

High School MCAS Chemistry Performance Level Descriptors

Student results on the MCAS tests are reported according to four performance levels: *Advanced*, *Proficient*, *Needs Improvement*, and *Warning/Failing*. The descriptors in this document illustrate the kinds of knowledge and skills students demonstrate on MCAS at each level. **Knowledge and skills are cumulative at each level.** No descriptors are provided for the *Warning/Failing* performance level because student work at this level, by definition, falls below the criteria of the *Needs Improvement* level.

Properties of Matter		
Needs Improvement	Proficient	Advanced
Identifies examples of physical and chemical changes, and identifies physical and chemical properties	Describes physical and chemical changes using physical and chemical properties	Solves complex problems using multiple physical and chemical properties
Identifies pure substances and heterogeneous and homogeneous mixtures	Solves simple problems that deal with the physical and chemical properties of mixtures and pure substances	Explains how properties may change due to physical or chemical changes
Identifies solids, liquids, and gases based on temperature, arrangement of particles, and particle motion	Describes pure substance as either elements or compounds and provides examples of each	Predicts how matter may change with respect to state, energy, arrangement of particles, and particle motion
	Describes heterogeneous and homogeneous mixtures and provides example of each	
	Describes phase changes in terms of energy, arrangement of particles, and particle motion	

Atomic Structure and Nuclear Chemistry

Needs Improvement	Proficient	Advanced
Identifies the correct charge and location of protons, neutrons, and electrons in an atom	Describes the differences between the various atomic models and describes the location of protons, neutrons, and electrons	Explains the strengths and weaknesses of various atomic models and describes how Rutherford's gold foil experiment changed the concept of the atom.
Identifies examples of conservation of mass	Solves simple problems using the laws of conservation of mass and constant composition	Solves complex problems using the laws of conservation of mass, constant composition, and multiple proportions
Identifies elements based on their electron configurations	Writes the correct electron configuration for a given element	Solves complex problems involving radioactive decay and writes nuclear equations for decay, fission, and fusion
Identifies a nuclear equation and generally describes radioactive decay	Describes the different types of radiation emitted during radioactive decay	Explains how the properties of alpha, beta, and gamma emissions affect their penetrating power
Recognizes nuclear fission and nuclear fusion reactions	Describes radioactive decay and solves simple problems for the half-life of an isotope	
	Describes the similarities and differences between nuclear fission and fusion	

Periodicity		
Needs Improvement	Proficient	Advanced
Identifies elements based on their atomic number and identifies families and periods on the periodic table	Explains why atomic numbers increase on the periodic table	Explains how and why elements combine with each other, based on their electron configurations
Identifies some metals and nonmetals	Identifies an element as a metal, nonmetal, or metalloid	Describes and applies trends on the periodic table
Identifies the number of valence electrons of an element based on its position on the periodic table	Identifies the valence electron configuration of an element based on its position on the periodic table	
Identifies the general trend that as the atomic number for elements increases, the atomic mass also increases	Identifies groups on the periodic table that readily react with one another and explains why noble gases do not react	
	Identifies most trends on the periodic table	

Chemical Bonding

Needs Improvement	Proficient	Advanced
Identifies ionic bonding as the transfer of electrons and covalent bonding as the sharing of electrons	Predicts number of valence electrons and chemical formulas for bonded atoms	Draws Lewis dot structures for molecules and ionic compounds, and identifies incorrect Lewis structures and explains why they are incorrect
Identifies and draws Lewis dot structures for single atoms	Identifies the correct Lewis structure for simple compounds	Predicts the shapes of some simple molecules
Recognizes that water is a highly polar molecule and has some unique properties that result from hydrogen bonding	Describes bonding in ionic compounds or covalent molecules based on Lewis structures	Describes the effects of hydrogen bonding in various phenomena
Names simple ionic and molecular compounds given the chemical formula	Identifies the shapes of some simple molecules	Writes chemical formulas for ionic and molecular compounds
	Recognizes that polarity increases between covalently bonded atoms as the electronegativity difference between them increases	
	Describes hydrogen bonding as an intermolecular force	
	Identifies the correct chemical formula for ionic and molecular compounds	

Chemical Reactions and Stoichiometry

Needs Improvement	Proficient	Advanced
<p>Balances simple chemical equations and classifies some chemical reactions</p> <p>Calculates the molar mass of simple compounds</p> <p>Determines simple empirical formulas given molecular formulas for compounds</p>	<p>Writes and balances chemical equations and classifies different chemical reactions</p> <p>Calculates number of particles and molar mass of elements and compounds and solves simple stoichiometry problems</p> <p>Determines most percent compositions, empirical formulas, and molecular formulas</p> <p>Calculates percent yield in a chemical reaction</p>	<p>Explains classifications of chemical reactions</p> <p>Solves mass-to-mass stoichiometry problems and complex problems for percent compositions, empirical formulas, and molecular formulas</p> <p>Explains percent yield in a chemical reaction</p>

States of Matter, Kinetic Molecular Theory, and Thermochemistry

Needs Improvement	Proficient	Advanced
<p>Recognizes the relationships of (1) volume and temperature, and (2) pressure and volume, in gases</p> <p>Solves simple problems for the ideal gas law</p> <p>Describes arrangement of particles, particle motion, and energy of gases, liquids, and solids at a given temperature</p> <p>Recognizes that energy is neither created nor destroyed and that there is a natural tendency toward disorder</p>	<p>Explains most behaviors of gases as they relate to the gas laws, and solves most problems using the combined gas law and the ideal gas law</p> <p>Describes in detail the properties of gases, liquids, and solids and relates these to phase transitions</p> <p>Identifies situations involving the law of conservation of energy and identifies endothermic and exothermic processes; identifies situations involving entropy changes</p>	<p>Explains the kinetic molecular theory and how it relates to the different gas laws</p> <p>Solves complex problems using the combined gas law and the ideal gas law</p> <p>Explains the behavior of matter as it undergoes phase transitions</p> <p>Provides examples of the law of conservation of energy and explains the difference between endothermic and exothermic processes; gives examples of entropy changes</p>

Solutions, Rates of Reaction, and Equilibrium

Needs Improvement	Proficient	Advanced
<p>Identifies solvents and solutes</p> <p>Identifies factors that affect rates of dissolving and factors that affect rates of chemical reactions</p> <p>Recognizes that colligative properties are affected by solutes</p> <p>Identifies factors that can cause a shift in equilibrium</p>	<p>Describes the dissolving process</p> <p>Calculates concentration in terms of molarity</p> <p>Explains most factors that affect rates of dissolving and factors that affect rates of chemical reactions</p> <p>Compares properties of solutions and pure solvents</p> <p>Predicts simple shifts in equilibrium</p>	<p>Solves problems involving solution dilution and solution stoichiometry</p> <p>Explains in detail the factors that affect the rates of dissolving and factors that affect the rates of chemical reactions</p> <p>Predicts and explains shifts in equilibrium</p>

Acids and Bases and Oxidation-Reduction Reactions

Needs Improvement	Proficient	Advanced
<p>Identifies acids and bases based on the pH scale, and recognizes common strong acids and bases</p> <p>Identifies the purpose of a buffer</p> <p>Identifies a redox reaction</p>	<p>Identifies Arrhenius acids and bases and Bronsted-Lowry acids and bases</p> <p>Describes the pH scale and how acids, bases, and neutral solutions are classified; compares the strengths of various common acids and bases</p> <p>Identifies the components of a buffer system and gives examples</p> <p>Describes redox reactions and assigns oxidation numbers in a reaction</p>	<p>Describes Arrhenius acids and bases and Bronsted-Lowry acids and bases</p> <p>Gives examples of various common acids and bases and describes their strength</p> <p>Explains how a buffer system works</p> <p>Gives examples of oxidation-reduction reactions and explains why they are classified as such</p>