Lakeside View Global Vision
CEGEP JOHN ABBOTT COLLEGE

John Abbott Science Program 200.BO

***General Chemistry I**: The Chemistry of Solutions*

A. General information:

Program:	Science	Instructor:	
Course Number:	202-NYB-05	Office:	
Ponderation:	3-2-3	Telephone:	
Credits:	$2\ ^{2}/_{3}$	E-mail:	
Competency:	To analyze the properties of solutions and reactions in solution (00UM)	Lecture:	
		Lab (2 hours):	
		Classroom:	
Prerequisite:	Sec.V Chem.(>70%)	Laboratory room:	
Semester:	Fall 2015		
Office Hours:			

B. Introduction:

General Chemistry I is the first of two chemistry courses required by the Science Program and is normally taken in the first semester. It is specifically designed to fulfill the requirements of objective **00UM** of the Science Program. Studying and working with phenomena they can experience directly, and with which they are already somewhat familiar, students will be provided with a thorough description of the properties of solutions and the chemical processes that occur in them. A rationale for these properties in terms of atomic and molecular structure then follows in General Chemistry II.

The vast majority of chemical processes take place in solution, including those of biological systems, industry and in the home. The course encourages students to relate the chemistry they study to the world in which they live. The course also involves developing problem-solving strategies; the student will be given many opportunities to exercise logical deduction and mental discipline, and to appreciate the way simple mathematics is a fundamental part of chemical language.

The laboratory is designed to allow the student to investigate and confirm properties of solutions and to study certain chemical processes occurring in solution. It is a normal part of the laboratory to use computers to both collect and analyze data.

The Program Approach and the Exit Profile

This course is part of the **Science Program**, an interrelated sequence of courses that seeks to demonstrate not only the integrity of each science discipline, but also an integrated understanding of science as a whole. These issues will be addressed, but not specifically addressed, in this course, and the student will be assisted in understanding where this particular course fits into the Program as a whole. In addition, while program competencies other than **00UM** will not be specifically assessed, the student should realize that many **Exit Profile** goals are being implicitly addressed and assessed in the course, if only at a fairly simple level; in particular: to apply a scientific method (3), to apply a systematic approach to problem solving (4), to use a computer to gather and analyze data (5), to reason logically (6), to communicate effectively (7) and to apply knowledge to new situations (14).

C.Objectives

Statement of the Competency

To describe and analyze properties of solutions and reactions that occur in solutions (00UM)**.**

STANDARDS

General Performance Criteria:

- Appropriate use of concepts, laws and principles
- Appropriate use of terminology
- Adequate understanding of chemical situations encountered
- Rigour and coherence in problem solving methods
- Validation of approximation when required
- Correct design and/or application of experimental procedures
- Adherence to safety and environmental protection regulations
- Validation of the contents of the laboratory report
- Logical discussion of results
- Estimation of uncertainties
- Quality of suitable presentation of experimental results

Elements of the Competency

1. To analyze the colligative properties of solutions.
2. To solve problems related to kinetics of reactions in solution.
3. To solve problems related to chemical equilibria.
4. To verify experimentally certain properties of solutions.
5. To determine experimentally some characteristics of reactions which occur in solutions.

Specific Performance Criteria:

Specific performance criteria for each of the elements of the competency are shown below, with the corresponding **Intermediate Learning Objectives**. *For the items in the list of learning objectives, it is understood that each is preceded by:*

'The student is expected to be able to…'

D. Evaluation Plan

Assessment	Ponderation*	Elements of the Competency (cf. p. 2)
Unit Test I	10%	3
Unit Test II	10%	1, 2
Unit Test III	10%	3
Final Exam	30%	1, 2, 3
Laboratories	25%	4, 5
Quizzes and assignments	15%	1, 2, 3

*Base ponderation. Cf. following paragraphs for exceptions. The ponderation of individual laboratory experiments, quizzes and assignments are at the discretion of each teacher. Your teacher is responsible for letting you know ahead of time how much each one will be worth.

Please Note:

a) A student may drop the lowest unit test mark, if it is lower than the final exam mark, so that the remaining unit tests are worth 20% of the final grade, and the final exam is worth 40% of the final grade. This is not available for a student assigned a grade of zero on a unit test because of cheating.

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 **zero** will be given and a maximum grade of 55% will be allowed for the course.

c) Notwithstanding other class grades, if a student passes the laboratory portion of the course, a grade of 60% or more on the final exam will guarantee a pass in the course.

d) Every effort will be made to ensure **equivalence amongst the various sections** of the course. Laboratory experiments are common to all sections, common policies are used with respect to replacement of term grades with final exam marks, the requirements of lab projects are reviewed by the course committee, the standard required to pass the course is that of the common text used, and the final exam is both agreed upon and graded by all members of the course committee.

E. Course Content

Specific Performance Criteria	**Intermediate Learning Objectives**
1. Simple Chemical Reactions in Solution	
1.1. Use of the particulate nature of matter and stoichiometry to describe and analyze some simple chemical reactions in aqueous solution	1.1.1. Describe the following fundamental particles: atom, molecule, ion, electron.
	1.1.2. Describe the nature of solids, liquids and gases in terms of the motions of the fundamental particles.
	1.1.3. Define the terms: element, pure substance, mixture, compound, molecular compound, and ionic compound.
	1.1.4. Describe the species present when these compounds dissolve in water.
	1.1.5. Write formulas for basic chemical substances – chemical nomenclature.
	1.1.6. Count amounts of substance present, using the 'mole' concept.
	1.1.7. Define molarity and molality.
	1.1.8. Describe how to prepare solutions of specific molarity from pure

Ch. 1* 1.1, 1.3-1.5
Ch. 2 2.4 (p.38-41), 2.6, 2.7
Ch. 3 3.1-3.4, 3.6, 3.7
Ch. 4 4.2, 4.4, 4.5,

*** References from N. J. Tro *et al.* (Canadian Ed.)**

4.7-4.9 **Ch. 12** 12.5 (p. 495- 496) **Ch. 15** 15.2, 15.3, 15.6 (p. 635-637), 15.4, 15.5 and 15.7: (strong acid and base only)	substances and from other solutions (dilution). 1.1.9. Recognize and classify various irreversible processes, specifically electron transfer and double replacement reactions. 1.1.10. Write balanced chemical equations representing the processes described above: 'net ionic equations'. 1.1.11. Define: limiting and excess reactant, theoretical, actual and percent yield. 1.1.12. Solve problems involving irreversible processes, using basic principles of stoichiometry and 'IRF' tables. 1.1.13. Examine Brønsted-Lowry definition of acids and bases. 1.1.14. Define pH with respect to strong acids and bases.
1.2. Use of proper terminology to describe the nature of aqueous solutions **Ch. 4** 4.3 **Ch. 9** 9.4 (p. 332-334)	1.2.1. Define weak, strong and non-electrolyte – predict their conductivity. 1.2.2. Correlate the definition of an electrolyte to the definition of solubility. 1.2.3. Correlate the definition of electrolyte to the definition of weak and strong aci and bases.
1.3. Investigation of Redox systems **Ch. 4** 4.6 (p. 115-116, 118-120) **Ch. 18** 18.3, 18.4, 18.8	1.3.1. Identify oxidation and reduction reactions. 1.3.2. Determine the products of electrolysis, and identify the oxidizing agent and t reducing agent. 1.3.3. Examine and distinguish between electrolytic and voltaic cells. 1.3.4. Calculate standard cell potentials.
1.4. Analysis of colligative properties of solutions **Ch. 11** 11.5 (p. 436-442), 11.6, 11.8 **Ch. 12** 12.6 (p. 501-502, 507-512), 12.7	1.4.1. Examine phase equilibria through phase diagrams. 1.4.2. Compare qualitatively the effects of molecular and ionic solutes on vapour pressure of the solvent, and the freezing and boiling points of the solvent. 1.4.3. Calculate ΔT_b and ΔT_f. 1.4.4. Discuss in detail the measurement and calculation of osmotic pressure. 1.4.5. Discuss the van't Hoff factor ('*i*'), and link to different types of electrolytes. 1.4.6. Use colligative properties to determine molar masses.

2. <u>Chemical Kinetics</u>

2.1. Definition of rate of reaction and interpretation of the rate law **Ch. 13** 13.1-13.3	2.1.1. Define rate of reaction in terms of the rate of disappearance of reactants a the appearance of products. 2.1.2. Write the rate law for a given reaction. 2.1.3. Define and interpret 'order' of reaction and 'rate constant' of a reaction.
2.2. Measurement of the rate of reaction, order of reaction and the specific rate constant **Ch. 13** 13.4	2.2.1. Design experimental methods to determine rate of reaction. 2.2.2. Use simple zero-, first- and second- order integrated rate laws to determine the order of reaction and the rate constant. 2.2.3. Use a 'swamping' technique to collect kinetics data for a multi-reactant reaction. 2.2.4. Define and use the concept of 'half-life'.
2.3. Discussion of chemical reactions and the factors that affect the rate at which they occur. **Ch. 13** 13.5 13.7 (p.558)	2.3.1. Describe a reaction in terms of collisions between reacting particles. 2.3.2. Discuss rate of reaction in terms of rate of collisions, rate of effective collisions, and the energy of activation, as described by collision theory. 2.3.3. Interpret and discuss a simple reaction progress diagram, showing the relative energies of reactants and products, and the energy of activation. 2.3.4. Discuss the effect on the rate of reaction of concentrations of reactants, energy of activation, temperature and a catalyst. 2.3.5. Use the Arrhenius equation to relate the rate of a reaction to the temperature and the activation energy.

2.4 Investigation of reaction mechanism **Ch. 13** 13.6	2.4.1 Explain 'reaction mechanism'; Rate laws, elementary steps, reaction intermediates rate determining steps and overall reaction rate laws
3. <u>Chemical Equilibrium</u>	
3.1. Description of chemical equilibrium in qualitative and quantitative terms **Ch. 14** 14.1-14.3: (K_c only) 14.4-14.8 (from concentrations only)	3.1.1. Define chemical equilibrium and the equilibrium position. 3.1.2. Distinguish between reversible and essentially irreversible processes. 3.1.3. Define the equilibrium constant, *K*, and the reaction quotient, *Q*. 3.1.4. Quantitatively apply Le Châtelier's principle. 3.1.5. Solve problems involving reversible processes using "IRE" tables.
3.2. Investigation of acid/ base chemical equilibria **Ch. 15** 15.1-15.9 (p.622-645, p.647-657) **Ch. 16** 16.1-16.3	3.2.1. Distinguish between weak and strong acids in terms of their reactions with water, and relate to conjugate pairs. 3.2.2. Define pH and pOH, and K_w. 3.2.3. Solve problems concerning the pH of aqueous solutions by analyzing the acid/ base equilibria of particles in solution. 3.2.4. Demonstrate an awareness of the approximations used in pH calculations and the limitations of the methods. 3.2.5. Demonstrate an awareness of the species present at any stage of an acid/ base situation and the factors that control the pH. 3.2.6. Recognize why salts may have a non-neutral pH, and explain the pH in terms of the reaction of the salts with water. 3.2.7. Estimate and calculate the pH of salts. 3.2.8. Understand what a buffer is and how it works; calculate the pH of buffers both before and after the addition of acid or base. 3.2.9. Examine qualitatively some polyprotic acids.
3.3. Description and analysis of aqueous acid/ base titration curves to illustrate acid/ base equilibria **Ch. 16** 16.4	3.3.1. Describe and compare the titration curves for strong and weak acids vs. bas and strong and weak bases vs. acid, with emphasis on: – the species affecting the pH throughout the titration. – pH at the equivalence point (calculated and measured). – the determination of pK_a (or pK_b) from a titration curve. – the changes when polyprotic acids or mixtures of acids are titrated.
3.4. Applications of equilibrium systems **Ch. 16** 16.5	3.4.1. Define precipitation as an equilibrium process. 3.4.2. Demonstrate an awareness of the common ion effect. 3.4.3. Predict how the pH will affect the solubility of various slightly soluble salts.

<u>Tentative time table for the above objectives</u>:
Sections 1.1-1.3 weeks 1-5.
Sections 1.4-2.4 weeks 6-10.
Sections 3.1-3.4 weeks 11-15.

F. Required Texts:

*Chemistry: A Molecular Approach (Canadian Ed.), Nivaldo J. Tro, Travis D. Fridgen, Lawton E. Shaw, Pearson Prentice Hall ($180)
*Chemistry NYB Lab Manual, John Abbott College ($4.30)

G. Bibliography:

Determined by individual teacher.

H. Teaching Methods

The course will be 75 hours, divided into Lecture and Laboratory periods, as follows:

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. In addition, preparation for upcoming laboratory sessions will be discussed during lecture time.
Laboratory Sessions: 30 hours.
One 2-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 equipped with computers interfaced with various instruments and students will be trained in their use. Periodically, laboratory sessions will be used for workshops that will help the student cope with course material.

Laboratory Requirements

* *Safety glasses must be worn at all times in the laboratory.* Good quality safety glasses are available from the bookstore (about $7 at the JAC Bookstore) or from most hardware stores. Normal prescription glasses may be worn.
* A sturdy cotton lab coat or lab apron is required (about $20 at the JAC Bookstore).
* An instructor may require the student to purchase additional materials, such as a laboratory notebook or course notes.

I. Departmental Attendance Policy:

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) There will be no make-up tests, quizzes or laboratory periods. 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 test is missed for a valid reason, then the final exam mark will be used as a basis for a substitute for the missed test mark. 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 5226, 5231, or 9-514-398-7777).
f) Cell phones and computers may only be used during class for pedagogical purposes.
g) Students are expected to behave respectfully towards their classmates and teachers. In case of inappropriate behavior a student will be asked to leave the class or the lab session. If an assessment is planned for this session, a mark of zero will be given in that case.

J. College Policies:

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

a) **Changes to Evaluation Plan in Course Outline** (Article 4.3 in IPESA)
Changes to the evaluation plan, during the semester, requires unanimous consent.

b) Mid-Semester Assessment MSA (Article 3.3)
All students will receive an MSA in accordance with College procedures.

c) **Religious Holidays** (Article 3.2)

Students who wish to observe religious holidays must inform their teacher in writing within the first two weeks of the semester of their intent.

d) **Student Rights and Responsibilities** (Article 3.2, item 19, and article 3.3, item 7)

It is the responsibility of students to keep all assessed material returned to them for at least one month in the event of a grade review. (The deadline for a Grade Review is 4 weeks after the start of the next regular semester.)

Students have the right to receive the results of evaluation, for regular day division courses, within two weeks. For evaluations at the end of the semester/course, the results must be given to the student by the grade submission deadline.

e) **Cheating and Plagiarism** (Article 8.1 & 8.2)

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.

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.

Plagiarism

Plagiarism is a form of cheating. It includes the intentional 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.