



**DEPARTMENT OF ACADEMIC UPGRADING  
COURSE OUTLINE WINTER 2016**

**CH 0130 (A3, B3, & C3): Chemistry Grade 12 Equivalent- 5 (5 - 0 - 1.5)**

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**Office Hours** AS POSTED ON MY OFFICE DOOR.

**CALENDAR DESCRIPTION:**

Course concepts include thermochemical changes; electrochemical changes; chemical equilibrium focusing on acid-base systems; and chemical reactions of select classes of organic compounds. Energy changes and safety are emphasized.

**PREQUISITES:**

CH0120 (Chemistry 20), and MA0122 (Math 20-2), or MA0120 (Math 20-1) or MA0130 placement

**REQUIRED TEXT/RESOURCE MATERIAL:**

**\*\*\* General Chemistry by Ebbing 10<sup>th</sup> Edition**

**\*\*\* Chemistry 0110 Review** if you were not in SC 0110 last semester.

- **CH 0130 lab manual**
- Lab coat
- Lab notebook (250 page coiled notebook is fine do not spend the money on a real lab notebook)
- **Non-programmable calculator** – this is the only electronic device allowed during tests or exams.
- 10 quad to 1 cm graph paper are also required.

SUPPLEMENTARY TEXTS: *These textbooks are available in the A-205.* Chemistry  
0110 Review by Fraser

Chemistry: A Study of Matter by Dorin

Introductory Chemistry: Zumdahl

Basic Chemistry by Seese and Daub 7<sup>th</sup> Edition

Chemistry: A Basic Introduction by Miller 4<sup>th</sup> Edition

**DELIVERY MODE(S):** Lecture will be the main method of delivery. There is also a large laboratory component in this course.

**OBJECTIVES:**

**Thermochemical Changes:**

The following are the topics that I will be covering in this course are:

1. the first law of thermodynamics, as well as distinguishing between system, and the surroundings.
2. enthalpy, endothermic, and exothermic reactions.
3. specific heat and bomb calorimetry, the equation  $q = sm\Delta t$  or  $mC\Delta T$ , heats of formation, reaction, combustion, and neutralization and solving related problems.
4. Hess' law, the solution related problems.
5. transition state theory, activated complex, activation energy, and reaction coordinate.
6. potential energy diagrams for exothermic and endothermic reactions.
7. factors affecting rate of reaction – temperature, concentration, catalyst, collision theory.

**Chemical Equilibrium:**

The following are the topics that I will be covering in this course are:

1. irreversible and reversible reactions.
2. equilibrium, and conditions affecting equilibrium
3. equilibrium constant and factors that affect it and solution related problems.
4. Le Chatelier's principle, and apply it to predict changes to systems at equilibrium. ( $K_c$ ).

## Acids and Bases:

The following are the topics that I will be covering in this course are:

1. Arrhenius acids and bases.
2. Bronstad – Lowery concept of acids and bases, conjugate acid-base pairs in acid-base reactions.
3. neutralization reactions.
4. strong acids, and bases.
5. strength of acids and bases.
6. Lewis acids and bases.
7. definition of  $K_w$ , pH, pOH and solution related problems.
8. expressions for the ionization constants,  $K_a$  and  $K_b$ , for acids and bases.
9. acid-base indicators.
10. buffers and relationship to living systems.

## Thermochemical Changes:

The following are the topics that I will be covering in this course are:

1. oxidation, reduction, oxidizing agent, and reducing agent.
2. the determination of oxidation numbers.
3. writing oxidation and reduction skeletal half reactions, balance the reaction using half reactions.
4. balance the reactions using half reactions in an acidic or basic solution.
5. spontaneous and non-spontaneous reactions.
6. the construction of an electrochemical (also Voltaic or Galvanic) cell using a spontaneous redox reaction
7. the parts of an electrochemical cell and identify the two electrodes – the anode and the cathode
8. definition of reduction potential,  $E$  and standard reduction potential,  $E_0$
9. calculation of the standard potential difference,  $E_0$  for a cell when the standard reduction potentials of the two half-reactions making up the cell are known.

10. how to design a cell which uses a given redox reaction (or two half-reactions). Write the complete cell reaction, and calculate  $E_0$  for the cell. Draw diagram for the cell listing all the parts and showing the direction of movement of all the charges.
11. the construction and electrode reactions of common batteries.

12. definition and explanation of electrolysis and electrolytic cell, electrode reactions for the electrolysis of select molten and aqueous solutions. Discuss electroplating.
13. Faraday's laws of electrolysis, and discuss quantitative aspects of electrolysis relating charge,  $Q$ , (amount of electricity) to the current and the time.
14. solution of problems based on electrolysis.
15. corrosion, and describe methods to prevent corrosion. (as time permits)
16. how the process of trial and error was used by early people to extract metals from ores (as time permits).

### **Organic Chemistry:**

The following are the topics that I will be covering in this course are:

1. definition of organic chemistry.
2. several functional groups such as: saturated and unsaturated aliphatic, aromatic hydrocarbon compounds, alcohols, aldehydes, ketones, carboxylic acids and esters.
3. names for common organic compounds using IUPAC system. Give formulas of common organic compounds and draw their structural, condensed structural, and line diagrams.
4. definition of isomers.
5. names for saturated and unsaturated aliphatic (including cyclic) and aromatic compounds containing up to ten carbon atoms in the parent chain.
6. carbohydrates, polymer, and monomers.
7. polymerization and hydrolysis.
8. lipids proteins, biochemical reactions and enzymes, nucleic acids

### **OUTCOMES:**

**Assumed Background Knowledge:** (These topics will **NOT** be reviewed in class) Students should already:

1. be able to perform linear, quadratic, cubic, liquid-dry metric conversions.
2. know elementary atomic structure – what protons, electrons, and neutrons are and where they are in an atom.

3. be able to define atomic number, atomic mass number and how to use them to calculate the number of protons, neutrons, and electrons in an atom.
4. be able to classify of matter.
5. be able to distinguish between chemical and physical properties and changes.
6. be able to draw atomic structure diagram for the first 20 elements.
7. be able to define valence electrons and draw electron dot diagrams.

***If you are unfamiliar with these topics see me. The Chemistry 0110 Review will explain these in detail. It is available in the bookstore. There is an answer key in A-205 and in the reference section of the library.***

**In addition to the above material:** These topics will be briefly reviewed in class.

8. know nomenclature (naming compounds and writing formulae). \*\*\*Nomenclature is one of the most important topics that you will learn at the secondary level. It will NOT be reviewed at the post secondary level. If you are having trouble with this topic, get help IMMEDIATELY!!! See me!\*\*\*
9. be able to balance equations by inspection.
10. be able to solve stoichiometry problems from chemical equations including mass to moles, mass to mass, mass to volume, and visa versa. Students should also be able to determine the limiting reagent. Most importantly, students should be able to calculate molarity.

### **Thermochemical Changes:**

Students should be able to:

1. define and explain the terms: System, and the Surroundings
2. state and explain the first law of thermodynamics giving examples.
3. explain enthalpy, changes in enthalpy, exothermic and endothermic reactions.
4. write chemical equations to include enthalpy changes
5. define specific heat capacity,  $s$  or  $C$ , of a substance, and state its units
5. explain the principles and the working of bomb calorimeter, and how it can be used to determine  $\Delta H$ . Use the equation:  $q = sm\Delta T$  or  $mC\Delta T$  to solve related problems
6. define and explain the terms: Enthalpy ( $H$ ), and change in enthalpy ( $\Delta H$ ) heat (enthalpy) of reaction,  $\Delta H_r$ ; Heat (enthalpy) of formation,  $\Delta H_f$ . Standard conditions.  $r$

7. calculate the heat (enthalpy  $H$ ), of a reaction if heats (enthalpies) of formation of all the reactants and the products are given.
8. calculate the heat (enthalpy) of formation of a reactant or a product if the heat (enthalpy) of the reaction, and the heats (enthalpies) of formation of all other species are given
9. state and explain the following terms clearly: Heat of reaction, Heat of combustion, and Heat of neutralization.
10. to state the relationship between heat of formation and the heat of reaction.
11. to solve related problems.
12. to define heat (enthalpy) of combustion,  $\Delta H_c$ , of a hydrocarbon, and explain how it can be determined using bomb calorimeter. Solve related problems.
13. to state Hess' law, and demonstrate how the enthalpy of a reaction can be calculated if enthalpies of related reactions are given.
14. to solve related problems.
15. to explain in detail transition state theory, activated complex, activation energy, and reaction coordinate. To be able to draw and label diagrams for exothermic and endothermic reactions.
16. collision theory
17. to define a catalyst.
18. to explain the effect of temperature and a catalyst in the rate of reaction.

### **Chemical Equilibrium:**

Students should be able to:

1. define reversible and irreversible reactions.
2. define equilibrium, and state conditions of equilibrium.
3. define equilibrium constant, and write mathematical expression for equilibrium constant for a given reaction.
4. explain the significance of the equilibrium constant and discuss the factors that affect it
5. solve related mathematical problems.
6. state Le Chatelier's principle, and apply it to predict changes to systems at equilibrium. ( $K_c$ ).

## **Acids and Bases:**

Students should be able to:

1. define and explain Arrhenius acids and bases
2. define and explain Bronstad – Lowery concept of acids and bases
3. identify acids and bases in an acid-base reaction



- define and identify conjugate acid-base pairs in acid-base reactions
- define strength of acids and bases, and state factors that affect their strengths
- name the common strong acids and bases
- define ionization of acids and bases in water as the solvent, and write down the expressions for the ionization constants,  $K_a$  and  $K_b$ , for acids and bases
- understand and define  $K_w$  and pH and to be able to perform related calculations.
- define pH and pOH, and state the relationship between them
- calculate the pH and pOH of a given acid or a base
- define and explain buffers, and discuss their role in living systems
- define indicators and discuss their use in titrations of acids and bases

### **Electrochemistry:**

Students should be able to:

- define and explain with examples oxidation, and reduction; and oxidizing and reducing agents
- define and explain the concept of oxidation numbers (O.N.) and determine the oxidation number (O.N.) of an element in a given compound or ion using the rules for O.N.
- split a given redox reaction into two half-reactions
- balance a given skeletal redox reaction in acidic and basic media using half-reactions method.
- define spontaneous and non-spontaneous reactions.
- explain how to construct an electrochemical (also Voltaic or Galvanic) cell using a spontaneous redox reaction.
- list all the parts of an electrochemical cell and identify the two electrodes – the anode and the cathode.
- define reduction potential,  $E$  and standard reduction potential,  $E_0$
- calculate the standard potential difference,  $E_0$  for a cell when the standard reduction potentials of the two half-reactions making up the cell are known
- design a cell which uses a given redox reaction (or two half-reactions). Write the complete cell reaction, and calculate  $E_0$  for the cell. Draw diagram for the cell listing all the parts and showing the direction of movement of all the charges
- discuss the construction and electrode reactions of common batteries

12. define and explain electrolysis and electrolytic cell. Discuss the electrode reactions for the electrolysis of select molten and aqueous solutions. Discuss electroplating

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13. state Faraday's laws of electrolysis, and discuss quantitative aspects of electrolysis relating charge,  $Q$ , (amount of electricity) to the current and the time
14. solve problems based on electrolysis
15. discuss corrosion, and describe methods to prevent corrosion (as time permits)
16. describe how the process of trial and error was used by early people to extract metals from ores (as time permits)

## Organic Chemistry

Students should be able:

1. to define organic chemistry.
2. to recognize inorganic compounds containing C.
3. to recognize several functional groups such as: saturated and unsaturated aliphatic, aromatic hydrocarbon compounds, alcohols, aldehydes, ketones, carboxylic acids and esters.
4. to name common organic compounds using IUPAC system. Give formulas of common organic compounds and draw their structural, condensed structural, and line diagrams
5. Define and explain isomers.
6. to name saturated and unsaturated aliphatic (including cyclic) and aromatic compounds containing up to ten carbon atoms in the parent chain
7. to give the molecular formula of a hydrocarbon – saturated or unsaturated.
8. to define functional groups and identify common organic compounds based on their functional groups.
9. to write structural formula(s) for a compound with given molecular formula.

On completing this section, you should understand (at a basic level):

9. Carbohydrates
10. Polymer and monomers
11. Polymerization and hydrolysis
12. Lipids
13. Proteins

14. Biochemical reactions and enzymes
15. Nucleic acids

**TRANSFERABILITY:** \*\* Grade of D or D+ may not be acceptable for transfer to other post-secondary institutions. Students are cautioned that it is their responsibility to contact the receiving institutions to ensure transferability

**GRADING CRITERIA:** Regular attendance is expected of all students, and is crucial to passing this course. Students who miss classes will soon find themselves falling behind and failing. Lateness will **not** be tolerated as it interrupts the instructor and fellow classmates. As per Department Policy, if you miss 10 or more classes per semester of classes in any course, you may be debarred from the final exam for that course.

A certificate (a doctor's or a note from the funeral home) will be required to make up the midterm or final exam. **You will receive a grade of F if you miss the final.** Call if you are going to miss a test. There may be a deduction of 10% for test rewrites. The possession of any kind of listening and/or communication devices such as Cellular phones, iPhones, iPods, Tabs, Netbook, laptop computers and/or any other hand-held device capable of receiving/transmitting information falling under this category are not allowed in the room during tests or final exams. Possession of any such device could result in an F in the course.

**\*\*\*Very important:** **Laboratory attendance to each specific experiment is compulsory; a passing grade in the laboratory component is required to pass the course.** There are **NO** 'make up' labs in this course. Being absent from an experiment will result in a grade of **ZERO** for that experiment.

Lab reports must be submitted on the required date and at the **required time.**

Penalties for late **lab reports** are as follows:

5 minutes – 10%, 24 hours – 20%, after that – 100%

**Marking Scheme:**

Lab Reports:	20%
Tests:	25%
Midterm:	20%
Final Exam:	<u>35%</u>
Total	100%

<b>GRANDE PRAIRIE REGIONAL COLLEGE</b>			
<b>GRADING CONVERSION CHART</b>			
<b>Alpha Grade</b>	<b>4-point Equivalent</b>	<b>Percentage Guidelines</b>	<b>Designation</b>
<b>A+</b>	<b>4</b>	<b>90 – 100</b>	<b>EXCELLENT</b>
<b>A</b>	<b>4</b>	<b>85 – 89</b>	
<b>A-</b>	<b>3.7</b>	<b>80 – 84</b>	<b>FIRST CLASS STANDING</b>
<b>B+</b>	<b>3.3</b>	<b>77 – 79</b>	
<b>B</b>	<b>3</b>	<b>73 – 76</b>	<b>GOOD</b>
<b>B-</b>	<b>2.7</b>	<b>70 – 72</b>	
<b>C+</b>	<b>2.3</b>	<b>67 – 69</b>	<b>SATISFACTORY</b>
<b>C</b>	<b>2</b>	<b>63 – 66</b>	
<b>C-</b>	<b>1.7</b>	<b>60 – 62</b>	
<b>D+</b>	<b>1.3</b>	<b>55 – 59</b>	<b>MINIMAL PASS</b>
<b>D</b>	<b>1</b>	<b>50 – 54</b>	
<b>F</b>	<b>0</b>	<b>0 – 49</b>	<b>FAIL</b>
<b>WF</b>	<b>0</b>	<b>0</b>	<b>FAIL, withdrawal after the deadline</b>

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**It is recommended that you have a grade of 60 % or better to continue to post secondary courses**

**\*\*\*\*\* STUDENT RESPONSIBILITIES:**

Students will:

- review material that is prerequisite to this course quickly so it does not slow you down. (See Assumed Background Knowledge on pages 2 & 3. Especially the section on nomenclature.)
- be at class regularly and on time. (If you miss more than 10 per semester of classes in any course, you may be debarred from the final exam for that course.) – complete all pre class and pre-lab assignments before arriving in class.
- keep up with course material.
- if experiencing difficulties with course get help immediately.
- catch up on missed material before the next class.
- provide documentation for missed midterms or finals.
- be aware of penalty for failing the lab component and not writing the final.

**STATEMENT ON PLAGIARISM AND CHEATING:**

Refer to the College Policy on Student Misconduct: Plagiarism and Cheating at [https://www.gprc.ab.ca/files/forms\\_documents/Student\\_Misconduct.pdf](https://www.gprc.ab.ca/files/forms_documents/Student_Misconduct.pdf)

\*\*Note: all Academic and Administrative policies are available at <https://www.gprc.ab.ca/about/administration/policies/> **Course**

**Schedule/Timeline:**

Days	Topics	Required Reading
	Review: Metric conversion, atomic structure, etc.	Ebbing 10 <sup>th</sup> edition CH 0110 Review
2	Review: Nomenclature, balancing equations, stoichiometry	CH 0110 Review 89 – 93, 156 – 164

**Thermochemical Changes**

4	Thermodynamics: Definition, enthalpy, definition heat and temperature, first law of thermodynamics heat capacity, specific heat, problems.	227 – 233 240 – 241 244 – 245
4	Hess' law, solve problems	246 – 249
	<b>Reaction Kinetics</b>	
4	Transition state theory, activated complex, activation energy, and reaction coordinate. Diagrams for endothermic and exothermic reactions. Rates of reaction: Collision theory, factors affecting rates of reactions, reaction mechanisms.	534 – 571
	<b>Chemical Equilibrium</b>	
2	Chemical equilibrium: Irreversible and reversible reactions, equilibrium, equilibrium constant, factors affecting equilibrium.	509 – 619
2	LeChatelier's Principle	
1	$K_{sp}$	710 – 719
	<b>Acids and Bases</b>	
.5	Electrolytes	128 – 131
.5	Arrhenius acids	636 – 638
3	Bronstad– Lowery acids and bases, conjugate acid-base pairs	636 – 644
2	pH and pOH, calculations of pH and pOH.	647 – 663
2	Ionization of acids and bases in water, $K_a$ , $K_b$ . indicators	644 – 682
1	Buffers	686 –
1	Titration curves	693
	<b>Electrochemistry</b>	
2	Spectator ions, net ion eq'ns,	133 – 135
2	Redox, oxidation numbers (O.N.)	146 – 155
4	REDOX in acidic and basic solutions	778 – 783
3	Electrochemical cells	784 – 795

## **Organic Chemistry**

2	Hydrocarbons: alkanes, alkenes, alkynes, aromatic hydrocarbons, nomenclature, isomers	976 – 997
1	Functional groups: Alcohols, ethers, aldehydes, ketones, acids, amines, amides and nomenclature and reactions.	998 – 1003 carboxylic
1	Polymers, monomers, biochemistry	1013 – 1032