Lakeside View Global Vision
CEGEP JOHN ABBOTT COLLEGE

A. General Information

Secondary V Chemistry

Program:	Pathways	Instructor:	Jean-Michel Régimbal
Course Number:	202-001-RE	Office:	Not applicable
Ponderation:	3-3-3	Tel:	Not applicable
Semester	Fall 2020	Office Hours:	Videoconferencing by appointment
Credits:	$2\ ^{2}/_{3}$		
Classrooms:	Not applicable	Email:	Use MIOs
Lectures:	T-Th 14:30-15:50		
Workshops:	F 8:30-11:30 *or*13:00-16:00		

Prerequisite: Sec. IV Science and Technology or Sec. IV Applied Science and Technology or Make-Up Environmental Science and Technology 982-003-50

B. Introduction

The course will be taught specifically as a preparation for Chemistry of Solutions, 202-NYB-05, the first chemistry course of the Science Program, but is also designed with the student who will never do another chemistry course in mind. Given the exceptional circumstances due to the COVID-19 pandemic, the course is offered entirely online, with no physical laboratory component.

In keeping with the Quebec high school exit profile, students must gain a mastery of the following competency: analyze the behavior of matter and the transformation of energy using principles of chemistry. This will be achieved in this course by covering the following elements which will not necessarily follow the same order as outlined below:

1. **Analyzing a chemical system for what is present**

   This section will include some very basic ideas concerning atomic and molecular structure and will rely heavily on some well-established patterns revealed in the traditional periodic table of the elements. Simple concepts of chemical bonding will be considered, followed by the system of naming compounds that is related to these bonding patterns. Since most reactions of chemical significance occur in solution, the nature of chemical species in aqueous solution will be considered here as well.

   The balanced chemical equation, the mole as a measure of chemical quantity, and the so-called 'IRE Table' as a tool for analyzing chemical systems will provide the framework for this section of the course. The three principal sources of mole calculations (from pure liquids and solids, from gases, and from solutions) will also involve the discussion and use of properties such as density, the ideal gas law and various concentration terms.

2. **Analyze the behavior of an ideal gas and its properties**

   The student will be introduced to the concept of the kinetic theory of gases, the ideal gas law, the law of partial pressures, as well as correct application of laws involving pressure, temperature, volume and molar quantities.

3. **Analyze energy changes in a chemical reaction**

   The student will learn how to correctly produce an energy diagram and accurately interpret its components. The student will also learn how to determine the molar heat of a reaction using Hess' law or calorimetric calculations, and correctly interpret the enthalpy change of a system or reaction.

4. **Explain reaction rates**

   The student will be able to explain the effects of the following on reaction rates: the nature of the reactants, concentration, surface area, temperature and catalysts. The student will also make appropriate use of rate laws.

5. **Solve problems related to the concept of equilibrium of a reaction**

   The student will develop statements for the algebraic expression of a reaction's equilibrium constant (auto-ionization of water, acidity, alkalinity, solubility-product), predict the behavior of equilibrium systems that are disturbed (Le Châtelier's principle), make use of equilibrium expressions to determine the concentration of reactants and products at equilibrium and understand the relationship between pH and the molar concentrations of either hydroxide or hydronium ions in a solution.

6. **Carry out experiments to verify several laws and principles of chemistry**

   The student will learn to implement an experimental procedure, analyze results using uncertainty, as well as interpret and communicate these results.

C. Course Objective(s)

For students to be chemically 'literate', whether for the purpose of simply being able to cope with the world around them, or for the purpose of pursuing further studies in chemistry or other scientific disciplines, certain fundamental ideas, patterns and even facts must not only be studied, but 'owned'. To this end, the objectives of this course are to help the student acquire knowledge and understanding of several basic chemical concepts and to encourage the learning of some material beyond this core.

D. Evaluation Plan

There are two options that are given with respect to course evaluation (as follows):

Option 1

Assessment	*Course objectives*	*Tentative date*
Unit Tests (three tests of equal value) – 30%	Test 1 –1.1-3.4 Test 2 – 3.5-3.14 Test 3 – 4.1-7.7	1st October 5 November 8 December
Final Exam – 30%	All Objectives	Final exam period
Assignments, quizzes and online activities – 40%	All Objectives	Weekly

Option 2

- Final Exam 60%
- Assignments, quizzes and online activities 40%

Please Note:

a) The final exam is scheduled during the college's final exam period. Students must be available to write the exam during this period.
b) Every effort will be made to ensure equivalence amongst the various sections of the course.
c) The student will receive the better of the two options automatically**.**
d) If an in-class unit test is missed with valid reason(s) and cannot be re-scheduled, the missing mark will be transferred to the final exam (Option 1 becomes final exam 40%, remaining unit tests 20%). Failure to write two or more tests with a valid reason automatically defers the student's evaluation to Option 2.
e) Late assignments are automatically assessed a 10% penalty to the assigned grade. For every subsequent 24-hour period the assignment is late, an additional 10% penalty is applied. Once the students' grades for an assignment have been released, or the assignments somehow returned, unsubmitted assignments will receive an automatic grade of zero.
f) The final exam and the three unit tests constitute the final evaluation.
g) The tests and exams will be offered online. No need to come to JAC for them.

E. Course Contents

Topic 1—The Basics

1.1. Define the term chemistry.
1.2. Define and recognize the various elements of the scientific method and explain how each step relates to proper experimental design.
1.3. Define matter and list its properties in each of the three standard phases: solid, liquid and gas.

1.4. Classify matter as either a pure substance (element, compound) or a mixture (homogeneous or heterogeneous solution).
1.5. Define the term element. Memorize the one or two letter codes for the first 36 elements, as well as barium, iodine, gold, silver, cadmium, mercury, tin.
1.6. Identify and correctly write the formulae of the diatomic elements (iodine, hydrogen, nitrogen, bromine, oxygen, chlorine, fluorine).
1.7. Classify the elements as either metals, metalloids or non-metals.
1.8. Classify the elements as alkali metals, alkaline earth metals, transition metals, halogens or noble gases.
1.9. List Dalton's postulates of the atom and correct his original statements that have since been changed following more recent scientific evidence.
1.10. Draw and identify the nucleus, protons, neutrons, electrons, electron cloud, valence shell and orbits in the Bohr-Rutherford model of an atom.
1.11. Correctly identify the charges of main group element ions, as well as the polyatomic ions nitrate, nitrite, sulfate, sulfite, carbonate, hydrogen carbonate, phosphate, hydroxide, acetate and ammonium.
1.12. Identify molecules, ionic compounds and covalent/molecular compounds.
1.13. Draw ionic and covalent compounds, at a molecular level, in any one of the three main phases of matter.
1.14. Name or write the formulae of binary ionic or covalent compounds using the IUPAC naming system.
1.15. Explain why water is a polar molecule.
1.16. Recognize acids and bases and identify from their chemical formulae if they are weak or strong.
1.17. Explain and draw what happens to soluble ionic compounds, molecular compounds, acids and bases (both weak and strong) when dissolved in water.
1.18. Define the term electrolyte. Recognize from a molecular formula whether a compound is a strong, weak or non-electrolyte.
1.19. Write appropriate chemical equations describing the dissociation of electrolytic compounds.
1.20. State, and apply the law of mass conservation in the context of balancing chemical equations, presented as either unbalanced chemical equations or as a description in words.
1.21. Predict the products and write a balanced chemical equation (molecular/formula, complete ionic or net ionic) for a precipitation or neutralization (including gas-forming) reaction.

Topic 2—Measurements

2.1. Apply the rules of significant figures to measurements and to calculations involving these measurements.
2.2. Define the term uncertainty and identify the uncertain digit in measurements
2.3. Convert between different scales from the SI unit system – giga-, mega-, kilo-, deci-, centi-, milli-, micro-, nano-.
2.4. Assess whether data is accurate and/or precise. Identify possible causes for imprecision or inaccuracy of data.

Topic 3—Stoichiometry

3.1. Define the mole and the Avogadro constant.
3.2. Determine the average atomic/molecular mass of an element or compound.
3.3. Convert between units of atoms/molecules, moles and mass of a pure substance.
3.4. Define the term molarity.
3.5. Convert between the number of moles of solute, the volume of a solution and the molarity of a solution.
3.6. Develop a protocol for preparing a solution of desired molarity or volume starting from a pure solute. Calculate the mass of the solute needed to prepare a solution of desired molarity and volume, or vice versa.
3.7. Determine a protocol for preparing a solution of desired molarity through the process of dilution. Calculate the molarity of a diluted solution.
3.8. Quantify the amount and/or molarity of a specific ion in a solution containing one or more electrolytic substances.
3.9. Produce and balance a chemical equation described in words.
3.10. Assuming ideality, calculate the amount of any substance/solution in a chemical reaction based a known quantity of reactant or product. Calculate the theoretical yield of one or more products.
3.11. Account for the amounts of any reactant or product in a chemical reaction using an IRE (initial, reaction, end) table.
3.12. Explain the effects of limiting and excess reactants on a chemical process. Explain how a limiting reactant impacts the potential of a reaction to occur.
3.13. Account for the amounts of reactants/products involved in a chemical reaction where a limiting reactant is present.
3.14 Given experimental data, calculate the percent yield of a reaction.

Topic 4—Gases

4.1. Define pressure. Convert between units of kilopascals, torr, atmospheres and bars.
4.2. Convert between units of degrees Celsius and kelvins.
4.3. Explain Avogadro's law and the relationship between the volume and number of moles of a gas present in a system, at constant pressure.
4.4. Explain Charles' law and the effect of temperature on the volume of a gas, at constant pressure.
4.5. Explain Boyle's law and the effect of pressure on the volume occupied by a gas, and vice versa, at constant temperature.
4.6. Using the combined gas law, predict changes in the pressure, volume and temperature of a gas when one or more of these parameters have changed.
4.7. Explain the ideal gas law. Using the ideal gas law, determine the pressure, volume, temperature or number of moles of gas present in a system.
4.8. Explain what is meant by 'standard temperature and pressure'.
4.9. Explain Dalton's law of partial pressures and calculate the partial pressure of a gas when it is present in a mixture.
4.10. Use the ideal gas law to determine the number of moles, the volume or the pressure of a gaseous reactant/product in a chemical reaction.
4.11. List the assumptions about the behaviour of an ideal gas, according to kinetic molecular theory.

Topic 5—Thermodynamics

5.1. Define the terms heat, enthalpy, exothermic and endothermic.
5.2. Explain heat changes to a system (the reaction) and its surroundings over the course of a chemical or physical change.
5.3. Determine how much heat is produced or absorbed over the course of a chemical reaction and how it scales, given an amount of reactant or product.
5.4. Label and explain the features of a reaction coordinate diagram (initial and final heat, change in heat, activation energy, reverse activation energy, transition state).
5.5. Recognize or draw a reaction coordinate diagram for an endothermic or exothermic reaction.
5.6. Calculate the enthalpy change, activation energy and reverse activation energy for a reaction.
5.7. Explain Hess' law. Using a series of chemical equations with known heats of reaction, determine the enthalpy change for a chemical process.

Topic 6—Equilibrium

6.1. Define dynamic equilibrium. Describe what occurs when a reaction is in a dynamic equilibrium.
6.2. Explain the difference between a reversible and an irreversible reaction. Recognize from a chemical equation whether it is reversible (⇆) or irreversible (→).
6.3. State the law of mass action and determine the equilibrium expression, K, based on a balanced chemical equation.
6.4. Explain the difference between homogeneous and heterogeneous equilibrium. Write an appropriate law of mass action for either of these cases.
6.5. Predict the ratio of product to reactant present at equilibrium based on a value of K for a chemical reaction (less than 1, approximately 1, greater than 1).
6.6. Using equilibrium concentrations of reactants and products, determine the value of K.
6.7. Using an initial molarity of reactants (provided there are no products), calculate the equilibrium concentrations of all reactants and products in an equilibrium system.
6.8. Recognize when to apply and how to justify the use of the '5% rule' in calculating equilibrium concentrations of reactants and products.
6.9. Define the acid, K_a, and base, K_b, dissociation constants. Determine the law of mass action for the dissociation of weak acids and bases.
6.10. Explain the relationship between K_a and acid strength, and K_b and base strength.
6.11. Calculate the pH or pOH of an acid or base.
6.12. Based on the pH, pOH, $[H^+]$ or $[OH^-]$, determine if a solution is acidic, basic or neutral.
6.13. Define Le Châtelier's Principle.
6.14. Apply Le Châtelier's Principle to predict how a system in dynamic equilibrium will respond to a stress, notably, the removal or addition of reactants or products, temperature changes or changes to pressure and volume.

Topic 7—Kinetics

7.1. Define the terms rate of reaction and rate of production.
7.2. Calculate how the rates at which different reactants are consumed, and different products are formed, are related to each other.

7.3. Explain how the temperature, the molarities of reactants and products, the molecularity and complexity of the reactants or products affect the rate of a reaction (the collision model).
7.4. Explain the relationship between the forward and reverse reactions rates when a system is in dynamic equilibrium.
7.5. Define the term catalyst and explain its role in speeding up a chemical reaction.
7.6. Determine the rate law for a chemical reaction and its rate constant, k, using concentration vs. time data (the integrated rate law).
7.7. Calculate the half-life of a reaction.

F. Required Text and Course Costs

Flowers, P., Theopold, K., Langley, R., Robinson, W. R. *Chemistry 2e*. OpenStax 2020. Available for free at https://openstax.org/details/books/chemistry-2e.

There is no cost specific to the course. The students are expected to already have access to the IT hardware, software and Internet connection necessary to participate in distance education.

H. Methodology

The course will be taught using online lectures as well as activities. Some activities will simulate laboratory exercises to reinforce course material and expose the student to a practical approach to the scientific method.

Homework assignments will be made available online.

Lectures: 45 hours
Two 1.5-hour online lectures per week, consisting of the introduction of new material, usually accompanied by the working of sample problems both individually and/or in groups.

Workshop Sessions: 45 hours
One three-hour workshop session per week, to be used as a combination of simulated lab work, exercise sessions and online office hours. There will be no traditional chemistry experiments that would normally be carried out due to the current COVID-19 pandemic.

I. Chemistry Department Policies

1. Attendance policy: (*Policy 6*) Students are expected to attend all lecture and laboratory sessions. Students are responsible for all assigned work, lecture material and other course related material announced or assigned during class.

> Addendum from the College: Due to the COVID-19 health crisis, attendance policies may need to be adjusted by your teacher. The normal attendance expectations are outlined

above, and your teacher will inform you of any modifications as needed. Please note that attendance continues to be extremely important for your learning, but your teacher may need to define it in different terms based on the way your course is delivered during the fall semester.

J. College Policies

Policy No. 7 – IPESA, Institutional Policy on the Evaluation of Student Achievement: http://johnabbott.qc.ca/ipesa

a) Changes to Evaluation Plan in Course Outline (Article 5.3). Changes require documented unanimous consent from regularly attending students and approval by the department and the program dean.

b) Religious Holidays (Articles 3.2.13 and 4.1). Students who wish to miss classes in order to observe religious holidays must inform their teacher of their intent in writing within the first two weeks of the semester.

c) Student Rights and Responsibilities (Articles 3.2.18 and 3.3.6). It is the responsibility of students to keep all assessed material returned to them and/or all digital work submitted to the teacher in the event of a grade review. (The deadline for a Grade Review is four (4) weeks after the start of the next regular semester.)
Student have the right to receive graded evaluations, for regular day division courses, within two weeks after the due date or exam/test date, except in extenuating circumstances. A maximum of three (3) weeks may apply in certain circumstances (ex. major essays) if approved by the department and stated on the course outline. For evaluations at the end of the semester/course, the results must be given to the student by the grade submission deadline (see current Academic Calendar).

d) Cheating and Plagiarism (Articles 9.1 and 9.2). Cheating and plagiarism are unacceptable at John Abbott College. They represent infractions against academic integrity. Students are expected to conduct themselves accordingly and must be responsible for all of their actions.

College definition of Cheating: Cheating means any dishonest or deceptive practice relative to examinations, tests, quizzes, lab assignments, research papers or other forms of evaluation tasks. Cheating includes, but is not restricted to, making use of or being in possession of unauthorized material or devices and/or obtaining or providing unauthorized assistance in writing examinations, papers or any other evaluation task and submitting the same work in more than one course without the teacher's permission. It is incumbent upon the department through the teacher to ensure students are forewarned about unauthorized material, devices or practices that are not permitted.

College definition of Plagiarism: Plagiarism is a form of cheating. It includes copying or paraphrasing (expressing the ideas of someone else in one's own words), of another

person's work or the use of another person's work or ideas without acknowledgement of its source. Plagiarism can be from any source including books, magazines, electronic or photographic media or another student's paper or work.

Additional College Policies due to the current COVID-19 health crisis

Please note that course outlines may be modified if health authorities change the access allowed on-site.

In addition to LEA, Teams and Moodle, additional software may be used for the submission of essays or projects or for testing. Further details will be provided if applicable.

Classes on Teams may be recorded by your teacher and subsequently posted on Teams to help for study purposes only. If you do not wish to be part of the recording, please let your teacher know that you wish to not make use of your camera, microphone or chat during recorded segments. Any material produced as part of this course, including, but not limited to, any pre-recorded or live video is protected by copyright, intellectual property rights and image rights, regardless of the medium used. It is strictly forbidden to copy, redistribute, reproduce, republish, store in any way, retransmit or modify this material. Any contravention of these conditions of use may be subject to sanction(s) by John Abbott College.

Tentative timetable (15 weeks of courses spread over 17 calendar weeks)

Week	Topics
'0'	First workshop: course outline
1	The basics, measurements and stoichiometry (Topics 1, 2 and parts of 3)
2	
3	
4	
5	
6	Stoichiometry and **Unit Test I***
7	Stoichiometry, gases and thermodynamics (Rest of topic 3, plus topics 4 and 5)
8	
9	
10	
11	Thermodynamics and **Unit Test II***
12	Equilibrium and kinetics (Topics 6 and 7)
13	
14	
15	
'16'	**Unit Test III***

* Reminder: test dates are tentative.