JOHN ABBOTT
CEGEP/COLLEGE

Secondary V Chemistry

Program:	Pathways	Instructor:	
Course Number:	202-001-50	Office:	
Ponderation:	3-2-3	Tel:	
Semester:	Fall 2019	Office Hours:	
Credits:	$2\,^2/_3$	Email:	
Competency:	01PU	Lecture:	
		Laboratory:	

A. 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 NYB, the first chemistry course of the Science Program, but is also designed with the student who will never do another chemistry course in mind. It will be divided between the laboratory and classroom.

In keeping with the Quebec high school exit profile, students must gain a mastery of the following competency 01PU: Analyze the behaviour of matter and the transformation of energy using the principles of chemistry.

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 a number of basic chemical concepts and to encourage the learning of some material beyond this core. This will be achieved in this course by covering the following elements which will not necessarily follow the same order as outlined below:

Competency Code: 01PU

Performance	*Standard*	
Statement of the Competency		
Analyze the behaviour of matter and the transformation of energy using the principles of chemistry.		
Elements of the Competency	**Performance Criteria**	
1. Analyze the behaviour of an ideal gas based on its properties.	1. Accurate description of the behaviour of gases using the Kinetic theory 2. Correct application of laws involving pressure, volume, temperature and the number of moles 3. Correct application of the ideal gas law 4. Correct application of the law of partial pressures	
2. Analyze the energy changes in a	1. Correct production of an energy diagram and accurate	

chemical reaction.	interpretation of its components
	2. Accurate determination of the molar heat of a reaction (e.g. Hess's law, calorimetry)
	3. Appropriate interpretation of the enthalpy change
3. Explain the reaction rate.	1. Appropriate explanation of the effect of the following factors on the reaction rate: nature of the reactants, concentration, surface area, temperature and catalyst
	2. Appropriate use of the rate law
4. Solve problems related to the concept of the equilibrium of a reaction.	1. Correct statement of the algebraic expression of a reaction's equilibrium constant (e.g. water ionization, acidity, alkalinity, solubility-product)
	2. Appropriate prediction of the behaviour of systems in a state of equilibrium that are subjected to variations in concentration, temperature and pressure, using Le Chatelier's principle
	3. Appropriate use of the relationship between the equilibrium constant of a reaction and the concentration of products and reactants
	4. Correct interpretation of the value of the equilibrium constant
	5. Appropriate use of the relationship between the pH and the molar concentration of hydronium and hydroxide ions
5. Carry out an experiment to verify several laws and principles of chemistry.	1. Appropriate implementation of an experimental procedure
	2. Appropriate determination of the uncertainty related to measurements
	3. Accurate interpretation of results
	4. Appropriate communication of results

D. Methodology:
Lectures: 45 hours

Two 1.5-hour lectures per week, consisting of the introduction of new material, usually accompanied by the working of sample problems both individually and/or in groups. In addition, preparation for upcoming laboratory sessions will be discussed during lecture time (if required).

Laboratory Sessions: 45 hours

One 3-hour laboratory session per week. These sessions will include practice in the basic techniques of experimental chemistry, experiments designed to verify certain properties of solutions, and experiments that illustrate the properties of some reactions that occur in solution. The chemistry laboratories are well-equipped with computers interfaced with various instruments and students will be trained in their use. These laboratory sessions will also be useful for term tests and final exam preparation.

E. Required Texts:
Introductory Chemistry Package ISBN 00099006253. (~$50 at the bookstore)

F. Laboratory Requirements:
- *Safety glasses must be worn at all times in the laboratory.* Good quality safety glasses are available from the bookstore (~ $10) or from most hardware stores. Normal prescription glasses may be worn.
- A sturdy cotton lab coat or lab apron is required. (~ $25 at the bookstore).
- A Hilroy notebook (32 pages minimum, included in course notes package).

G. Evaluation:

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

<u>Option 1</u>

Assessment		*Date*	*Course Competencies*	*Course Content*
Unit Test 1	10%	Week 6	1, 2	1.1 – 3.4
Unit Test 2	10%	Week 10	1, 2	3.5 – 3.14
Unit Test 3	10%	Week 15	2, 3, 4	4.1- 7.7
Final Exam	30%	Exam Period	All	1.1 – 7.7
Laboratory	20%	Weekly	5	
Assignments and quizzes	20%	TBA	All	

<u>Option 2 – Same objectives as above</u>

- Final Exam   60%
- Laboratory   20%
- Assignments & Quizzes   20%

Please Note:
a) The final exam is scheduled during the college's Exam Period. Students must be available to write the exam during this period.
b) To pass the laboratory portion of the course, a minimum of 60% of the total laboratory grade must be obtained. Failing this, a laboratory grade of **<u>zero</u>** will be given and a maximum grade of 55 will be allowed for the course.
c) Every effort will be made to ensure equivalence amongst the various sections of the course.
d) The student will receive the better of the two options automatically. **It should be emphasized, however, that it is unusual for a student to do better on the final examination than on term work.**
e) 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.
f) 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. When graded assignments have been handed back to the class, unsubmitted assignments will receive an automatic grade of zero.
g) The final evaluation for this course is comprised of the Final Exam (30% - Option 1) and the Laboratories (20%).

H. Course Costs:
The major course costs are specified above.

I. Teaching Methods:
The course will be taught using the following pedagogical approaches: lectures, in-class activities and group projects. Laboratory exercises will be used to reinforce course material and to expose the student to a practical approach to the scientific method.

Homework assignments will be made available in class.

J. Departmental Policies:
a) Regular attendance is expected. If lectures are missed, it is the responsibility of the student to cover the material missed and to be aware of any announcements made concerning assignments, quizzes, tests or changes to the laboratory schedule.
b) Students must attend the laboratory session in which they are officially registered.
c) If you miss an evaluation session or deadline due to illness, you must notify your instructor as soon as possible. A valid medical note is required to prove absence for a medical reason. If a major evaluation is missed for a valid reason, then the final exam may be used as the alternate major evaluation. Late homework policy will be determined by individual teachers.
d) Periodically there will be workshops held during the laboratory period. Attendance is required. Quizzes or assignments may be given during these workshops.
e) **A special note concerning the use of chemicals:** this course uses chemicals as part of its normal teaching practices. If a student has experienced allergic reactions in the past due to any particular chemical or chemicals he or she must inform the instructor. In the event that an allergic reaction is experienced at the college, the student should report to Campus Security immediately (local 6911, or 514-457-6911).
f) Cell phones and computers may only be used during class for pedagogical purposes. Note that computers are available in class for any activities requiring the use of the internet.

K. College Policies:

Policy No. 7- IPESA, Institutional Policy on the Evaluation of Student Achievement

http://departments.johnabbott.qc.ca/wp-content/uploads/2017/08/Policy-7-IPESA.pdf

a) Changes to Evaluation Plan in Course Outline (Article 5.3).
All changes to evaluation plan in the course outline must have documented unanimous consent from the regularly attending students affected by the change(s) before submission.
b) Evaluation (Article 6)
Teachers should evaluate and enter grades for a sufficient number of assessments in Gradebook in order that the College may advise DEC students of their progress by mid semester as per the ACADEMIC PROCEDURE: Academic Progress by Mid Semester.
c) Religious Holidays (Article 3.2)
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.
d) Student Rights and Responsibilities (Article 3.2 and Article 3.3)

It is the responsibility of students to keep a copy of all assessed material returned to them and/or all digital work submitted to the teacher for at least four (4) weeks past the grade submission deadline (See current Academic Calendar) in the event that they request a Final Grade Review (Refer to Article 8).

Students 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.

e) Cheating and Plagiarism (Article 9)

Cheating and plagiarism are serious infractions against academic integrity which is highly valued at the College; they are unacceptable at John Abbott College. 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.

L. Course Content:

Section 1

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, semi-metals 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, ammonium.

1.12.   Identify molecules, ionic compounds, covalent/molecular compounds.

1.13.   Draw ionic and covalent compounds, at a molecular level, in any one of the 3 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 or strong) when dissolved in water.

1.18.   Define the term electrolyte. Recognize from a molecular formula whether or not 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 reactions, 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, neutralization or gas-forming reaction.

Section 2

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 S.I. unit system – giga-, mega-, kilo-, deci-, centi-, milli-, micro-, nano-.

2.4.   Assess whether or not data is accurate and/or precise. Identify possible causes for imprecise or inaccurate data.

Section 3

3.1.   Define the mole and Avogadro's number.

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 a limiting and excess reactant 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.

Section 4

4.1.   Define pressure. Convert between units of kPa, Torr and atmospheres.

4.2.   Convert between units of degrees Celsius and Kelvin.

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.

Section 5

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.

Section 6

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 or not it is reversible ($\rightarrow$) or irreversible ($\leftrightarrows$).

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 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 Chatelier's Principle.

6.14.   Apply Le Chatelier's Principle to predict how a system in dynamic equilibrium will respond to a stress, notably, the removal or addition of reactants or products, heat changes or changes to pressure and volume.

Section 7

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.

Tentative timetable

Lectures	Topics
1-2	The scientific method, basics of chemistry and matter
3	Nomenclature, the law of mass conservation
4	Double-displacement reactions
5	Chemical quantities
6	Stoichiometry , **Unit Test I***
7	Limiting reagents
8	Molarity, chemistry of solutions
9	Energy and heat
10	Ideal gas laws, **Unit Test II***
11	Le Chatelier's principle, equilibrium
12-13	Acids and Bases
13-14	Kinetics
15	Kinetics, **Unit Test III***

* These are tentative <u>or</u> approximate scheduled Unit Tests I, II & III dates.