SCH 4U
Grade 12 University Chemistry
Course outline/ expectations

Purpose: to cover all aspects of the Ontario curriculum and provide sufficient **depth** for success in the **Advanced Placement** Chemistry examination and the University of Waterloo CHEM News contest.

The fundamental question Grade 12 Chemistry tries to answer :

How can I tweak conditions so that I can maximize the products I intend to make ?

A lot of correspondence in this course will occur online via email

Topics covered: (in sequence)

Time schedule	Material covered
Week 1 and 2	**Review of Grade 11 material such as :** • Chemical nomenclature of ionic, molecular and Transition metal species. • Balancing equations and their reaction types • Drawing Lewis/ VSEPR diagrams and intermolecular forces acting between molecules such as London, dipole-dipole and H-bonding. • Predicting solubility of different compounds • The concept of the Mole and Avogardo's number. • Stoichiometric and ratio calculations involving finding limiting reagents, finding mass of products and % yield • Determining empirical and molecular formulas of compounds • How Atomic trends such as size, electronegativity and ionization energy affect bonding arrangements of atoms

	• Detemining % abundances from isotopic masses • Nuclear decay • Gas laws PV= nRT and finding partial pressures of gases in a mixture • Organic nomenclature of alkanes, alkenes, alkynes, aldehydes, ketones • Finding concentration → Beer's law • Acid/ base theories and finding pH of Strong acid with Strong base. **<u>On the last day of the 1st week,</u>** • Students will be given 1 day training on how to clean up spills, manage lab station tidiness, how to make solutions, manage probe-ware. • They will select their lab partner and be assigned to a specific lab station for work for the entire year. **<u>Lab :</u> Qualitative Analysis** (precipitation lab Q on AP exam) **<u>Objective</u>**: Students will determine unknown cation through testing of Solubility via the color of precipitate formed. **<u>Lab 2</u>**: Beer's Law lab using green food coloring **<u>Objectives:</u>** Students will determine the concentration of a solution from its measured absorbance using a colorimeter. Students will learn/ revise proper calibration techniques for their colorimeter.
Week 3	**<u>Unit Test:</u>** on all Grade 11 material will be split into 3 parts 2 days of review… followed by 3 days of tests.

	Part A: Moles & Stochiometry & Gas law (Day 1) Part B: Organic naming, Lewis drawing, atomic structure (Day 2) Part C: Acid+ base, Qual Analysis Lab question (modeled after AP)

Week 4,5	**General overview of Chemical equilibrium:** Students will learn the extent to which most reactions are reversible in that, in nature, there always exist a balance between [products] versus [reactants] in a mixture at all times. • Le Chatelier's principle • Writing equilibrium expressions of K • Calculation of K by setting up ICE tables • Knowing the different types of K: There are different types of equilibrium systems: (A) regular concentration → K_C or K_{eq} (B) pressure → K_P (C) acid-base → K_A , K_B (D) solubility → K_{SP} **Lab:** Finding the K_{eq} of FeSCN with a colorimeter (probeware) **Quiz**: 10 questions on theory of equilibrium and LeChatelier's 2 questions: 1 on K_C and 1 on K_P
Week 6	**Solubility equilibrium:** • How do you calculate individual solubilities of ions in solution. • How can K_{SP} values be used to predict when a precipitate will form ? • **Common ion effect:** how does the solubility of a substance change with the addition of an ion that is common to what is already present in the solution. **Lab:** finding the K_{SP} of $Ca(OH)_2$ **Quiz:** 5 questions on solubility theory, 1 question on K_{SP} calculations with common ion effect

Week 7 , 8, 9	**Acid-base equilibrium :** • Review of conjugate acid-base • Introduce Lewis acids/ base • ICE table for K_A , K_B • Finding pH from ICE table • Buffers: Proof of Henderson Hasselbach equation, finding pH • Buffer capacity • **Indicator chemistry:** which indicator to use under what acid-base titration conditions • Finding pH at equivalence point (2 days) **Lab1:** use probe-ware to measure pH from the titration of SA + SB, SA + WB, WA + SB **Lab 2:** finding equivalence point using probe-ware Alternatively, **Lab 1:** titration of acetic acid + NaOH to find K_A (Lab 24, AP book) **Lab 2:** neutralization of H_3PO_4 (Lab 26, AP book) **Test:** 10 questions Acid-base theories (Multiple Choice) 1 comprehensive question on finding pH of buffer, pH of SA + SB, pH at equivalence point.
Week 10, 11	**Spontaneity of a reaction, ? G + Electrochemistry** What drives reaction to occur in the direction or produce the products that they do? From the previous section, we learn about how placing stresses on the system (like changing pressure, temperature, volume) can affect the amount of products made (via Le Chatelier's), are there other alternatives to force a reaction to give us more products ? • What is entropy (? S) , enthalpy (? H) and how are these 2 things related to spontaneity (? G) of a reaction ?

	• The 3 laws of thermodynamics ***<u>Electrochemistry:</u>*** The study of how to harness electricity from chemical energy (movement of electrons) • Writing half cell equations • Calculating E cell (learning how to read the chart) • Strongest oxiding/ reducing agent • Balancing redox equations in acid/base conditions • Nerst equation: relating E to ? G • Electrolysis (Q = I ? t) **<u>Lab:</u>** Conductivity of solutions **<u>Test:</u>** 10 multiple choice E or ? G related questions 1 question on strongest oxidizing or reducing agent 1 question on E and ? G calculations 1 question on electrolysis 2 questions on redox balancing: 1 in acid, 1 in base
Week 12, 13	**<u>Rate of reactions</u>** • Determining rate law from given data • What is k, the rate constant • First, 2^{nd} order rate calculations (using derivatives) • Finding half life, Arrhenius equation to find E_A • Rate determining step + reaction mechanism **<u>Lab:</u>** finding the rate order of $FeCl_3$ + KI (Lab 25 in AP book) Or **<u>Lab:</u>** finding the activation energy and order of Crystal Violet. (lab 35, AP book)

	Quiz: 5 multiple choice questions on finding k, rate order, half life Identifying reaction mechanism, RDS, 1 calculation question for finding k from the tables.

Week 14	**Colligative properties of solutions :** • Calculating molality • Henry's Law (solubility versus pressure) • Vapor pressure of solutions (Raoult's law) • 3 colligative properties: Boiling point elevation, freezing point depression, osmotic pressure
Week 15 to 16.5	**More details on intermolecular forces :** • in detail: what is a dipole moment and how do temporary dipoles contribute to London forces ? • Van der Waals' equation for non-ideal gases • Heating and cooling curves + phase diagrams (triple point) • Clausius- Clapeyron equation (relating vapor pressure and temperature) **test**: 5 questions on colligative properties 5 multiple choice on intermolecular forces (theory) 1 question on interpreting heating/ cooling curves 1 question involving phase diagram 1 calculation question for Clausius- Clapeyron 1 calculaton question for non-deal gases
Week 16.5 to 17	**Chemical bonding and molecular structure: in detail** • Bond dissociation energy (relates to the strength of a bond) • Orbital hybridization • Band theory of solids, molecular orbital theory (MO) This is the most theory laden chapter of all of chemistry.. we will go through how to give good quality answers for AP exam.

Week 18	**Thermochemistry + Hess Law :** • More details and specific heat + Hess Law calculations • How to deal with nasty calorimetry questions **Lab**: burning peanut, marshmallows & measuring ? H with temperature probe.

Evaluation scheme:

All tests, quizzes will be split into 4 categories, KU, TIPS, APP, C, each weighted equally at 25 %

Test, quizzes :	30% of final mark	(Tests and quizzes have equal weighting)
Lab skill :	10 % of final mark	
Lab reports :	20 % of final mark	
Assignment:	10 % of final mark	
Exam (written)	30 % of final mark	

*** All marks will be posted regularly on Ms. Ng's website http:// www.eClassInfo.com/home.asp?id=RSYNg

Things you need to know to do well in this course :

All material from :

1. **Ms. Ng's notes and practice exercises on CD**

   ** All exercises on the CD are expected to be completed and handed in to Ms. Ng on the date stated.

2. **Extra material sent via email from Ms. Ng**

   **** Students are responsible for studying from all notes and websites suggested by Ms. Ng via email.

3. **Any extra worksheets and practice exams handed out in class.**

Good textbooks to use for "study" :

1. **General Chemistry**, Darrell Ebbing (any edition)

   A **very easy to read** textbook written by Ms. Ng's professor's professor.

   The Full Answer booklet is extremely helpful resource for all levels of Chemistry. (Probably, the only Chemistry text you need to have on your shelf)

   It can be purchased for $ 110 at UT Bookstores. A worthwhile investment.

2. Apex learning's **AP Chemistry** workbook

3. Barron's **AP Chemistry** workbook