# 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.

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| **Properties of Matter** | | |
| **Needs Improvement** | **Proficient** | **Advanced** |
| Identifies examples of physical and chemical changes, and identifies physical and chemical properties  Identifies pure substances and heterogeneous and homogeneous mixtures  Identifies solids, liquids, and gases based on temperature, arrangement of particles, and particle motion | Describes physical and chemical changes using physical and chemical properties  Solves simple problems that deal with the physical and chemical properties of mixtures and pure substances  Describes pure substance as either elements or compounds and provides examples of each  Describes heterogeneous and homogeneous mixtures and provides example of each  Describes phase changes in terms of energy, arrangement of particles, and particle motion | Solves complex problems using multiple physical and chemical properties    Explains how properties may change due to physical or chemical changes    Predicts how matter may change with respect to state, energy, arrangement of particles, and particle motion |
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| **Atomic Structure and Nuclear Chemistry** | | |
| **Needs Improvement** | **Proficient** | **Advanced** |
| Identifies the correct charge and location of protons, neutrons, and electrons in an atom    Identifies examples of conservation of mass    Identifies elements based on their electron configurations  Identifies a nuclear equation and generally describes radioactive decay  Recognizes nuclear fission and nuclear fusion reactions | Describes the differences between the various atomic models and describes the location of protons, neutrons, and electrons    Solves simple problems using the laws of conservation of mass and constant composition  Writes the correct electron configuration for a given element  Describes the different types of radiation emitted during radioactive decay  Describes radioactive decay and solves simple problems for the half-life of an isotope  Describes the similarities and differences between nuclear fission and fusion | Explains the strengths and weaknesses of various atomic models and describes how Rutherford's gold foil experiment changed the concept of the atom.  Solves complex problems using the laws of conservation of mass, constant composition, and multiple proportions  Solves complex problems involving radioactive decay and writes nuclear equations for decay, fission, and fusion  Explains how the properties of alpha, beta, and gamma emissions affect their penetrating power |
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| **Periodicity** | | |
| **Needs Improvement** | **Proficient** | **Advanced** |
| Identifies elements based on their atomic number and identifies families and periods on the periodic table  Identifies some metals and nonmetals  Identifies the number of valence electrons 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 | Explains why atomic numbers increase on the periodic table  Identifies an element as a metal, nonmetal, or metalloid  Identifies the valence electron configuration of an element based on its position on the periodic table  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 | Explains how and why elements combine with each other, based on their electron configurations  Describes and applies trends on the periodic table |
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| **Chemical Bonding** | | |
| **Needs Improvement** | **Proficient** | **Advanced** |
| Identifies ionic bonding as the transfer of electrons and covalent bonding as the sharing of electrons  Identifies and draws Lewis dot structures for single atoms  Recognizes that water is a highly polar molecule and has some unique properties that result from hydrogen bonding  Names simple ionic and molecular compounds given the chemical formula | Predicts number of valence electrons and chemical formulas for bonded atoms  Identifies the correct Lewis structure for simple compounds  Describes bonding in ionic compounds or covalent molecules based on Lewis structures  Identifies the shapes of some simple molecules  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 | Draws Lewis dot structures for molecules and ionic compounds, and identifies incorrect Lewis structures and explains why they are incorrect  Predicts the shapes of some simple molecules  Describes the effects of hydrogen bonding in various phenomena  Writes chemical formulas for ionic and molecular compounds |
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| **Chemical Reactions and Stoichiometry** | | |
| **Needs Improvement** | **Proficient** | **Advanced** |
| Balances simple chemical equations and classifies some chemical reactions  Calculates the molar mass of simple compounds  Determines simple empirical formulas given molecular formulas for compounds | Writes and balances chemical equations and classifies different chemical reactions  Calculates number of particles and molar mass of elements and compounds and solves simple stoichiometry problems  Determines most percent compositions, empirical formulas, and molecular formulas  Calculates percent yield in a chemical reaction | Explains classifications of chemical reactions  Solves mass-to-mass stoichiometry problems and complex problems for percent compositions, empirical formulas, and molecular formulas  Explains percent yield in a chemical reaction |
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| **States of Matter, Kinetic Molecular Theory, and Thermochemistry** | | |
| **Needs Improvement** | **Proficient** | **Advanced** |
| Recognizes the relationships of (1) volume and temperature, and (2) pressure and volume, in gases  Solves simple problems for the ideal gas law  Describes arrangement of particles, particle motion, and energy of gases, liquids, and solids at a given temperature  Recognizes that energy is neither created nor destroyed and that there is a natural tendency toward disorder | 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  Describes in detail the properties of gases, liquids, and solids and relates these to phase transitions  Identifies situations involving the law of conservation of energy and identifies endothermic and exothermic processes; identifies situations involving entropy changes | Explains the kinetic molecular theory and how it relates to the different gas laws  Solves complex problems using the combined gas law and the ideal gas law  Explains the behavior of matter as it undergoes phase transitions  Provides examples of the law of conservation of energy and explains the difference between endothermic and exothermic processes; gives examples of entropy changes |
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| **Solutions, Rates of Reaction, and Equilibrium** | | |
| **Needs Improvement** | **Proficient** | **Advanced** |
| Identifies solvents and solutes  Identifies factors that affect rates of dissolving and factors that affect rates of chemical reactions  Recognizes that colligative properties are affected by solutes  Identifies factors that can cause a shift in equilibrium | Describes the dissolving process  Calculates concentration in terms of molarity  Explains most factors that affect rates of dissolving and factors that affect rates of chemical reactions  Compares properties of solutions and pure solvents  Predicts simple shifts in equilibrium | Solves problems involving solution dilution and solution stoichiometry  Explains in detail the factors that affect the rates of dissolving and factors that affect the rates of chemical reactions  Predicts and explains shifts in equilibrium |
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| **Acids and Bases and Oxidation-Reduction Reactions** | | |
| **Needs Improvement** | **Proficient** | **Advanced** |
| Identifies acids and bases based on the pH scale, and recognizes common strong acids and bases  Identifies the purpose of a buffer  Identifies a redox reaction | Identifies Arrhenius acids and bases and Bronsted-Lowry acids and bases  Describes the pH scale and how acids, bases, and neutral solutions are classified; compares the strengths of various common acids and bases  Identifies the components of a buffer system and gives examples  Describes redox reactions and assigns oxidation numbers in a reaction | Describes Arrhenius acids and bases and Bronsted-Lowry acids and bases  Gives examples of various common acids and bases and describes their strength  Explains how a buffer system works  Gives examples of oxidation-reduction reactions and explains why they are classified as such |
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