

Note: items marked with \* you should be able to perform on a closed book exam.

### Chapter 17 Learning Objective Checklist

Be sure to review the margin notes and boxed comments for major concepts. Also read the chapter summary.

After studying this chapter you should be able to:

- write the mole balances using  $\xi$  for a given feed properly using the stoichiometric numbers for single and multiple reactions.\*
- write the mole fractions using  $\xi$  for single and multiple reactions.\*
- solve for the equilibrium  $\xi$  and the equilibrium mole fractions for a given  $K_a$  and  $P$ .\*
- properly include inerts in chemical equilibrium calculations.\*
- explain and apply LeChatelier's principle including the effect of inerts.\*
- find  $\Delta G^\circ_{298}$  and  $\Delta H^\circ_{298}$  for a given reaction.\*
- find  $\Delta G^\circ_T$  and  $K_{aT}$  using the shortcut van't Hoff equation.
- set up the energy balance for a given feed and equilibrium conversion, testing for closure or solving for  $Q$ .
- work equilibrium problems for reactions involving solids or liquids.
- set up the solution for multiple reactions.

### Chapter 18 Learning Objective Checklist

Be sure to review the margin notes and boxed comments for major concepts. Also read the chapter summary.

After studying this chapter you should be able to:

- Compute the effects of salts on boiling points, freezing points, osmotic pressure and acid/base equilibria.
- Using dissolved NaCl, explain the difference between the apparent concentration(s) and the true concentration(s).\*
- Explain why molality is more appropriate than molarity for industrial calculations with electrolytes.\*
- Explain why a model using hydrogen ions in solution is inferior and some circumstances where it can give completely wrong results.\*
- Explain why the conventional  $K_{sp}$  may be an approximate model for a multivalent electrolyte.\*
- Define the terms strong electrolyte, weak electrolyte, strong acid/base, weak acid/base.\*
- Be able to interconvert the acid/base form of a reaction for a specified reactant.\*
- Explain in words the strategy used to obtain a proton condition.\*
- Be able to properly combine the material balance and charge balance to obtain and use the proton condition.\*

- Properly sketch a Sillen diagram for a give acid/base with multiple dissociations at a given apparent concentration using the ideal solution approximations and the  $pK_{a,A}$  values.\*
- Explain the acid/base moieties that exist on proteins and why biomolecules are almost always charged at physiological pH.\*
- Define a zwitterion.\*
- Understand and articulate the reason for charges on biological molecules and the isoelectric point.\*
- Qualitatively describe the ‘salting in’ and ‘salting out’ effects and the common ion effect.\*
- Qualitatively describe Donnan equilibria.\*
- Estimate the true and apparent mole fractions of gaseous solutes in electrolyte solutions using Henry’s law.
- Use Gibbs energies to calculate dissociation constants.\*
- Define ‘reduction’ and ‘oxidation’.\*
- Combine half reactions correction to relate the Gibbs energy of reaction.\*
- Given the Nernst equation, calculate the potential under actual concentrations, or the concentrations where an electrochemical cell is ‘dead’.
- Writing the binding reactions for two binding events, derive the binding polynomial.
- For an acid with two protons, write the dissociation equation for each dissociation and show the relation with the equilibrium constant for a model where they are considered to both dissociate simultaneously.
- Explain why use of apparent equilibrium constants is convenient for biological reactions.
- Explain using words why the binding polynomial is convenient for representing transformed thermodynamic Gibbs energies for apparent species in biological systems.\*
- Define ionic strength.\*

#### Advanced Level

- Use the extended Debye-Huckel model to calculate activity coefficients.