries around the world seeking to attend college in the United States will find the assistance they need in REA's publications. For college students seeking advanced degrees, REA publishes test preps for many major graduate school admission examinations in a wide variety of disciplines, including engineering, law, and medicine. Students at every level, in every field, with every ambition can find what they are looking for among REA's publications. While most test preparation books present practice tests that bear little resemblance to the actual exams, REA's series presents tests that accurately depict the official exams in both degree of difficulty and types of questions. REA's practice tests are always based upon the most recently administered exams, and include every type of question that can be expected on the actual exams. REA's publications and educational materials are highly regarded and continually receive an unprecedented amount of praise from professionals, instructors, librarians, parents, and students. Our authors are as diverse as the fields represented in the books we publish. They are well-known in their respective disciplines and serve on the faculties of prestigious high schools, colleges, and universities throughout the United States and Canada.

**PREFACE** This book provides an accurate and complete representation of the Advanced Placement Examination in Chemistry. Our six practice exams are based on the most recently administered Advanced Placement Chemistry Exams. Each exam is three hours in length and includes every type of question that can be expected on the actual exam. Following each exam is an answer key complete with detailed explanations designed to clarify and contextualize the material. By completing all six exams and studying the explanations which follow, you can discover your strengths and weaknesses and thereby become well prepared for the actual exam. The formulas and tables for the AP Chemistry Exam can be found at the back of this book, beginning on page 417. You will be provided these formulas and tables when you take the actual exam. You should also use this material when taking the practice tests in this book.

**ABOUT THE TEST** The Advanced Placement Chemistry Examination is offered each May at participating schools and multi-school centers throughout the world. The Advanced Placement Program is designed to allow high school students to pursue college-level studies while attending high school. The participating colleges, in turn, grant credit and/or advanced placement to students who do well on the examinations. The Advanced Placement Chemistry course is designed to be the equivalent of a college introductory chemistry course, often taken by chemistry majors in their first year of college. Since the test covers a broad range of topics, no student is expected to answer all of the questions correctly. The exam is divided into two sections: 1) Multiple-choice: Composed of 75 multiple-choice questions designed to test your ability to recall and understand a broad range of chemical concepts and calculations. This section constitutes 45% of the final grade and you are allowed 90 minutes for this portion of the exam. Calculators are not permitted for this section of the

exam. 2) Free-response section: Composed of several comprehensive problems and essay topics. This section constitutes 55% of the final grade and the student is allowed 90 minutes for this portion of the exam. You may choose from the questions provided. These problems and essays are designed to test your ability to think clearly and to present ideas in a logical, coherent fashion. You can bring an electronic hand-held calculator for use on the 40-minute free-response section. Essay and chemical-reaction questions comprise the last 50 minutes of the test, during which calculators are not permitted. A final note about calculators: Most hand-held models are allowed in the test center; the only notable exceptions are those with typewriter-style (QWERTY) keypads. If you are unsure if your calculator is permitted, check with your teacher or Educational Testing Service. SCORING The multiple-choice section of the exam is scored by crediting each correct answer with one point, and deducting only partial credit (one-fourth of a point) for each incorrect answer. Omitted questions receive neither a credit nor a deduction. The essay section is scored by a group of more than 1,000 college and high school educators familiar with the AP Program. These graders evaluate the accuracy and coherence of the essays accordingly. The grades given for the essays are combined with the results of the multiple-choice section, and the total raw score is then converted to the program's five-point scale: 5 - Extremely well qualified 4 - Well qualified 3 - Qualified 2 - Possibly qualified

Radiopharmaceutical Chemistry

Uranium Enrichment and Nuclear Weapon Proliferation

Chemistry in the World

Assessing the Risks of Nuclear and Chemical Contamination in the Former Soviet Union

Science, Implications and Lessons for the Nuclear industry

This book, "A Whole Year of Chemistry Sentence Starters" was written to provide easy to use sentence starters to assess the comprehension of honors students, Advance Placement students (AP), and International Baccalaureate (IB) students. The 25 chapters of sentence starters have a total of 250 comprehensive chemistry sentence starters that guides the teacher and the student through what is required in a non-watered-down chemistry course that leads students towards test and college readiness. These sentence starters will add a resource that prepares students for the formative assessment associated at the end of all chapters. The 25 chapters include topics that are covered in the honors chemistry setting as well as specialty topics like thermodynamics, kinetics, rates of reactions that are seen in the Advance Placement classes. Included within this book

are quizzes for the International Baccalaureate teacher that wishes to test students on environmental chemistry as well as biological and food chemistry. This is a book that was written to fill the void of valuable resources needed for novice and experienced teachers in institutions that continually push for more summative assessments, higher DOKs, and rapid feedback, while limiting preparation time. As a teacher for over 25 years, I know that any well outlined, structured, and comprehensive resource saves time in additional planning, searching, and preparing. Use this book to help you identify and test students on topics that are important to their comprehension and success with their final test.

Chapter 1. Matter and change  
Chapter 2. measurement and calculations  
Chapter 3. Atoms: The building blocks of matter  
Chapter 4. Arrangement of electrons in atoms  
Chapter 5. The periodic law  
Chapter 6. Chemical bonding  
Chapter 7. Chemical formulas and chemical compounds  
Chapter 8. Chemical equations and reactions  
Chapter 9. Stoichiometry  
Chapter 10. Physical characteristics of gases  
Chapter 11. Molecular composition of gases  
Chapter 12. Liquids and solids  
Chapter 13. Solutions  
Chapter 14. Ions in aqueous solution and colligative properties  
Chapter 15. Acids and bases  
Chapter 16. Acid-base titrations  
Chapter 17. Reaction energy and reaction kinetics  
Chapter 18. Chemical equilibrium  
Chapter 19. Oxidation-reduction reactions  
Chapter 20. Chemical thermodynamics  
Chapter 21. Carbon and hydrocarbons  
Chapter 22. Other organic compounds  
Chapter 23. Nuclear chemistry  
Chapter 24. Biological and Food chemistry  
Chapter 25. Environmental chemistry

This publication provides the basis for the education of medical physicists initiating their university studies in the field of nuclear medicine. The handbook includes 20 chapters and covers topics relevant to nuclear medicine physics, including basic physics for nuclear medicine, radionuclide production, imaging and non-imaging detectors, quantitative nuclear medicine, internal dosimetry in clinical practice and radionuclide therapy. It provides, in the form of a syllabus, a comprehensive overview of the basic medical physics knowledge required for the practice of medical physics in modern nuclear medicine.

Since the publication of the bestselling first edition, there have been numerous advances in the field of nuclear science. In medicine, accelerator based teletherapy and

electron-beam therapy have become standard. New demands in national security have stimulated major advances in nuclear instrumentation. An ideal introduction to the fundamentals of nuclear science and engineering, this book presents the basic nuclear science needed to understand and quantify an extensive range of nuclear phenomena. New to the Second Edition— A chapter on radiation detection by Douglas McGregor Up-to-date coverage of radiation hazards, reactor designs, and medical applications Flexible organization of material that allows for quick reference This edition also takes an in-depth look at particle accelerators, nuclear fusion reactions and devices, and nuclear technology in medical diagnostics and treatment. In addition, the author discusses applications such as the direct conversion of nuclear energy into electricity. The breadth of coverage is unparalleled, ranging from the theory and design characteristics of nuclear reactors to the identification of biological risks associated with ionizing radiation. All topics are supplemented with extensive nuclear data compilations to perform a wealth of calculations. Providing extensive coverage of physics, nuclear science, and nuclear technology of all types, this up-to-date second edition of *Fundamentals of Nuclear Science and Engineering* is a key reference for any physicists or engineer.

This book is a comprehensive guide to radiopharmaceutical chemistry. The stunning clinical successes of nuclear imaging and targeted radiotherapy have resulted in rapid growth in the field of radiopharmaceutical chemistry, an essential component of nuclear medicine and radiology. However, at this point, interest in the field outpaces the academic and educational infrastructure needed to train radiopharmaceutical chemists. For example, the vast majority of texts that address radiopharmaceutical chemistry do so only peripherally, focusing instead on nuclear chemistry (i.e. nuclear reactions in reactors), heavy element radiochemistry (i.e. the decomposition of radioactive waste), or solely on the clinical applications of radiopharmaceuticals (e.g. the use of PET tracers in oncology). This text fills that gap by focusing on the chemistry of radiopharmaceuticals, with key coverage of how that knowledge translates to the development of diagnostic and therapeutic radiopharmaceuticals for the clinic. The text is divided into three overarching sections: First

Principles, Radiochemistry, and Special Topics. The first is a general overview covering fundamental and broad issues like "The Production of Radionuclides" and "Basics of Radiochemistry". The second section is the main focus of the book. In this section, each chapter's author will delve much deeper into the subject matter, covering both well established and state-of-the-art techniques in radiopharmaceutical chemistry. This section will be divided according to radionuclide and will include chapters on radiolabeling methods using all of the common nuclides employed in radiopharmaceuticals, including four chapters on the ubiquitously used fluorine-18 and a "Best of the Rest" chapter to cover emerging radionuclides. Finally, the third section of the book is dedicated to special topics with important information for radiochemists, including "Bioconjugation Methods," "Click Chemistry in Radiochemistry", and "Radiochemical Instrumentation." This is an ideal educational guide for nuclear medicine physicians, radiologists, and radiopharmaceutical chemists, as well as residents and trainees in all of these areas.

College Chemistry

Advancing Nuclear Medicine Through Innovation

Over 240 Sentence Starters

The Elements: A Very Short Introduction

Chemistry

*Bishop's text shows students how to break the material of preparatory chemistry down and master it. The system of objectives tells the students exactly what they must learn in each chapter and where to find it.*

*This expanded, revised, and updated fourth edition of Nuclear Energy maintains the tradition of providing clear and comprehensive coverage of all aspects of the subject, with emphasis on the explanation of trends and developments. As in earlier editions, the book is divided into three parts that achieve a natural flow of ideas: Basic Concepts, including the fundamentals of energy, particle interactions, fission, and fusion; Nuclear Systems, including accelerators, isotope separators, detectors, and nuclear reactors; and Nuclear Energy and Man, covering the many applications of radionuclides, radiation, and reactors, along with a discussion of wastes and weapons. A minimum of mathematical background is required, but there is ample opportunity to learn characteristic numbers through the illustrative calculations and the exercises. An updated Solution Manual is available to the instructor. A new feature to aid the student is a set of some 50 Computer Exercises, using a diskette of personal computer programs in BASIC and spreadsheet, supplied by the author at a nominal cost. The book is of principal value as an introduction to nuclear science and technology for early college students, but can be of benefit to science teachers and lecturers, nuclear utility trainees and engineers in other fields. Chemistry in the World helps students become familiar with the ways in which chemistry is relevant to society and everyday life on personal, local, and global levels. The book presents chemical concepts in the context of their social applications and focuses on those most relevant to our common daily experiences and global challenges. It provides students with an appreciation for the applicability,*

*visibility, and universality of chemistry, and an understanding of the reciprocal relationship between the science of chemistry and the organism of society. The fourth edition has been reorganized into 13 chapters, which cover the composition of the atmosphere, carbon-based life forms, chemistry of water, acids and bases, pharmaceuticals and poisons, nuclear chemistry, and more. A new chapter titled "A Swiftly Warming Planet" addresses the timely issue of global warming and presents readers with the latest research-based climate assessment from the Intergovernmental Panel on Climate Change. This edition includes two new pedagogical features, which explore interesting exceptions to general rules in chemistry, as well as questions real students have asked and common areas of confusion. Chemistry in the World is an excellent comprehensive introduction to the subject, but more importantly, the book teaches students that chemistry is more than the stuff of science; it is the stuff of life.*

*Principles, Patterns, and Applications*

*Radionuclide Behaviour in the Natural Environment*

*A Whole Year of Chemistry Quizzes*

*Nuclear Medicine Physics*