

Arizona Educator Proficiency Assessments (AEPA™)

FIELD 08: CHEMISTRY TEST OBJECTIVES

Subarea	Range of Objectives	Approximate Test Proportions
I. Scientific Inquiry	1–6	23%
II. Matter and Atomic Structure	7–12	23%
III. Energy, Chemical Bonds, and Molecular Structure	13–17	20%
IV. Chemical Reactions	18–22	19%
V. Quantitative Relationships	23–26	15%

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Arizona Educator Proficiency Assessments (AEPA™) Subject Knowledge Test

Test Objectives Field 08: Chemistry

Subareas:

Scientific Inquiry
Matter and Atomic Structure
Energy, Chemical Bonds, and Molecular Structure
Chemical Reactions
Quantitative Relationships

SCIENTIFIC INQUIRY

0001 Understand the historical and contemporary contexts of the study of chemistry.

For example: the significance of key events, theories, and individuals in the history of chemistry; the historical development of theories and knowledge in chemistry; and the societal implications of developments in chemistry (e.g., pharmaceuticals, new materials, food production).

0002 Understand the nature of science and scientific inquiry.

For example: processes by which new scientific knowledge and hypotheses are generated; processes by which science advances; the reliance of scientific investigation on empirical data, verifiable evidence, and logical reasoning; ethical issues related to scientific processes (e.g., accurately reporting experimental results); and the role of communication among scientists and between scientists and the public in promoting scientific progress.

0003 Understand principles and procedures of scientific investigations.

For example: the identification of questions that can be answered using scientific methods; procedures and considerations in setting up and conducting a scientific investigation; knowledge of sampling techniques; the use of control and experimental groups to test hypotheses; the appropriateness of a specified experimental design to test a given chemistry hypothesis; and the selection and use of materials and techniques for chemistry investigations.

TEST OBJECTIVES
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0004 Understand the processes of gathering, organizing, reporting, and analyzing scientific data in the context of chemistry investigations.

For example: the appropriateness of a given method or procedure for collecting data for a specified purpose; the design and use of models; appropriate and effective graphic representations (e.g., graph, table, diagram) for organizing and reporting experimental data; the application of simple descriptive statistics to data; the analysis of data to make predictions and draw conclusions; and procedures and criteria for formally reporting experimental results and data to the scientific community.

0005 Understand the interrelationships among chemistry, society, technology, and the other sciences and the applications of chemistry to everyday life.

For example: unifying concepts and processes (e.g., systems, constancy, form and function) among the sciences; the impact of chemistry and technology on one another and on society; similarities and differences between science and technology (e.g., science as investigating the natural world, technology as solving human adaptation problems); ethical considerations related to science and technology; and the application of chemistry to daily life.

0006 Understand principles and procedures related to safety.

For example: procedures for labeling, storing, and disposing of chemicals; safe methods for preparing and dispensing laboratory chemicals; and proper safety techniques for students in the laboratory.

MATTER AND ATOMIC STRUCTURE

0007 Understand the concept of matter, and analyze chemical and physical properties of and changes in matter.

For example: differentiating among elements, compounds, and mixtures; using the physical and chemical properties of an unknown substance in order to identify it; analyzing the methods by which chemical properties of matter are determined; and distinguishing between physical and chemical changes in matter.

0008 Understand the various models of atomic structure, the principles of quantum theory, and the properties and interactions of subatomic particles.

For example: major features of models of atomic structure (e.g., Bohr, Rutherford, Schrödinger); interactions among electrons, protons, and neutrons and their properties (e.g., mass, charge); relationships among electron energy levels, photons, and atomic spectra; and analysis of the electron configurations of atoms and ions.

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0009 Understand the organization of the periodic table.

For example: the organization of the periodic table in terms of atomic number and properties of the elements; trends (e.g., ionization energies, covalent atomic radii) within periods and groups in the periodic table; predicting physical and chemical properties of given elements based on their positions in the periodic table; and using the periodic table to gain information (e.g., relative reactivity) about given elements.

0010 Understand the kinetic theory, the nature of phase changes, and the gas laws.

For example: arrangements and movements of particles in solids, liquids, and gases; basic principles of the kinetic theory (e.g., particles of matter are in continual motion, real versus ideal gas behavior); analyzing heating and cooling curves qualitatively and quantitatively; and setting up and solving problems involving gas law relationships.

0011 Apply the conventions of chemical notation and representations.

For example: the symbolic notation for given elements; applying the IUPAC rules of nomenclature to name given inorganic compounds from their formulas; recognizing and interpreting Lewis structures; and determining molecular geometry from Lewis structures.

0012 Understand the process of nuclear transformation.

For example: characteristics (e.g., mass, penetrating power) of the different types of emanations from the decay of radioactive elements; the processes of natural radioactivity and artificial transmutation; solving problems involving half-life of radioactive particles; understanding the relationship between nuclear mass defect and nuclear binding energy; and applications of nuclear reactions.

ENERGY, CHEMICAL BONDS, AND MOLECULAR STRUCTURE

0013 Understand the principles of thermodynamics and calorimetry.

For example: the three laws of thermodynamics and their applications to chemical systems; predicting the spontaneity of given reactions based on enthalpy changes, entropy changes, and temperatures of the systems; analyzing the results of calorimetry experiments; and distinguishing between heat and temperature.

0014 Understand energy relationships in chemical bonding and chemical reactions.

For example: energy changes due to the formation or breaking of chemical bonds; solving problems involving energy changes during chemical reactions (e.g., heat of combustion, heat of formation); and interpreting potential energy diagrams of chemical reactions.

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- 0015 Understand the types of bonds between atoms (including ionic, covalent, and metallic bonds), the formation of these bonds, and properties of substances containing the different bonds.**

For example: the characteristics of various types of bonds between atoms and ions (e.g., bond strength, polarity); electron behavior in the formation of bonds; factors that affect bond strength (e.g., electronegativity, electron affinity); and predicting properties of a substance based bond type.

- 0016 Understand types and characteristics of molecular interaction and properties of substances containing different types of interactive forces between molecules.**

For example: predicting the kind of interaction between molecules of a given structure; the unique properties of water and its molecular structure and intermolecular forces; and relating the physical properties of substances to their intermolecular forces.

- 0017 Understand the nomenclature and structure of organic compounds.**

For example: the chemical composition and basic structure of organic compounds (e.g., hydrocarbons and their derivatives); and distinguishing among structural, geometric, and optical isomers.

CHEMICAL REACTIONS

- 0018 Understand factors that affect reaction rates and methods of measuring reaction rates.**

For example: collision theory and factors that influence reaction rates; relating experimental measurements to reaction rates and rate laws; relating reaction mechanisms to rate laws; determining order of reactions and rate constants; and solving first-order rate problems.

- 0019 Understand the principles of chemical equilibrium.**

For example: the effects of concentration, pressure, temperature, and catalysts on chemical equilibrium; applying Le Chatelier's principle to chemical systems; solving problems involving equilibrium constants; and solving problems involving solubility product constants of slightly soluble salts.

- 0020 Understand the theories, principles, and applications of acid-base chemistry.**

For example: analyzing acids and bases according to operational and conceptual definitions (Arrhenius, Brønsted-Lowry, Lewis); the principles and applications of acid-base titration; determining the hydronium ion concentration and the pH for various acid, base, and salt solutions; and the relative strengths of given acids based on their equilibrium constant, K_a .

TEST OBJECTIVES
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0021 Understand redox reactions and electrochemistry.

For example: processes that occur during redox reactions; determining oxidation numbers and balancing redox equations; predicting whether given redox reactions will occur based on standard electrode potentials; and analyzing the components (e.g., anode, cathode) and operating principles of electrochemical and electrolytic cells.

0022 Understand the nature of organic reactions.

For example: analyzing the rates of reactions involving organic compounds based on bond types and strengths; and analyzing common types of reactions (i.e., combustion, addition, substitution, polymerization, oxidation, esterification).

QUANTITATIVE RELATIONSHIPS

0023 Understand the mole concept.

For example: relating the mole to Avogadro's number; relating the gram-atomic mass (i.e., molar mass) of an element to the mass of one mole of the element; and calculating the number of moles in a given mass or volume of a substance.

0024 Understand the relationship between the mole concept and chemical formulas.

For example: solving problems involving molar masses; solving percentage composition problems; and determining empirical and molecular formulas.

0025 Understand the quantitative relationships expressed in chemical equations.

For example: interpreting chemical notation; balancing equations; recognizing net ionic equations; and solving stoichiometric problems involving moles, mass, and volume (including limiting reactant and percent yield).

0026 Understand the properties of solutions, and analyze factors that affect solubility.

For example: the colligative properties of solutions (i.e., freezing point depression, boiling point elevation, osmotic pressure, vapor pressure lowering); solving problems involving concentrations of solutions (e.g., molarity, molality, percent concentration); and factors (e.g., temperature, pressure, molecular structure) that affect solubility.