Final Exam Study Guide

Chem 112, Gallagher **Spring 2010**

Post Exam #3 Material:

Concepts and Trends to know:

- What happens to the equilibrium constant when-
  - a reaction is reversed
  - a reaction is multiplied by a constant
  - two reactions are added
- LeChatelier's Principle- be able to predict how a system will respond to changes in volume, temperature, or concentration.
- Be able to compare a set of compounds and determine which is the strongest acid/base, given the pK_a or K_a or K_b.
- Determine the conjugate acid/base of a weak base/acid.
- Be able to determine the acid/base behavior of a salt and whether it will raise, lower, or not affect the pH of the solution.
- Be able to identify whether a mixture will act as a buffer or not
- Understand how buffers work.
- Identify a Brønsted acid/base or a Lewis acid/base

Calculations/Problem Types to be able to solve:

Equilibrium calculations

- Write an expression for the equilibrium constant of a reaction
- Calculate the value of the reaction quotient and determine whether a reaction is at equilibrium, and if not, tell in which direction the reaction proceeds.
- Determine the equilibrium concentrations for reactants and products using an ICE table.
- Be able to determine equilibrium concentrations after additional reactant/product has been added to the system.
- Determine the value of an equilibrium constant (K_{eq} or K_a) from concentration data using an ICE table.

pH calculations

- Given $[H_3O^+]$ or $[OH^-]$, determine the pH or pOH of a solution
- Given the pH or pOH of a solution, determine $[H_3O^+]$ or $[OH^-]$
- Provided with pH titration data, determine the pK_a or K_a of an acid
- Calculate K_a or K_b given a concentration and the pH of the solution
- Calculate the concentration of a weak acid or base given pH and K_a or K_b
- Predict the pH of a solution (for strong acid/base or weak acid/base)

Exam 3 Material:

- Determine osmotic pressure given concentration and temperature
- Calculate molar mass given osmotic pressure, mass, and volume
- Know how reaction rates respond to increases/decreases in temperature, specificity of orientation, activation energy, and number of collisions
- Be able to determine a rate law using the graphical method, initial rate method, or a mechanism containing elementary steps (including determining the value of the rate constant *k*)
- Identify the order of a reaction with respect to a particular reactant and the overall order of the reaction (graphical and initial rate methods)
- Identify intermediates or catalysts involved in a reaction
- Use the 2-point Arrhenius equation to determine activation energy, E_a

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Exam 2 Material:

- Identify type(s) of intermolecular forces between two molecules
- Compare compounds in terms of boiling point, freezing point, vapor pressure, enthalpy of vaporization, and solubility in water (based on their structure/formula)
- Interpret the following graphs:
    - vapor pressure vs. temperature curves
    - phase diagrams
- Determine whether the solubility of a compound will increase/decrease with temperature
- Determine the melting point/freezing point of a solution given the requisite data
- Determine the vapor pressure of a solution
- Determine chemical formula from unit cell information
- Calculate the molarity, molality, mole fraction, or weight percent of a solution
- Determine how to make a solution of a particular molarity/molality

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Exam 1 Material:

- Know the sign of the enthalpy change for endothermic and exothermic reactions
- Be able to interpret a heating curve (heat energy vs. temperature)
- Be able to tell whether a reaction is exothermic or endothermic
- Predict the sign of the entropy change for a reaction without doing a calculation
- Determine whether a reaction is spontaneous under given conditions
- Be able to tell whether a reaction is entropy-favored, enthalpy-favored, or both
- Specific heat calculations:
    - determine the specific heat for a material
    - given ΔT, calculate the amount of heat transferred to a material
    - calculate the amount of heat required to change the temperature of a material by a given amount (with and without a phase change)
- Use Hess' Law to determine the enthalpy change for a reaction
- Determine the change in entropy of a system's surroundings
- Calculate the Gibbs free energy of a reaction
- Determine the temperature at which a reaction becomes spontaneous

Terms to know:

activation energy (E_a)
Arrhenius equation
boiling point
Brønsted acid/base
buffer
calorimeter
catalyst
colligative
conjugate acid
conjugate base
dipole
elementary step
endothermic
enthalpy (H)
entropy (S)
equilibrium
equilibrium constant (K_{eq})
exothermic
freezing point
Gibbs free energy (ΔG)
half-life
heat of vaporization (ΔH_{vap})
heat capacity (specific heat, c)
Henry's Law
Hess' Law
hydrogen bond
hydronium ion
hydrophillic
hydrophobic
hydroxide ion
induced dipole (dispersion)
initial rate
intermediate
intermolecular forces
K_w, K_a and K_b
kinetics
LeChatelier's Principle
Lewis acid/base
molality (*m*)
molarity (M)
mole fraction (χ)
osmotic pressure (Π)
pH
phase diagram
pK_a
pOH
Raoult's Law
rate constant (*k*)
rate determining (limiting) step
rate law (rate equation)
reaction mechanism
reaction quotient (Q)
solute
solvent
spontaneous
standard conditions
unit cell
vapor pressure (P)
weight percent