CHEM 150 Engineering Chemistry,

Sections X02A and X02B
Quarter 2: 4 January to 18 March 2016

General Information

Instructor: Daniel Dönnecke

Office: Tec 232

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Office Hours: Mondays 15:30–16:20 in Tec 232 and/or 230

Feel free to drop by my office any time or arrange a convenient time. I check e-mails regularly and will make every effort to return e-mails as soon as possible, generally within 24 hours.

Text:

No text is required, but it is strongly recommended that you have a first year university chemistry text, either used or from the library. The following are suitable chemistry books (older editions are fine too).

General Chemistry, *Petrucci* (excellent book)

Chemistry the Central Science, *Brown Le May* (good book but a bit weak on quantum mechanics)

Lab:

The lab Manual is available online (D2L). **Print it and bring it to each lab.** It contains procedures for the experiments you are conducting. Come prepared. Having read and understood the lab manual will safe you valuable lab time. You also need to bring a pair of **safety glasses** and a **lab coat.** You will not be allowed in the lab without safety glasses.

Timetable

Lectures: Both sections: Monday 16:30-17:20 in Tech 173, Tuesday 13:30-14:20 in Tech 173, Thursday 10:30-12:20 in Tech 173 and Friday from 15:30-16:20 in Tech 173

Laboratory: Sections X02A **Wednesday** 12:30 - 15:20, Tech 230

Sections X01B **Monday** 8:30 - 11:20, Tech 230

Evaluation **Grading as in Camosun College Calendar**

Review test	**7 %**	**Term Tests (two)**	**10 % each**
Midterm	**18 %**	**Lab**	**20 %**
Final	**35 %**		

Problem sets which will prepare you for exams will be provided approximately biweekly. These problem sets are not graded but answer keys will be posted online (D2L).

A 50 min review test covering basic topics of chemistry such as atomic structure, chemical nomenclature and stoichiometry (which will be reviewed during the first week) will be written during lecture time of week 2. Two 50 min Term Tests, worth 10 % each, will be written during lecture time of week 4 and week 9. Topics for both tests will be announced in class. A midterm, written during week 6, will cover material from week 1 to week 6 of the course. A 3 hour final examination will cover material from week 1 to week 11.

Attendance in the lab is mandatory. If you miss more than two labs unexcused you have failed the lab. You must pass both the lab and the lecture component separately to pass the course. You must also pass the final exam to pass the course. A lab that is missed, an exam that is not written or a lab report that is not handed in, within the beginning of the following lab period, counts as zero towards your course grade. Exceptions can be made if a valid excuse is produced in writing to the instructor (such as a note from a medical doctor) as soon as possible. It is important to let me know what is happening.

Send me an e-mail if you cannot attend a lab or an exam.

Detailed outline (schedule subject to availability of equipment)

Week	Activity
1	Lab safety **EVERYONE ATTENDS**
2	*Lab 1* Densities **Review test** (50 min, during lecture time)
3	*Lab 2* Stoichiometry
4	*Lab 3* Spectroscopic Determination of Nickel **Term Test 1** (50 min, during lecture time)
5	*Lab 5* Distillation
6	8 February, Family Day, College closed **11 February, Midterm**, 90 min during lecture) No labs during midterm week
7	*Lab TBA* 19 February, Conversations Day, College closed
8	*Lab 4* Thermochemistry
9	*Lab 7* Bromination of Acetone **Term Test 2** (50 min, during lecture time)
10	*Lab 6* Determination of Chloride
11	Review of the course material and demos during lab sections

Week 12: Final Examination Period

Note that the Lab # refers to the number of the lab as in the lab manual: E.g. we will conduct lab 5 prior to lab 4.

Detailed Lecture Outline (approximate):

Week 1-2 Review: Foundations of chemistry including Matter, Daltons atomic theory, fundamental particles, isotopes, atomic weights, ionic bonding, ionization energy, Electron Affinity, Metals, Non-metals, Octet rule, covalent bonding, Lewis structures of simple molecules and ions. Nomenclature of ionic and molecular compounds including acids. Stoichiometry and solution stoichiometry.

Week 2-3: The shape of molecules, Lewis structures of molecules and ions part (II), Resonance Hybrids, formal charges, Valence Shell Electron Pair Repulsion Theory, exception to the octet rule, Odd electron species, electron deficient compounds, expanded valence shell, coordinate covalent bond.

Week 4: Electronegativity, polar covalent bonds, polarity and shape of molecules, resultant Dipole moment, Intermolecular forces, dipole-dipole, London dispersion forces, induced dipole-induced dipole, polarizability and shape of molecules, hydrogen bonding, boiling point, melting point, surface tension, viscosity, vapour pressure, phase diagram,

Week 5: Colligative Properties (Raoult's Law, Osmosis and Osmotic pressure) Gases: Units of pressure, Boyle's law, Charles's law, Avogadro's law, ideal gas law, Daltons law of partial pressure, gas stoichiometry, Kinetic molecular gas theory, effusion, diffusion, real gasses, Van der Waals equation, Joule-Thomson effect.

Week 6: Thermochemistry, work and heat, systems and surroundings, first law of thermodynamics, Internal energy, state functions, enthalpy of reaction, 2^{nd} law of thermodynamics, heat capacities, Hess law, enthalpies of formation, entropy, spontaneous processes, irreversible processes, third law of thermodynamics. Gibbs free energy.

Week 7: Electrolytes, Dissociation and Ionization, pH of strong and weak acids and bases, pH of salt solutions, buffers, molecular structure and acid base behaviour.

Week 8: Electrochemistry: Voltaic cells, electromotive force, standard cell potential, standard hydrogen electrode, electrochemical series, Nernst equation, concentration cell, pH-meter, lead acid battery, dry cell, fuel cell, corrosion, anodizing, electroplating, sacrificial anode.

Week 9: Introductory Quantum Mechanics: electromagnetic radiation, photoelectric effect, Planks equation, Dual nature of light, De Broglie relationship, Heisenberg's uncertainty principle, Wave mechanics, wave functions and standing waves, Schrodinger equation, Particle in a box, quantization of energy, probability and electron charge density, wave functions for the hydrogen atom, atomic orbitals, quantum numbers, multi electron atoms, electron configuration and the periodic table, Pauli exclusion principle, Hund's rule, para and diamagnetism.

Week 10: Advanced bonding models: Valence-bond method: sp^3, sp^2 and sp hybrid orbitals. Strengths and limits of VB method. MO theory: constructive and destructive interference of wave functions, Bonding and anti-bonding molecular orbitals, MO-diagrams' for homonuclear diatomic species of the first and second period up to Z =10, Paramagnetism of dioxygen. Band theory, conductors, insulators and semiconductors, band gap of group 14 elements, doping, LED and photo voltaic cells, thermal properties of semiconductors.

Week 11, Organic chemistry, important functional groups, important polymers, structure and properties of polymers, composite materials.