

## Preview Sheet for Final

Wednesday, December 19, from 7:30 to 10:00 a.m. in Olin-Rice 100 (our normal classroom)

Part 1: (40 points) Typical Questions on Chemical Equilibrium and Kinetics  
(Lectures from 12/3 through 12/14; Problem Set 7)

Part 2: (100 points) 25 American Chemical Society Multiple-Choice Questions  
(Lectures from 9/5 through 11/30; Problem Sets 1-6)

The ACS Exam in Thermodynamics does not cover everything we have covered this semester. Here is a quite detailed list of what you are, and are not, responsible for:

### Test 1/PS 1 and 2

**YES:** Perfect gas law, expansion coefficient, isothermal compressibility, van der Waals and virial equations of state, compression factor, first law, heat and work, microscopic interpretation of  $C_v$ , isothermal and adiabatic processes, reversible vs. irreversible processes, calculating  $\Delta U$  and  $\Delta H$  for processes involving perfect and real gases.

**NO:** Kinetic-molecular theory, barometric formula, internal pressure (*i.e.* how  $U$  depends on  $V$ ), Kirchhoff's law (*i.e.* calculating  $\Delta_r H^\circ$  at  $T \neq 298$  K), calorimetry.

### Test 2/PS 3 and 4

**YES:** Calculating  $\Delta S$  for non-reactive systems, phase transitions, and chemical reactions, Clausius inequality and the Helmholtz and Gibbs energies, adjusting  $H_m^\circ$  and  $S_m^\circ$  to temperatures other than 298 K, the relationships between  $H$  and  $C_p$  and between  $S$  and  $C_p$ , Trouton's rule, Maxwell relations (derivation and use), Clapeyron and Clausius-Clapeyron equations (derivation and use), calculating  $\Delta_r G^\circ$ ,  $\Delta_r H^\circ$ , and  $\Delta_r S^\circ$  for a phase change or a chemical reaction, qualitative interpretation of  $\Delta_r H^\circ$  and  $\Delta_r S^\circ$ , calculating work done in a phase change or a chemical reaction.

**NO:** Carnot cycle, efficiency, Boltzmann distribution, microscopic definition and interpretation of  $S$ , Joule-Thomson coefficient,  $G$ - $T$  curves, calculating  $\Delta A$ .

### Test 3/PS 5 and 6

**YES:** How  $G$  depends on  $p$ , thermodynamics of mixing gases and liquids, imperfections and non-idealities, using Raoult's law, vapor pressure and boiling points of ideal and non-ideal solutions, Gibbs phase rule for one-component systems, two-component phase diagrams for liquid/gas and solid/liquid systems, eutectics, azeotropes.

**NO:** Deriving Raoult's law, colligative properties (*i.e.* vapor pressure lowering, boiling point elevation, and freezing point depression), Gibbs-Helmholtz equation, Gibbs phase rule for two-component systems, lever rule, excess functions.

### Chemical Equilibrium and Kinetics

As usual, you are responsible only for what we have covered in class and on the homework. In particular, note that you are not responsible for using an equilibrium constant to calculate the equilibrium composition of a system.

Please ask me if you are uncertain about whether a particular topic is "fair game."

Also note the following:

- I will provide you all of the equations and constants provided on the three units tests. (I am not going to take the time to pick and choose the relevant equations; that is, just because I give you a certain equation does not necessarily mean you are responsible for knowing how to use it.)
- You may, in addition, fill both sides of an 8.5" x 11" sheet filled with whatever information you would like. This should include equations from our last two weeks on chemical equilibrium and kinetics; I will not provide you any equations on this material.
- For the multiple-choice section, you will not need to justify your answers, and there is no penalty for incorrect answers. However, you will not receive any partial credit.
- You should, of course, bring a calculator to the exam. However, a ruler is not necessary.
- I will not hand this final exam back. It is, course, your prerogative to come to my office to look through your graded exam.