Missouri Educator Gateway Assessments

FIELD 018: CHEMISTRY
TEST FRAMEWORK

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DRAFT

Content Domain		Range of Competencies	Approximate Percentage of Test Score
I.	Science and Engineering Practices	0001–0003	20%
II.	Matter and Atomic Structure	0004–0006	20%
III.	Energy and Chemical Bonding	0007–0009	20%
IV.	Chemical Reactions	0010–0013	27%
V.	Stoichiometry and Solutions	0014–0015	13%

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A scientific calculator will be available to examinees taking the Chemistry test.

SCIENCE AND ENGINEERING PRACTICES

0001 Understand the practices of scientific inquiry and engineering design.

For example:

1.1 Apply knowledge of the principles and procedures for designing and carrying out scientific investigations.

1.2 Recognize methods and criteria for collecting, organizing, analyzing, and presenting scientific data.

1.3 Analyze the evidential basis of scientific claims and engineering solutions.

1.4 Apply knowledge of safety procedures and hazards associated with scientific investigations.

1.5 Demonstrate knowledge of the materials, equipment, and technology used in the sciences.

1.6 Apply mathematical procedures and modeling to the analysis and interpretation of data and to solve problems in the sciences.

1.7 Apply knowledge of engineering design practices to solve a problem or address a need (e.g., defining problems, designing and evaluating solutions, optimizing solutions).

0002 Understand crosscutting concepts in the sciences and engineering.

For example:

2.1 Demonstrate knowledge of the crosscutting concepts that unite core ideas across the sciences and engineering (e.g., patterns, cause and effect, stability and change).

2.2 Apply knowledge of the nature of science as a system of inquiry based on a set of shared characteristics (e.g., empirical evidence, peer review, ethics in experimentation and in the reporting of results).

2.3 Demonstrate knowledge of the historical development of major scientific ideas, including contributions by men and women of diverse backgrounds.

2.4 Demonstrate knowledge of major contemporary theories, laws, models, and concepts in biology, physics, and Earth and space science.

2.5 Apply literacy skills to the interpretation, synthesis, and analysis of information from scientific and technical sources (e.g., explaining central ideas, interpreting domain-specific terminology, recognizing how texts structure information into categories and hierarchies).

0003 Understand the relationships between science, technology, and human activity in a global context.

For example:

3.1 Demonstrate knowledge of the ways in which science and technology can be used to solve problems affecting society (e.g., green chemistry, alternative fuels, medical imaging).

3.2 Recognize the ways in which society affects scientific progress.

3.3 Recognize how technology is used in the sciences and the scientific advances its use has made possible.

3.4 Evaluate the accuracy of reported scientific information and the credibility of the reporting source (e.g., scientific journals, newspapers, Web sites).

3.5 Analyze social, economic, and ethical issues and contexts associated with technological and scientific developments.

MATTER AND ATOMIC STRUCTURE

0004 Understand the properties of matter.

For example:

4.1 Analyze the characteristics and properties of elements, compounds, and mixtures.

4.2 Apply knowledge of chemical and physical properties of matter and the methods used to determine them.

4.3 Analyze physical, chemical, and nuclear changes in matter.

4.4 Apply knowledge of the characteristics of radioactive materials.

0005 Understand atomic theory and the periodic table.

For example:

5.1 Analyze various historical and contemporary models of atomic structure and the supporting evidence for these models.

5.2 Demonstrate knowledge of the properties of and interactions between electrons, protons, and neutrons; and the relationships between energy levels, photons, and atomic spectra.

5.3 Analyze electron configurations, orbital diagrams, and Lewis dot symbols.

5.4 Demonstrate knowledge of the organization of the periodic table and its usefulness in predicting the physical and chemical properties and relative reactivity of given elements.

0006 Understand the kinetic molecular theory, the nature of phase changes, and the gas laws.

For example:

6.1 Demonstrate knowledge of the basic principles of the kinetic molecular theory and the distinguishing characteristics of different states of matter.

6.2 Analyze heating and cooling curves and phase diagrams.

6.3 Demonstrate knowledge of the relationships between volume, temperature, and pressure in gases.

6.4 Solve problems involving the gas laws.

ENERGY AND CHEMICAL BONDING

0007 Understand energy changes in chemical and physical processes.

For example:

7.1 Analyze the three laws of thermodynamics and their applications to chemical and biochemical systems.

7.2 Differentiate among forms of energy and between heat and temperature.

7.3 Analyze energy changes due to the formation or breaking of chemical bonds.

7.4 Analyze energy changes during chemical reactions, phase transitions, dissolving solutes in solvents, and diluting solutions.

7.5 Analyze the results of calorimetry experiments.

7.6 Analyze entropy changes in chemical reactions and predict the spontaneity of given chemical reactions.

0008 Understand the nomenclature and structure of inorganic and organic compounds.

For example:

8.1 Apply the International Union of Pure and Applied Chemistry (IUPAC) rules of nomenclature.

8.2 Analyze the characteristics of inorganic structures, including ionic solids, network solids, and metallic solids.

8.3 Predict the geometry of molecules and polyatomic ions using the valence-shell electron-pair repulsion (VSEPR) model and valence bond theory.

8.4 Analyze the chemical composition and basic structure of organic compounds.

8.5 Recognize the characteristics of structural, geometric, and optical isomers.

0009 Understand chemical bonding and intermolecular forces and their effect on the properties of substances.

For example:

9.1 Compare the characteristics of different types of chemical bonds.

9.2 Analyze chemical bonding in terms of electron behavior and the factors that affect bond strength.

9.3 Use Lewis structures to represent chemical bonding in molecules.

9.4 Analyze the characteristics of various types of intermolecular forces (e.g., dipole-dipole, dispersion, hydrogen bonding) and the forces between molecules of a given structure.

9.5 Relate the properties of substances to their atomic bonds and intermolecular forces.

CHEMICAL REACTIONS

0010 Understand the nature of chemical reactions.

For example:

10.1 Analyze different types of inorganic chemical reactions.

10.2 Recognize fundamental organic and biochemical reactions (e.g., addition, substitution, photosynthesis).

10.3 Demonstrate knowledge of collision theory and factors that influence reaction rates.

10.4 Analyze rate problems and experimental rate data.

0011 Understand the principles of chemical equilibrium.

For example:

11.1 Apply knowledge of the concept of chemical equilibrium and the factors that influence chemical equilibrium.

11.2 Apply Le Châtelier's principle to chemical systems.

11.3 Solve problems involving equilibrium constants.

0012 Understand acid-base chemistry.

For example:

12.1 Analyze acids and bases according to how they behave and how they are defined.

12.2 Determine the hydronium ion concentration, hydroxide ion concentration, pH, and pOH for acid, base, and salt solutions.

12.3 Demonstrate knowledge of the relationship between molecular structure and acid strength and the relative strengths of acids and bases.

12.4 Analyze buffer solutions qualitatively and quantitatively.

12.5 Demonstrate knowledge of the principles and applications of acid-base titrations.

0013 Understand oxidation-reduction reactions and electrochemistry.

For example:

13.1 Demonstrate knowledge of oxidation, reduction, oxidation numbers, and the balancing of oxidation-reduction equations.

13.2 Analyze the components and operating principles of electrochemical cells and electrolytic cells.

13.3 Solve problems involving electrochemical cells.

13.4 Demonstrate knowledge of the applications of electrochemistry.

STOICHIOMETRY AND SOLUTIONS

0014 Understand the mole concept and stoichiometry.

For example:

14.1 Demonstrate knowledge of the mole concept and its use in chemical calculations.

14.2 Solve problems involving molar mass, percent-composition, and empirical and molecular formulas.

14.3 Demonstrate the ability to interpret chemical notation and recognize net ionic equations.

14.4 Apply the law of conservation of mass to the balancing of chemical equations.

14.5 Solve stoichiometric problems involving moles, mass, volume, and energy, including limiting reactant and percent yield.

0015 Understand the properties of solutions and colloidal suspensions.

For example:

15.1 Demonstrate knowledge of different types of solutions, colloids, and suspensions.

15.2 Solve problems involving concentrations of solutions.

15.3 Analyze factors that affect solubility and solubility curves.

15.4 Analyze the colligative properties of solutions.