

Study Guide

Chapter 4

- 1) What is the practical equilibrium constant in terms of pressure, concentration, mole fraction or activity?
- 2) Relationships between K_p and K_c , and between K_p and K_x ?
- 3) Relation between the standard-state ΔG and the thermodynamic equilibrium constants?
- 4) Do K_p and K_c , K_x , and K_a depend on P , V , and T ?
- 5) What is the definition of chemical potential?
- 6) What is Le Chatelier principle?
- 7) What is the direction of the shift in equilibrium upon a change in pressure and volume?
- 8) How does a reaction shift if one adds A or C after the equilibrium is established? Does ΔG change?
- 9) What does the degree of association mean for the above reaction?
- 10) Remember the van't Hoff equation in two forms: derivative with respect to dT and $d(1/T)$.
- 11) What is the x axis and y axis in a van't Hoff plot? What is the slope? What is the intercept?
- 12) A way to shift the equilibrium is to couple the reaction of interest with a second one. To make an unfavorable reaction possible, what is the requirement for the second reaction?

Chapter 5+6

- 1) Definition for phase.
- 2) What is the number of phases in a) a gas mixture; b) an aqueous solution of NaCl, c) a metal alloy; d) a suspension of oil in water; e) an aqueous solution of NaCl and MgCl₂?
- 3) Number of components c : minimum number of species necessary to specify the composition of the system = number of species in the system minus the number of constraints.
- 4) Variance of the system (degrees of freedom) is the number of independent intensive variables for describing the system, such as temperature, pressure or concentration.
- 5) What is the phase rule?
- 6) Draw a phase diagram for water. Point out the co-existence curves (or phase boundaries) for liquid-solid; liquid-gas; gas-solid equilibriums; triple point and critical point.
- 7) What is the thermodynamic quantity that drives phase transition at constant pressure?
- 8) At triple point what is the thermodynamic quantity that is the same for all three phases?
- 9) What is Raoult's law ?
- 10) Given a pressure-composition (P-x/y) diagram for a liquid mixture in equilibrium with vapor, what is the number of number of degree of freedom f in the liquid, vapor phase and the coexistence region?

- 11) Given a point in the diagram, read out the composition in the liquid and vapor phase.
- 12) Explain how isothermal distillation works. Which phase is removed during the distillation? Which component is left in the residual liquid?
- 13) How does the diagram change if the liquid mixture has positive or negative deviation from the ideal behavior?
- 14) When does one want to use the temperature-composition diagram to describe the liquid-vapor equilibrium? Which curve is the boiling point curve? What are the boiling points for the pure liquids? Which liquid is more volatile?
- 15) Explain fractional distillation. What kind of liquid mixtures can be separated using fractional distillation?
- 16) What kind of liquid mixtures can be separated using steam distillation?
- 17) What is an azeotrope?