CHEMISTRY 145 PLACEMENT EXAM INFORMATION

Entrance to Chemistry 145, honors general chemistry is by entry code only.

With two exceptions, all students must take and pass the CHEM 145 placement exam. Sample exam questions follow the listing of study materials.

The exam is given in The Office of Educational Assessment, 440 Schmitz Hall, 543-1170, on a **space available basis**. The web site below lists the testing times for the exam.

http://www.washington.edu/oea/services/testing_center/exams/placement.html

Students who need to take the placement exam after October 1 should contact The Office of Educational Assessment directly for testing times.

This exam may be taken twice (different versions!), with a two-week waiting period required. Students may take up to 60 minutes to work the exam. A periodic table and useful formulae will be provided. Bring a "non-programmable" hand calculator; that is, one that does the usual mathematical operations plus log, ln, exp, and powers of 10, but has no permanent memory or programming capabilities. Such calculators cost $10-15.

Exceptions: ***Students with a 4 or 5 AP score may directly contact the chemistry advisers in 109 Bagley (advisers@chem.washington.edu) to register for CHEM 145. Such students will be given a review problem set to work before classes start. Note that AP scores should be on file with the Office of Undergraduate Admissions before students may be registered for CHEM 145. Students may also present an unofficial copy of their AP scores to the chemistry advisers for verification of their score. Similar rules apply to IB scores on the High Level chemistry exam, with a 5, 6, or 7 allowing immediate admission to Chem. 145. Note that the Chemistry Faculty encourages all AP and IB students to enter the Honors program, which runs for two full years, rather than "skipping ahead" in the non-honors sequence.

***Students in the Early Entrance Program (EEP) are admitted on a case-by-case basis and should be specifically referred for registration in CHEM 145 to the chemistry advisers by staff from the Robinson Center.

Prerequisites for Chemistry 145:
Note that what is desired is familiarity with, and a working knowledge of, the following "elementary" parts of chemistry, and associated mathematical concepts, rather than a broad coverage of "all topics" in a full year of high school or AP chemistry. These topics will NOT be reviewed in Chemistry 145, although they will be needed for solution of problems, and to follow lecture materials, starting on "day one."

The Atom.

Atomic constituents: electrons, protons, neutrons, nuclei, isotopes. Atoms and atomic "ions."

The mole or "gram-atom"; Avogadro's Number; atomic masses, conversions from AMU to grams and Kg, names of the atoms.

The Periodic Table.

Groups of elements, periods, periodicity, "the representative elements & their natural states of occurrence in nature, e.g. hydrogen, oxygen, nitrogen, fluorine all occur as diatomic gases at room temperature and pressure", these being the elements through argon, Lewis dot structures for atoms & ions, shell structure.

Molecules and Compounds.

Molecular formulae, empirical formulae, combining ratios by weight and number, % compositions, molecular weights, formula weights. Lewis structures of simple molecules (ionic and covalent, multiple bonds) and molecular ions, names of simple compounds, and common molecular ions, e.g. fluoride, phosphate, carbonate.

Chemical Reactions & Stoichiometry

Balanced chemical equations at the bulk and atomic/molecular levels; weight and mole relations, % yields, limiting reagents.

Measures of concentration in solution, composition of solutions, solution stoichiometry.

Examples of simple types of chemical reactions: precipitations & solubility rules; simple acid-base "neutralizations," recognition of simple strong acids and strong bases; oxidation-reduction reactions, assignment of oxidation numbers to individual elements in representative compounds.

Solids, Liquids, Gases and Phase Transitions

Temperature, coefficients thermal expansion, densities

Standard Boiling and Freezing points of pure substances

The "empirical" ideal gas laws: Charles's Law, Boyle's Law; the Avogadro Hypothesis

The "universal" ideal gas equation of state: $PV = nRT$

Mathematics and Problem Solving

Familiarity with logarithms, the exponential function, scientific notation, significant figures, unit conversions, solution of "coupled" linear and quadratic equations, extraction of information from graphs, slopes and intercepts of straight lines, "tangents" to curves are all assumed. As calculus is a co-requisite, understanding of the notion of derivatives as tangents, and integrals as "areas under curves" will be helpful.

Zumdahl (appendices 1,2) and Oxtoby (appendices A,B,C), below, both have substantive appendices covering the more elementary mathematical prerequisites.

Where to find review help, if needed:

A solid course in high school chemistry will normally cover the above materials. Check your problem solving abilities by working the sample problems below. If you took chemistry in the 11th grade, and it's now a year later, you will definitely want to "review" the above topics.

These materials are also contained in any "standard" college level text, such Zumdahl, currently used in "non-honors" general chemistry at the University of Washington.

Zumdahl, Chemical Principles, 4th Edition, Houghton Mifflin, Chapters 1-4 and Sections 1-5 of Chapter 5. This is a nice text for review or self-study as the text's organization is essentially in the order of topics above. Note: as Zumdahl is the general chemistry text at UW, and many of the local Community Colleges, that new (and used!) copies are readily available.

Or

A college text, often used in AP chemistry courses: **Brown, LeMay, Bursten, Chemistry the Central Science, 9th Edition, Prentice Hall**, Chapters 1-4, parts of Ch 7 and the elementary discussion of Lewis structures in Ch 8, Sections 1-5, and gases Chapter 10, Sections 1-6. The coverage here is fine, but the topics are introduced in a rather different order.

Or

At a more advanced level this material, and more, is contained in

c) **Oxtoby, Gillis, Nachtrieb, Principles of Modern Chemistry, 5th Edition, Thompson, Brooks/Cole**, Chapters 1-3, Sections 1-4 of Chapter 4 for gases, Sections 1-3 of Chapter 6 for solutions, and “typical” chemical reactions. Oxtoby is the text book for Chemistry 145, and discussion of the elementary topics, listed above, will not be explicitly covered in lecture, although they will often appear in the context of discussion of more advanced material, and in assigned problems. Note that the Oxtoby coverage is “above the level” of the elementary prerequisites, and that many other concepts and examples appear in the above chapters.

Sample “chemistry” problems; note that on the actual exam questions will be multiple-choice, so the style and format will be somewhat different. The sample problems, below, are intended to give a feel for “coverage” and level of difficulty to be expected.

1) (note that not all parts of this question require solution of prior parts!)

a) How many moles of O_2(gas) are required for complete combustion of one mole of cyclopropane, C_3H_6, to give CO_2(gas) and H_2O(liq)?

b) What weight (in grams) of CO_2 would result?

c) Draw Lewis structures for all four of the molecular species mentioned in part a).

d) What is the bond order of “O” in CO_2, and in O_2?

e) In an Oxygen deficient environment CO (gas), rather than CO_2(gas) is produced. If only one gram of O_2 were available how many grams of CO could be produced?

f) What is the bond order of “O” in CO?

g)What would the volume of this CO(gas) be at STP?

h) How many molecules of CO would be formed?

i) What is the mass in grams of “one” of these molecules?

2)

a) How many grams of NaCl would it take to precipitate “all” of the silver in 200mL of an 0.2<u>M</u> solution of $AgNO_3$ in water?

b) Write a balanced “net ionic equation” for the above chemical reaction.

c) If filtered and dried, how many grams of “what” precipitate could be isolated?

d) Draw a Lewis diagram for the molecular ion NO_3^-. How many “equivalent” resonance structures are there?

3)

Classify the following reactions as “neutralizations,” “precipitations,” or “oxidation-reduction”

a) $Pb(NO_3)_2 + NaI \Rightarrow NaNO_3 + PbI_2$, in water solution.

b) $H_2SO_4 + NaOH \Rightarrow NaHSO_4 + H_2O$, in water solution.

c) C(graphite, solid) + O_2(gas) $\Rightarrow$ CO_2(gas)

d) In the case of an “neutralization” identify the “acid” and “base” species; in the case of an “oxidation-reduction” reaction give the “oxidation” numbers of all elements in all of the reactant and product species, and state which elements are oxidized, and which reduced; in the case of a “precipitation” write a balanced net ionic equation for the reaction, and name the precipitate.

Sample "Math" Problems

1) The speed of light is 3×10^{10} cm/sec in a vacuum. What is this "speed" in "furlongs/fortnight". One fortnight is "2 weeks", and there are 8 furlongs/mile. A US or British "statute mile" is 5280 feet, a foot contains 12 inches. 1inch = 2.54cm, exactly.

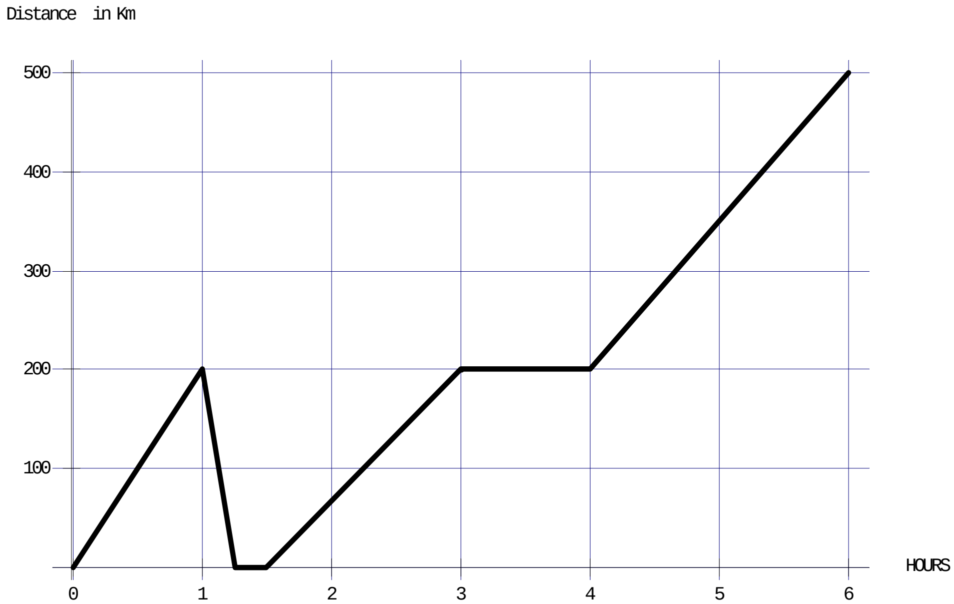
2) A lake of constant depth has a surface area of 1 km^2. It contains 10^{16} kg of water.

i) How deep is the lake? The density of water may be taken to be "1".

ii) What mass of water (kg) would a lake of half the depth, but four times the surface area, contain?

3) Determine all the roots of the cubic $x^3 - 2x^2 - x + 2 = 0$. Hint, $(x - 1)$ is a factor!

4) Below is a graph of actual "distance" from Seattle, as measured along the roadway in km, as a function of time in hours, on a car trip from Seattle to Spokane, which is 500 km from Seattle, along the road taken. The trip began at 9am, Seattle time. Following the graph are several questions.



a) Estimate the average "speed" in km/hour over the duration of the entire 6 hour trip.

b) What do you think happened "one hour" into the trip?

c) Estimate the "instantaneous speed" at 5 hours into the trip. Was this above the likely speed limit (75mph)?

d) At what time interval in the trip, to the nearest 15 minutes, was the speed a maximum?

e) At what point, or points, between hours 2.5 and 5 hours, was the speed a minimum?

f) What were the occupants likely doing at 3.5 hours into the trip?