

CHEM 311: PHYSICAL CHEMISTRY-I**Instructional objectives for Exam-2 (Chapters 3 & 4) (version date 10/15/2004)**

	Sec. No.	Objective	Bloom's cognitive levels	Related problems
1.	3.1	Calculate q , w , ΔU° and ΔH° for each step of the Carnot Cycle.	1,2,3	3.3, 3.4
2.	3.1	Calculate the efficiency of a heat engine from the source and sink temperatures.	1,2,3	3.1, 3.2, 3.4, 3.5
3.	3.1	Define entropy of the system, ΔS , in the most general terms.	1,2	
4.	3.2	Explain to a high school graduate the relationship between entropy and spontaneity, and entropy and equilibrium.	1,2	
5.	3.4	Outline the strategy for calculating ΔS for various reversible processes including phase changes.	2,4	HW2.3, HW3.2
6.	3.4	Design reversible paths between initial and final states for irreversible processes involving the expansion/compression of gases.	3,4,5	HW2.3, HW3.2
7.	3.4	Design reversible paths between initial and final states for irreversible processes involving phase changes.	3,4,5	3.17, 3.25, 3.30, 3.31, 3.35, 3.43, HW3.3
8.	3.4	Calculate the entropy change of surroundings for irreversible processes involving gases.	3,4	3.16, 3.20, 3.24, 3.33, 3.40, 3.43, 3.48, 3.49, HW3.2
9.	3.4	Calculate the entropy change of surroundings for irreversible processes involving phase changes.	3,4	3.17, 3.25, 3.30, 3.31, 3.35, 3.38, 3.50, HW3.3
10.	3.4	Analyze a given process and predict, on the basis of entropy changes in the system and surroundings, whether it may be spontaneous.	4,5,6	HW3.4, most of the problems above under Objs. 8 & 9
11.	3.4	Calculate ΔS for constant pressure and constant volume temperature changes of a gas when the specific heats are functions of temperature.	3	HW3.1, 3.17, 3.23, 3.36, 3.51
12.	3.5	Apply the third law of thermodynamics for calculations of absolute entropies.	3,4	HW4.1, 3.36, 3.47
13.	3.6-3.7	Define the Helmholtz free energy A , and Gibbs free energy, G .	1,2	
14.	3.7	Explain, to a scientifically literate non-expert, what is meant by "free" energy.	1,2	

15.	3.7	Use standard Gibbs energies of formation, $\Delta_f G^\circ$, to calculate the free energy change for a reaction, $\Delta_r G^\circ$.	3,4	3.37, 3.52
16.	3.7	Calculate the change in Gibbs free energy, ΔG , for a reversible isothermal process involving an ideal gas.	3	3.40
17.	3.8	Calculate the change in Gibbs free energy, ΔG , for a reversible isothermal process involving a liquid or a solid.	3	3.45
18.	3.8	Calculate the change in Gibbs free energy, ΔG , for isothermal processes involving phase changes.	3	3.38, 3.43, 3.54
19.	3.8	Derive the four Maxwell's relations, given the equations for dU , dH , dA and dG .	3,4	3.63
20.	3.8	Apply Maxwell's relationships in order to derive new thermodynamic relationships.	4,5	3.6, 3.62, 3.63, 3.64, HW4.3
21.	3.8	Design experiments for measuring various quantities making use of Maxwell's relationships.	4,5,6	Class discussion
22.	3.8	Use the definitions of isothermal compressibility and cubic expansion coefficients to simplify thermodynamic relations.	4,5	3.62, 3.63, 3.64, HW4.3
23.	3.8	Calculate the fugacity of a real gas from a given equation of state or an expression for its compressibility factor, Z .	3	3.71, 3.72, HW4.4
24.	4.1	Apply the relationship between K_C , K_P , and K_x .	2,3	4.8, 4.9, 4.12, 4.20
25.	4.1	Calculate $\Delta_r G^\circ$ and the equilibrium constant from $\Delta_r G^\circ$ for reactants and products.	3,4,5	4.27, 4.28, 4.29, 4.35, 4.38, HW5.2
25.	4.1	Analyze given reactions on the basis of Le Chatelier's principle to predict the outcome of changing the equilibrium conditions.	4,5	HW5.3
26.	4.1	Set up and solve problems involving chemical equilibria.	3,4	4.1–4.5, 4.7–4.12, 4.15, 4.16, 4.21
27.	4.4	Explain the convention for defining the equilibrium constants for heterogeneous equilibria involving pure liquids and solids.	2	
28.	4.4	Perform equilibrium calculations involving heterogeneous equilibria.	3	Example 4.4, 4.24, 4.46
30.	4.8	Use the Gibbs-Helmholtz equation to solve problems dealing with the temperature dependence of equilibrium constants.	3	4.25, 4.27, 4.28, 4.32, 4.33, 4.34, 4.42, 4.46