CHEM 311: PHYSICAL CHEMISTRY–I

Instructional objectives for Exam-3 (Chapters 5, 6, 7 & 8) (version date 11/11/2004)

	Sec. No.	**Objective**	**Bloom's cognitive levels**	**Related problems**
1.	5.1	Explain the relationships between three regions on a one-component phase diagram, and what is meant by the "normal" freezing point and "normal" boiling point of a liquid.	1,2,3	
2.	5.1	Relate the slope of the solid-liquid equilibrium line to the densities of the two phases using Le Chatelier's principle.	1,2,3	HW6.3, Also see Problem 5.2 (textbook)
3.	5.1	Determine the conditions for equilibrium between two phases.	3,4	5.1 (see corrected solution), 5.18
4.	5.2	Explain, to a high school graduate, the assumptions made in going from the Clapeyron equation to the Claussius-Clapeyron equation.	1,2	
5.	5.2	Apply the Claussius-Clapeyron equation to various liquid-vapor and solid-vapor equilibria.	2,4	5.3, 5.4, 5.7, 5.8, 5.20, HW6.2, HW7.1
6.	5.2	Use the Claussius-Clapeyron equation to determine the triple point temperatures and pressures of various substances.	3	5.12, HW 6.1
7.	5.2	Use the Gibbs equation for predicting the variation of vapor pressure with applied pressure.	3,4	5.5, 5.17
8.	5.4	Apply Raoult's Law to calculate the vapor pressure and vapor composition of binary miscible liquid mixtures.	3	5.19, 5.21, 5.28, 5.32, 5.34, 5.35, HW7.2
9.	5.4	Apply Henry's Law to calculate the solubility of gases in liquids	3	5.36, 5.38
10.	5.4	Understand and apply the concept of activities in the context of deviations from Raoult's law.	3,4	5.34, 5.43, 5.46
11.	5.5	Explain to a group member the concept of partial molar quantities.	1,2	
12.	5.5	Explain to a group member why Eq. (5.33) makes sense even though it appears to be a violation of the chain-rule of calculus.	1,2	
13.	5.5	Determine partial molar volumes and predict the total volumes of solutions.	3,4	5.29, HW8.1

14.	5.8	Calculate the lowering of vapor pressure of a solvent due to the presence of a non-volatile solute.	3	5.40
15.	5.8	Use Eqs. (5.115)-(5.120) for calculations of freezing point depressions and related calculations. Also use analogous equations for boiling point elevation and related calculations.	3,4	5.39, 5.43, 5.48, 5.52, 5.55, 5.56, HW8.2
16.	6.1	Apply the phase rule to different parts of a one-component phase diagram and determine the degrees of freedom.	2	6.1, 6.2, 6.3
17.	6.1	Determine the number of components in a given system.	2,3	6.4, 6.5, 6.6
18.	6.3	Apply the bubble-point line and the dew-point line equations for calculations on binary miscible liquid mixtures.	3,4	HW8.3, 6.14, 6.15
19.	6.3	Explain to a group member the relationship between a vapor pressure diagram and a distillation diagram.	2	
20.	6.3	Apply the lever rule to calculate the relative amounts of each phase in a vapor pressure diagram, distillation diagram, or a phase diagram of two partially miscible liquids.	3,4	6.9
21.	6.3	Explain what is meant by "positive" and "negative" deviations from Raoult's law and the implications of such deviations for separations of liquid mixtures by distillation.	2	AS7.40*
22.	6.3	Perform calculations related to steam distillation and distillations of two nearly immiscible liquids.	3	6.10, 6.11, 6.13,
23.	6.4	Construct phase diagrams for two partially miscible liquids, identify the critical solution point(s), and use the diagram to explain the behavior of the system under different circumstances	2,3,4	6.22
24.	6.5	Relate cooling curves to the phase diagrams of liquid-solid binary mixtures	2,3,4	HW9.1, 6.24, 6.26, AS7.56*
25.	6.5	Construct phase diagrams of liquid-solid binary mixtures with and without compound formation from cooling-curve data, and label all regions.	3,4	HW9.1, 6.24, 6.26, AS7.56*

* AS refers to problems from *Physical Chemistry* by Alberty and Silbey

26.	6.5	Predict the shapes of cooling curves at different compositions on a given phase diagram of a liquid-solid binary mixture.	3,4,5	
27.	6.5	Determine the empirical formulae of compounds formed in liquid-solid binary mixtures.	3,4	6.27
28.	6.6	Construct triangular phase diagrams for three-component systems from given data.	3,4	HW9.2, 6.40, AS7.28,* AS7.29, AS7.57
29.	6.6	Use ternary phase diagrams to interpret the behavior of the system under different conditions, and to make predictions.	3,4,5	HW9.2, 6.39, 6.40, 6.41, AS7.28,* AS7.57
30.	7.1	Use the electrolysis equation (see lecture notes) to solve problems related to electrolysis.		7.1-7.3
31.	7.2	Understand and apply the relationship between observed and molar conductance of an electrolyte.		7.7
32.	7.2	Understand and apply the relationship between molar conductance, ionic conductance, and degree of dissociation.		7.5, 7.6, 7.8, 7.12, 7.13
33.	8.1	Explain the working of a Daniel cell.		
34.	8.2	Write the short-hand notation for an electrochemical cell, given a description of the electrodes and the electrolytes		
35.	8.2	Write the electrode reactions and the cell reaction for a given cell.		8.1
36.	8.2	Using the table of standard electrode potentials, calculate the cell potential of a given cell.		8.1, 8.3.
37.	8.2	Predict which reaction will occur in a given cell under standard conditions.		8.2
38.	8.2	Design electrochemical cells in which a given reaction will occur.		8.5

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