

Suggestions and Hints on Studying, Problem Solving, and Taking Chemistry Examinations

STUDYING FOR EXAMINATIONS: GENERAL CHEMISTRY EXAMINATION 2

1. Focus on **basic operations**, and practice them in all different ways until you are fluent in
 - (a) applications of the ideal gas law to single gases, to gas mixtures, and to reacting systems
 - (b) how to interconvert among moles, volumes, and molar concentrations of solutions
 - (c) how to write balanced net ionic equations for a variety of chemical processes
 - (d) how to find molar ratios from chemical formulas and from balanced equations
 - (e) how to write equilibrium expressions from balanced chemical reaction equations
2. Do **memorize**:
 - (a) complete key *definitions* (not the exact wording, but a thorough, complete understanding): solubility, strong electrolyte, weak electrolyte, non-electrolyte, acid, base, salt
 - (b) *units* of key quantities [for example, the concentration units: weight %, mole fraction X, molality m (moles solute/kg solvent), molarity M (moles solute/liters solution)]
 - (c) *names* and *formulas* of the *strong acids* and the *strong bases* listed on the handout sheet
 - (d) *solubility rules* and *important exceptions* for salts of common ions, given on the sheet
 - (e) how to recognize *strong electrolytes*, *weak electrolytes*, *non-electrolytes*, *acids*, and *bases*
 - (f) general rules and conventions for writing *equilibrium constants* for chemical reactions
 - (g) *fundamental* relationships and equations:
 - (i) the ideal *gas* law: $PV = nRT$ (ii) Raoult's law for *ideal solutions*: $P_A = X_A P_A^{\circ}$
 - (iii) the limiting laws for the four colligative effects on solutions:
 $\Delta P_A = i P_A^{\circ} X_B^{liq}$, $\Delta T_{bp} = i K_b m$, $\Delta T_f = i K_f m$, $\Pi = i c RT$
3. Do **not** memorize:
 - (a) *numerical* values of R, N_A , atomic weights, properties, and the like. Any numerical values that you need are always supplied on data sheets given out with the examination.
 - (b) the details of the kinetic theory of gases, or any step-by-step derivations.
 - (c) *uncommon* exceptions to solubility rules, or rules about slightly soluble or reactive salts.
4. You **learn chemistry** from four **sources**: lectures, textbooks, problems, and laboratory work.
 - (a) **Lectures** (including handouts) are designed to organize and clarify the material, and stress what is important to understand, but differ from the textbook presentation. Review and annotate your lecture notes.
 - (b) Use your **textbook** together with the lectures for explanations, examples, and reference material. Read actively, ask questions all the time, and use pencil and paper to check that you follow explanations in detail. Consult other textbooks if this helps you.
 - (c) The ability to solve **problems** is the one and only test of understanding. Each assigned problem has a point, and is testing some particular skill. Make sure you know what that is. *If you can not work out a problem, you do not fully understand the relevant material.*
 - (d) **Laboratory** exercises teach you experimental practice, illustrate theoretical concepts, show you chemical reactions, and show how chemical calculations work in practice.

The second examination will consist mostly but not entirely of problems, involving quantitative calculations, of about the same kind as those in the text, or supplied for practice, or assigned to hand in, but easier than many. **There may also be short qualitative questions**, for example, on acids, bases, salts, solubility, ionization, and/or physical and chemical equilibria.

Topics tested may include: the ideal gas law, gas mixtures, partial pressures, the van der Waals equation, gases, liquids, and solids, intermolecular forces, phase changes, phase equilibria, P-T phase diagrams of single substances, solutions, concentration units, volumetric measurements, Henry's law, Raoult's law, P-X and T-X phase diagrams for binary liquid mixtures, distillation, colligative effects, reactions in aqueous solution, solubility, strong, weak, and non-electrolytes, writing net ionic equations for reactions in water, general features of chemical equilibrium.

Topics **not** on Examination 2: solubility products K_{sp} and subsequent material. (over) →

SOLVING PROBLEMS

1. A useful strategy in starting a problem is to *list what is given, what you know, what you seek*. Define symbols. Write units. If appropriate, write balanced chemical reaction equations or draw pictures to clarify what is happening. Then, using relevant relationships, reason your way to the end, step by step. Write each step explicitly, especially if substitution is involved.
2. Always use dimensional analysis: *write out all units*; carry units through equations; check that the answer has correct units. This is a quick, effective way to detect certain kinds of errors.
3. *Don't expect to see how to solve a problem right away, and don't expect to be able to reach the answer in one simple step*. Several steps of reasoning will almost always be required. Move forward, one step at a time. There may be several different ways to solve a problem.
4. *Thinking out a problem backwards is often very useful*. Ask what you must know to be one step from the desired result; then ask what you must know to get that information, and so on, until you reach a set of data that you do know and relationships that get you to the answer.
5. It is not sensible to do extensive numerical calculations before thinking the whole problem through. It is easier to work with symbols and to keep track of the relations among quantities algebraically than it is to work with long chains of numbers. *Do calculations at the end*.
6. After solving a problem, look carefully at the result. *Make sure it is reasonable* – in sign, in magnitude, in dimensions. Many calculation errors can be found this way. If an answer is clearly nonsensical and you do not have time to find your error, tell me how you know it is wrong. *If time permits, check your calculations*.

TAKING EXAMINATIONS

1. **NEVER EVER** stay up late the night before an examination. You must be able to think clearly and quickly during examinations, not merely repeat masses of memorized material. Always get a good night's sleep. Be on time, and arrive relaxed and ready.
2. The in-term examinations will last from **9:00 to 10:25 exactly**. If you arrive late, you will *not* be given extra time to complete the examination.
3. Read quickly through the *entire* examination first *before* you start working. You may answer the questions in any order, so work selectively – *do the question you know best first*.
4. *Read each question twice through* before answering. Think before you start writing anything. Understanding correctly what a question asks is key to solving that problem. You should understand the situation qualitatively, know what is happening, before doing any calculations.
5. *Budget your time wisely*. The examination lasts 85 minutes. If the total credit is 150 points, for example, then don't spend very much longer than 12 to 15 minutes on a 25 point question.
6. Set up problems clearly – *partial credit is given if* I can understand your work. Define symbols used. Write out any general equations relevant to the problem. You must **SHOW** explicitly all your work, both the reasoning and the calculations, to receive credit for it.
7. *Try each question*; leave none out. You should be able to get at least some partial credit.
8. Units and significant figures matter – unless both are specified completely and accurately, final answers are not completely correct..
9. **BRING A WORKING CALCULATOR**. Get it ready the night before, and don't forget it.
10. You are only entitled to take a make-up examination for one of the following three reasons:
 - (a) serious illness, requiring a visit to the health service or bed rest;
 - (b) a death in the family or some equally serious personal emergency;
 - (c) conflict with a religious observance, *which must be made known in advance*.

Absence from an examination for any other reason will result in an unalterable grade of zero.

If a serious health problem or emergency situation arises so you must miss an examination, please leave a message for Professor Chapman by telephone (854-2098) or by e-mail (schapman@barnard.edu) as soon as possible, in advance if you can. If I have not heard from you within 24 hours of the examination, I will assume you have dropped the course. Be prepared to take a make-up examination as soon as we can possibly arrange it.