

OBJECTIVES FOR EXAM 3

CHMY 361
November 6, 2017

HANDOUT#8

Exam 3 is on **Thursday, November 9, 7:55-8:55 am.** in the usual meeting room. It is over chapters 6, 8, and the selected parts of chapters 4, 5 and 7 assigned for reading and homework. *You may bring a 4 x 6" sheet of notes (both sides) for use during the exam.*

For full credit show all work and put correct units on final answers.

Read, please: *If you get a quantitative answer that is many powers of 10 from what you think it should be and cannot find the error, you will be rewarded for pointing out approximately what you expected and why. 25% will be deducted on a problem for sign and unit errors that lead to unreasonable results if you do not recognize it is unreasonable and indicate what you expected.*

Know or be able to:

Chapter 6 and 7

1. Definition of chemical potential. (**Chapter 4**)
2. That at equilibrium the chemical potential for a given component is the same in each phase present.
3. That $\Delta G = \Delta G^0 + RT\ln(Q/Q^0)$ becomes $\Delta\mu = \Delta\mu^0 + RT\ln(Q/Q^0)$ when there is only one mole of one chemical species involved in the reaction, e.g., transfer across membrane.
4. Definition of usual standard states, activities and activity coefficients.
5. Given concentrations or activities in two different phases for substance A, and $\Delta\mu_A^0$, find $\Delta\mu_A$. If the material has a charge use given electrical potentials as part of the equations. Know that $\Delta\mu_A^0 = 0$, if the solvent is the same on both sides (as in membrane transfer). Know that μ_A is the same in all phases present at equilibrium.
6. Given ΔH^0 for a reaction and K at a certain temperature, calculate K at another temperature. (**NEVER calculate the change in K with temperature without using ΔH^0 and Vant Hoff Eq.**) In other words: Recall that LeChatelier's principle says: the K of an endothermic reaction, one with **positive ΔH^0** , (increases (shifts to right) as T increases.
7. Definition of surface tension. Given a surface area change and the surface tension, calculate the work of creating the surface, i.e., calculate the $\Delta G_{\text{surface}}$.
8. Use Henry's Law and Raoult's Law to find solubilities of gases and vapor pressures. Given ΔH^0 , find these at a different temperature, given them at a certain temperature. Realize that this is just an example of: **given ΔH^0 for a reaction and K at a certain temperature, calculate K at another temperature (objective of the last exam), because solubilities and vapor pressures are just equilibrium constants.** In other words the Henry Law constant is just an equilibrium constant for the "reaction" B(solution) \rightleftharpoons B(gas). It will depend on the units used and which direction the reaction is written.

9. Find osmotic pressure, melting point depression, boiling point elevation, vapor pressure, and activity of *solvent* or molar concentration (assuming ideal), given one of these and the temperature as a starting point.
10. Find molecular weight if given osmotic pressure and grams/L, using the equation that looks like the ideal gas law.

Chapter 5, 8

0. **Always use SI units:** (unless asked for g, cm, etc.) **Note that bar and Å are NOT SI.** If units don't cancel, numbers will usually be ridiculous.
1. Given temperature and molecular weight, find the root mean square speed of a gas molecule. If also given the pressure and collision diameter, find the collisions per sec. per molecule (z) and mean free path. Know that z is about 10^{10} collisions/sec. per molecule when $p = 1$ atm or bar and $T = 300$ K, for a molecule the size and mass of N_2 . (You may always use the v_{rms} in this course, even if other average speeds are more formally correct (for marbles). Atoms and molecules are not marbles.
2. From collision number and mean free path, find the root mean square displacement for a gas molecule in a certain time.
3. Draw qualitative Maxwell-Boltzmann distribution of velocities for a gas at two different temperatures.
4. Relationship between applied force, frictional coefficient, and terminal velocity.
5. Definitions of sedimentation coefficient and electrophoretic mobility.
6. Given the sedimentation coefficient in Svedbergs and the diffusion coefficient in cm^2s^{-1} or m^2s^{-1} , the partial specific volume of polymer, temperature, and the density of the solution, calculate the molecular weight of polymer.
7. Know roughly the order of magnitude expected for the diffusion coefficient of a typical protein molecule. Given diffusion coefficient and temperature, find the frictional coefficient, and calculate the root mean displacement in a given time for a molecule in solution.
8. Concept of isoelectric focusing. Given the numbers and types of ionizable amino acids in a protein, their charge when protonated, and their pK_a values, roughly determine the charge on the protein at a given pH. Predict the effect on isoelectric point of adding or removing ionizable amino acids of a given type.
9. Understand the concepts underlying SDS acrylamide gel electrophoresis of proteins.

General: Be able to work problems of the type given as homework.
