Georgia Assessments for the Certification of Educators®

TEST DESIGN AND FRAMEWORK

TEST DESIGN

Chemistry

The **Chemistry** assessment consists of **two tests**. Each test contains a section with selected-response questions and a section with constructed-response assignments. Each section counts for a percentage of your total test score. The areas of content assessed by each test, the approximate number of selected-response questions and constructed-response assignments in each content area, and the percentage of your total test score derived from each test section are shown in the tables below. Further information regarding the content included in each subarea can be found in the test framework.

Test I (Test Code 028)

Subareas:	Objectives	Approximate Number of Selected-Response Questions	Constructed-Response Assignments
➢ Atomic Structure and the Properties of Matter	0001–0006	36	1
➢ Chemical Bonding and Energy	0007–0010	24	1
	TOTAL	**60**	**2**
Percentage of Test Score		**80%**	**20%**

Test II (Test Code 029)

Subareas:	Objectives	Approximate Number of Selected-Response Questions	Constructed-Response Assignments
➢ Chemical Reactions	0011–0016	36	1
➢ Characteristics of Science	0017–0020	24	1
	TOTAL	**60**	**2**
Percentage of Test Score		**80%**	**20%**

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TEST DESIGN AND FRAMEWORK

TEST FRAMEWORK

Chemistry

ATOMIC STRUCTURE AND THE PROPERTIES OF MATTER

0001 Understand the various models of atomic structure, the principles of quantum theory, and the properties and interactions of subatomic particles.

For example:

- identifying major features of models of atomic structure (e.g., Bohr, Rutherford, Heisenberg, Schrödinger) and the supporting evidence for these models (e.g., gold foil experiment, emission spectra)
- identifying the characteristics of protons, neutrons, and electrons and the contribution each makes to atomic number, mass number, and the formation of ions
- analyzing the relationship between atomic mass and the relative abundance of different isotopes of a particular element
- analyzing an atom's electron configuration
- demonstrating knowledge of how atomic spectra relate to the quantum properties of atoms, including how spectra are used for identifying elements and determining their electron configuration

0002 Understand the organization of the Periodic Table.

For example:

- analyzing the organization of the Periodic Table in terms of atomic numbers and properties of the elements
- predicting periodic trends within periods and groups of the Periodic Table
- inferring physical and chemical properties of the elements based on their position in the Periodic Table
- demonstrating knowledge of how the chemical properties of elements are related to their electron configurations

0003 Understand the physical and chemical properties and changes of matter.

For example:

- distinguishing between physical and chemical properties and changes of matter
- identifying methods for determining physical and chemical properties of substances
- identifying unknown substances based on physical and chemical properties
- selecting appropriate techniques to achieve a desired separation of a mixture

0004 Understand the factors that affect the solubility of a substance and the properties of solutions.

For example:

- demonstrating knowledge of the dissolution process at the atomic and molecular levels
- analyzing factors that affect the solubility of a substance (e.g., temperature, pressure) and the rate of the dissolving process
- interpreting solubility curves
- solving problems involving solution concentrations (e.g., molarity, molality, percent by mass, mole fraction)
- demonstrating knowledge of how to prepare solutions of desired concentration and properties
- analyzing the colligative properties of solutions (e.g., freezing point, boiling point, osmotic pressure, vapor pressure)
- distinguishing among colloids, solutions, and suspensions

0005 Understand chemical formulas and the nomenclature of ionic and covalent compounds.

For example:

- predicting the formulas of stable ionic compounds based on the charges of the ions that compose them
- applying knowledge of IUPAC and common nomenclature in the analysis of the names and formulas of ionic and covalent compounds
- analyzing the basic composition and chemical structure of organic compounds (e.g., alkanes, alkenes, alkynes)
- distinguishing among the common functional groups of organic compounds (e.g., alcohols, ketones, aldehydes, esters, ethers, carboxylic acids, amines, alkylhalides)

0006 Understand the processes of nuclear transformations.

For example:

- differentiating between nuclear and chemical reactions
- comparing the characteristics (e.g., mass, charge, penetrating power) of different types of emanations from the decay of radioactive elements
- analyzing the processes of natural radioactivity and artificial transmutation
- solving problems involving half-life of radioactive particles
- calculating the energies associated with various nuclear reactions
- demonstrating knowledge of nuclear fission and its applications
- recognizing the role of nuclear fusion in the production of elements more massive than hydrogen

CHEMICAL BONDING AND ENERGY

0007 Understand the different types of chemical bonds, the formation of these bonds, and the effect bond type has on the properties of substances.

For example:

- comparing the characteristics of the different types of bonds between particles (e.g., bond strength, polarity, hybridization)
- predicting the properties of a substance (e.g., ductility, electrical and thermal conductivity) based on the type of bonds
- predicting molecular geometry based on Lewis structures

0008 Understand the different types of intermolecular forces and the effects they have on the properties of substances.

For example:

- identifying and comparing the characteristics of the different types of intermolecular forces
- determining the type of intermolecular force present between the particles of a given substance
- demonstrating knowledge of the relationship between the physical properties of substances (e.g., boiling point, solubility, vapor pressure) and their intermolecular forces
- interpreting phase diagrams

0009 Understand the kinetic molecular theory and the gas laws.

For example:

- comparing the arrangement and movement of particles in the solid, liquid, gas, and plasma phases of matter
- demonstrating knowledge of basic principles of kinetic molecular theory
- analyzing the effects of intermolecular forces on real gases
- solving problems involving relationships among temperature, pressure, volume, and moles of a gas (e.g., ideal and combined gas laws)

0010 Understand the laws of thermodynamics and the flow of heat in physical and chemical processes.

For example:

- distinguishing between heat and temperature
- analyzing heating and cooling curves both qualitatively and quantitatively
- solving problems involving calorimetry
- interpreting the laws of thermodynamics and their applications to chemical systems
- predicting the spontaneity of chemical reactions based on enthalpy changes, entropy changes, and the temperature of the system
- analyzing energy changes in terms of the breaking and formation of chemical bonds
- solving problems involving energy changes during chemical reactions using standard heats of formations
- interpreting potential energy diagrams for chemical reactions

CHEMICAL REACTIONS

0011 Understand the basic types and characteristics of chemical reactions.

For example:

- identifying the basic types of chemical reactions (i.e., synthesis, decomposition, single replacement, double replacement, and combustion)
- recognizing possible indications of a chemical reaction (e.g., precipitation, gas evolution, color change)
- determining net ionic equations for chemical reactions
- applying knowledge of the principle of conservation of mass as it applies to chemical reactions and balancing chemical equations
- analyzing redox reactions in terms of oxidation and reduction half-reactions
- identifying oxidizing and reducing agents in a chemical reaction
- analyzing the components (e.g., anode, cathode, salt bridge) and operating principles of electrochemical cells

0012 Understand factors that affect reaction rates and methods for measuring reaction rates.

For example:

- identifying factors that affect reaction rates (e.g., concentration, temperature, pressure, catalyst)
- demonstrating knowledge of reaction mechanisms for simple reactions
- determining the rate law for a chemical reaction from experimental data

0013 Understand the concept of chemical equilibrium.

For example:

- demonstrating knowledge of the key characteristics of a system at equilibrium
- solving problems involving equilibrium constants
- applying knowledge of Le Chatelier's principle as it applies to systems at equilibrium

0014 Understand the theories, principles, and applications of acid-base chemistry.

For example:

- identifying acids and bases according to different acid-base theories (e.g., Arrhenius, Brønsted-Lowry, Lewis)
- demonstrating knowledge of the principles and applications of acid-base titrations and solving titration problems
- determining the hydronium ion concentration and the pH or pOH of acid, base, and salt solutions
- recognizing factors that determine the relative strengths of acids and bases
- interpreting K_a and K_b values for weak acids and bases
- demonstrating knowledge of buffer solutions and indicators

0015 Understand the mole concept and its relationship to chemical formulas.

For example:

- relating the mole of a substance to its molar mass and the number of particles present
- determining the mass of a substance or the volume of a gas based on the number of moles it contains at standard temperature and pressure (STP)
- solving percent-composition by mass problems
- determining empirical and molecular formulas from experimental data

0016 Understand molar relationships and stoichiometry.

For example:

- solving stoichiometry problems involving moles, mass, and molarity
- solving limiting-reactant and percent-yield problems
- demonstrating knowledge of appropriate chemical notations used to represent reactions as balanced chemical equations

CHARACTERISTICS OF SCIENCE

0017 Understand the characteristics of scientific knowledge and the process of scientific inquiry.

For example:

- demonstrating knowledge of the nature, purpose, and characteristics of science (e.g., reliance on verifiable evidence or scientific laws) and the limitations of science in terms of the kinds of questions that can be answered
- recognizing the dynamic nature of scientific knowledge through the continual testing, revision, and occasional rejection of existing theories
- determining an appropriate scientific hypothesis or investigative design for addressing a given problem through scientific inquiry
- demonstrating knowledge of the principles and procedures for designing and carrying out scientific investigations (e.g., changing one variable at a time)
- recognizing the importance of scientific ethics and strategies for avoiding bias in scientific investigations
- recognizing that science has developed, and continues to develop, through the contributions of diverse individuals and cultures

0018 Understand scientific tools, instruments, materials, and safety practices.

For example:

- recognizing procedures for the safe and proper use of scientific tools, instruments, chemicals, and other materials in investigations
- identifying appropriate tools and units for measuring objects or substances
- identifying potential safety hazards associated with scientific equipment, materials, procedures, and settings
- recognizing appropriate protocols for maintaining safety and for responding to emergencies during laboratory activities

0019 Understand the skills and procedures for analyzing and communicating scientific data.

For example:

- applying the concepts of precision, accuracy, and error analysis in evaluating experimental data
- applying appropriate mathematical concepts and computational skills to analyze data (e.g., using ratios; determining mean, median, and mode)
- using appropriate presentation methods (e.g., tables, graphs) and criteria for organizing and analyzing data (e.g., detecting patterns)
- using data to support or challenge scientific arguments and claims
- identifying appropriate methods for communicating the outcomes of scientific investigations (e.g., publication in peer-reviewed journals)
- demonstrating knowledge of criteria for determining the reliability of resources for gaining scientific information

0020 Understand the unifying concepts of science and technology.

For example:

- demonstrating knowledge of the unifying concepts (e.g., system, model, change, scale) of science and technology
- recognizing the characteristics of systems, how the components of a system interact (e.g., negative and positive feedback), and how different systems interact
- identifying types and characteristics of models used in science and technology and the advantages and limitations of models