List of Competencies for CHE 111 Placement Exam

- Understand scientific thinking.
- Describe the method scientists use to study nature.
- Determine the number of significant figures in a calculated result.
- Use dimensional analysis to solve problems.
- Convert from one unit to another.
- Define density and its units.
- Distinguish between physical and chemical properties.
- Distinguish between physical and chemical changes.
- Distinguish between mixtures and pure substances.
- Understand about the relative abundance of elements.
- Understand and illustrate the law of constant composition.
- Describe the structure of an atom and some important features of subatomic particles.
- Understand Rutherford's experiment to characterize the atom's structure.
- Describe isotopes, atomic number, mass number.
- Learn about the various features of the periodic table.
- Describe properties of metals, nonmetals, and metalloids.
- Understand the formations of ions from their parent atoms, and be able to name them.
- Describe how ions combine to form neutral compound. Learn to name binary compounds of a metal and nonmetal.
- Learn to name binary compounds containing only nonmetals.
- Be able to write names and formulae of common polyatomic ions and how to use them in naming compounds.
- Learn names of common acids.
- Be able to write the formula of a compound given its name.
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- Learn the signals that show a chemical reaction has occurred.
- Learn to identify the characteristics of a chemical reaction and the information given by a chemical equation.
- Be able to balance chemical reactions.
- Describe the factors that cause reactions to occur.
- Identify the solid that forms in a precipitation reaction.
- Describe reactions in solutions by writing molecular, complete ionic, and net ionic equations.
- Identify key characteristics of reactions between strong acids and strong bases.
- Describe the general characteristics of a reaction between a metal and a nonmetal.
- Understand the electron transfer as a driving force for a chemical reaction.
- Learn various classification schemes for reactions.
- Understand the concept of average mass, atomic mass, molar mass.
- Explain the concept of mole and Avogadro's number.
- Be able to convert among moles, mass, and number of atoms in a given sample.
- Be able to find mass percent of an element in a given compound.
- Describe empirical formula ad be able to calculate empirical formula.
- Be able to calculate the molecular formula of a compound from its empirical formula and molar mass.

- Understand the molecular and mass information in a balanced equation.
- Be able to use the balanced equation to determine the relationships between moles of reactants and products in a chemical reaction.
- Be able to relate masses of reactants and products in a chemical reaction.
- Be able to recognize the limiting reactant in a chemical reaction.
- Be able to use the limiting reactant to do stoichiometric calculations.
- Be able to calculate actual yield as a percentage of theoretical yield.
- Understand the general properties of energy, temperature, heat.
- Understand how heat is measured.
- Be able to describe Rutherford's model of atom.
- Be able to identify shapes of orbitals designated by s, p, d, and f.
- Understand how the principal energy levels fill in atoms beyond hydrogen.
- Describe/identify valence and core electrons.
- Write electron configurations of elements 1 through 20.
- Explain trends in the periodic table (ionization energies, atomic size, electron affinity, etc.)
- Describe ionic and covalent bonds and explain how they are formed.
- Describe polar and covalent bonds.
- Be able to predict the formula of ionic compounds.
- Be able to write Lewis dot structures.
- Be able to predict molecular geometry using VSEPR model.
- Understand and explain Boyle's, Charles', Dalton's Avogadro's, and Ideal gas laws. Be able to use these laws in calculations., including calculating the molecular weight of a gas.
- Explain the basic postulates of the kinetic molecular theory.
- Explain STP, absolute zero, molar volume.
- Explain the important properties of water.
- Understand and use heat of fusion and heat of vaporization in calculations.
- Explain dipole-dipole attraction, hydrogen bonding, and London-dispersion forces.
- Explain the terms condensation, vaporization, sublimation, boiling, melting, freezing.
- Explain how bonding in metals determines metallic properties.
- Describe the process of dissolving solids in water.
- Be able to explain the different units of concentration—% (w/v), % (w/v), % (w/w), Molarity, and use them in calculations.
- Be able to calculate the concentration of a solution made by diluting a stock solution.
- Be able to solve stoichiometric problems for solution reactions.