Miami Dade College

CHM1046 General Chemistry and Qualitative Analysis

CHM1046 **General Chemistry and Qualitative Analysis**

Course Description: CHM 1046 is the second course in the CHM 1045-1046 sequence. Students will learn major topics in modern chemistry including but not limited to thermodynamics, kinetics, solutions equilibria including acids, bases, and other ionic equilibria and electrochemistry. Special fee. (3 hr. lecture)
Prerequisite: CHM1045
Corequisite: CHM1046L

Course Competency	Learning Outcomes
Competency 1: The student will **demonstrate knowledge of liquids and solids** by:	
1. Describing the properties of liquids and solids and how they differ from the properties of gases. 2. Using the kinetic-molecular description of liquids and solids, and showing how this description is different from that of gases. 3. Describing phase changes considering the strengths of the intermolecular forces. 4. Identifying the various kinds of intermolecular forces. 5. Relating the various kinds of intermolecular attractions that exist in substances to physical properties such as vapor pressure, melting point, boiling point, and viscosity. 6. Applying the Clasius-Claperyon equation to relate changes in temperature and vapor pressure to a substance's molar heat of vaporization. 7. Calculating the heat transfer during phase transitions. 8. Interpreting Pressure versus Temperature phase diagrams. 9. Describing the various types of solids and their properties.	
Competency 2: The student will **demonstrate knowledge of solutions** by:	
1. Identifying the components in a solution. 2. Comparing and contrasting different types of solutions as follow: 1) diluted and concentrated, 2) saturated, unsaturated, and super saturated, 3) miscible and immiscible]. 3. Describing the factors that favor the dissolution process. 4. Describing the dissolution of solids in liquids, liquids in liquids, and gases in liquids. 5. Expressing concentrations of solutions in molarity, mass percent, molality, and mole fraction. 6. Interconverting among the concentration units: molarity, mass percent, molality and mole fraction. 7. Calculating the four colligative properties of solutions: lowering of vapor pressure (Raoult's Law), boiling point elevation, freezing point depression, and osmotic pressure. 8. Describing the associated effects on the colligative properties of compounds that undergo dissociation and ionization.	
Competency 3: The student will demonstrate knowledge of chemical thermodynamics by:	
1. Using the First Law of Thermodynamics to relate heat, work, and energy changes. 2. Calculating pressure-volume work. 3. Calculating heat transfer in a constant pressure calorimeter and in a constant volume calorimeter.	

4. Identifying the relationship between internal energy and enthalpy.
5. Recognizing the relationship between entropy and the order or disorder of a system.
6. Summarizing the three Laws of Thermodynamics.
7. Determining the spontaneity and entropy changes of a process or chemical reaction.
8. Using tabulated values of absolute entropies and standard molar free energy of formation to calculate entropy changes (ΔS) and free energy changes (ΔG), respectively.
9. Working out problems that involve the relationship between: free energy changes, enthalpy changes, entropy changes, and temperature.
10. Predicting the temperature range of spontaneity of a chemical or physical process.

Competency 4: The student will demonstrate knowledge of chemical kinetics by:

1. Outlining the factors that affect the rate of a reaction (e.g., temperature, concentration, and catalysis).
2. Expressing the rate of a chemical reaction in terms of changes in concentration of reactants and products with time.
3. Applying the rate law-expression for a reaction to express the relationship between concentration and rate.
4. Applying the method of initial rates to find the rate-law expression for a reaction.
5. Determining the order of a reaction from the reaction rate law.
6. Using the integrated rate equation to determine the half-life of a reaction or to determine the concentration of substrate at some point in time.
7. Analyzing concentration versus time data to determine the order of a reaction.
8. Pointing out the fundamental notions of collision theory and transition state theory.
9. Describing the main aspects of transition state theory and the role of activation energy in determining the rate of a reaction.
10. Using potential energy diagrams to identify where the transition state occurs, to find the energy of activation, and obtain the net amount of energy released or absorbed during a reaction.
11. Predicting the rate-law expression for elementary and multi-step mechanisms.
12. Identifying reactants, products, intermediates, and catalysts in a multistep reaction mechanism.
13. Using the Arrhenius equation to relate the energy of activation for a reaction to changes in its rate constant with changing temperature.
14. Explaining how catalyst changes the rate of a reaction.

Competency 5: The student will **demonstrate knowledge of homogeneous and heterogeneous equilibria** by:

1. Explaining the basic principles of chemical equilibrium.
2. Writing the equilibrium expression for a reaction.
3. Calculating the equilibrium constant from concentration data, or from partial pressure data.
4. Relating the magnitude of the equilibrium constant to the extent of a reaction.
5. Combining equilibrium expressions to determine the equilibrium constant for a particular chemical reaction.
6. Analyzing heterogeneous equilibrium and writing equilibrium expressions for heterogeneous reactions.
7. Predicting the extent of a reaction by evaluating the reaction quotient (or mass action expression) Q.
8. Recognizing the factors that affect the equilibrium constant.
9. Applying the Le Chatelier's Principle to show how a variety of applied stresses affect the equilibrium system (temperature, pressure, concentration).
10. Interconverting between Kp and Kc.
11. Finding equilibrium concentrations (or partial pressures) when initial concentrations (or partial pressures) and the equilibrium constant are supplied.
12. Determining the relationship between free energy and the equilibrium constant.
13. Evaluating an equilibrium constant at different temperatures.

Competency 6: The student will **demonstrate knowledge of ionic equilibria involving soluble electrolytes** by:

1. Calculating the concentration of each ion present when a strong electrolyte is placed in water.

2. Evaluating the ion product for water to obtain the relationship between the molarity of the hydrogen ion and that of the hydroxide ion.
3. Describing the relationship between pH and pOH.
4. Interconverting between pH, pOH, [H+], and [OH-].
5. Writing equilibrium expressions for weak acids and bases.
6. Calculating Ka (or pKa) or Kb (or pKb) from: 1) initial and equilibrium concentrations, 2) initial concentrations and pH, [H+], or [OH-] values, and 3) initial concentrations and percent ionization data and vice-versa.
7. Calculating equilibrium concentrations, pH, pOH, [H+], and [OH-], and percent ionization when given the Ka (or pKa) or Kb and (or pKb) and the initial concentration.
8. Identifying and relating the strength of acids and bases to their equilibrium constants.
9. Describing the effect of adding a "common ion" on the equilibrium.
10. Recognizing a buffer solution and giving illustrations of its operation.
11. Predicting the effect upon the pH of 1) distilled water, 2) a strong acid, and 3) a strong base, and 4) a buffer when a strong acid or a strong base is added.
12. Writing equations for the action of buffers with H+ ions and with OH- ions.
13. Calculating the ratio of components of a buffer, given the pH of the buffer. (Hendersn-Hasselbach Equation)
14. Predicting and calculating the pH of a buffer, when strong acids or bases are added.
15. Predicting whether an aqueous salt solution is acidic, basic, or neutral.
16. Illustrating the ionization of a soluble salt solution and subsequent hydrolysis of the ion derived from a weak acid or base.
17. Interconverting between Ka and Kb of conjugate acid-base pairs.
18. Writing the equilibrium expression and solving problems involving hydrolysis of a salt.

Competency 7: The student will **demonstrate knowledge of acid-base titrations** by:

1. Recognizing the shape of a titration curve and describing what species are present at various stages of titration curves for (i) a strong acid vs. a strong base, (ii) a weak acid vs. a strong base, and (iii) a weak base vs. a strong acid titrations.
2. Calculating titration curves.
3. Selecting an appropriate indicator for titrations.

Competency 8: The student will **demonstrate knowledge of electrochemistry** by:

1. Comparing and contrasting electrolytic and galvanic (voltaic) cells.
2. Writing the shorthand notation of a galvanic (voltaic) cell.
3. Describing the construction of galvanic (voltaic) cells from half cells and a salt bridge and the function of each component.
4. Using standard reduction potentials to calculate standard cell potentials and predict spontaneity of an oxidation-reduction reaction.
5. Relating amounts of reactants and products in oxidation-reduction reactions to electrical charge (Faraday's First Law of Electrolysis and Faraday's Second Law of Electrolysis).
6. Identifying relative strengths of oxidizing and reducing agents.
7. Relating standard cell potential to standard Gibbs free energy change and equilibrium constants.
8. Calculating the electromotive force under nonstandard conditions by using Nernst equation.
9. Comparing and contrasting the components of common batteries and fuel cells.

Competency 9: The student will **demonstrate an understanding of nuclear chemistry** by:

1. Describing uses of radionuclides.
2. Describing the common types of radiation emitted when nuclei undergo radioactive decay.
3. Completing and balancing nuclear equations.
4. Predicting nuclear stability and expected type of nuclear decay from the neutron-proton ratio of an isotope.

5. Using the half-life of a radionuclide and calculating age of an object or amount of radionuclide remaining after a period of time. 6. Comparing and contrasting nuclear fission and nuclear fusion. 7. Comparing and contrasting ionization power and penetrating power.	
Competency 10: The student will Competency 8: The student will demonstrate knowledge of equilibria of slightly soluble substances by: by:	
1. Writing the equilibrium expression for the saturated solution of a slightly soluble substance. 2. Calculating the value of the solubility product, Ksp, when given the solubility of the substance. 3. Calculating the solubility of a substance from its Ksp value. 4. Calculating the solubility of a substance when dissolved in a solution containing a common ion. 5. Calculating the concentration of ions needed to initiate precipitation. 6. Predicting if precipitation will occur if solutions of known ionic concentration are mixed.	