Adult Basic Education
Science

Chemistry 2102C

Solutions and Organic Chemistry

Curriculum Guide

Prerequisites: Chemistry 1102
Chemistry 2102A
Chemistry 2102B

Credit Value: 1

Chemistry Concentration

Chemistry 1102
Chemistry 2102A
Chemistry 2102B
Chemistry 2102C
Chemistry 3102A
Chemistry 3102B
Chemistry 3102C

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To the Instructor

I. Introduction to Chemistry 2102C

Chemistry 2102C is the fourth course in the Chemistry Concentration in the Adult Basic Education program. **Chemistry 1102, 2102A and 2102B are pre-requisites to Chemistry 2102C.**

The first part of this course introduces (or reviews) the basic concepts of solutions. It goes on to teach students how to calculate the concentrations of solutions and how to apply their stoichiometry skills (developed in 2102A) to chemical reactions that involve solutions.

The second part of this course introduces organic chemistry, the study of molecular compounds of carbon. Students will discover the amazing variety of organic compounds in their bodies and their lives. They will come to appreciate the need for a systematic naming scheme. They will learn how to name organic compounds and how to draw their structures. They will discover how the classification of organic molecules into different family groups depends on the type of bonding and atoms present.

The knowledge and skills that students acquire in this course are essential for the remainder of the ABE Chemistry courses. Therefore, **Chemistry 2102C is a pre-requisite for all remaining chemistry courses in the chemistry concentration.**

II. Curriculum Guides

Each new ABE Science course has a Curriculum Guide for the instructor and a Study Guide for the student. The Curriculum Guide includes the specific curriculum outcomes for the course. Suggestions for teaching, learning, and assessment are provided to support student achievement of the outcomes. Each course is divided into units. Each unit comprises a **two-page layout of four columns** as illustrated in the figure below. In some cases the four-column spread continues to the next two-page layout.

To the Instructor

Curriculum Guide Organization:
The Two-Page, Four-Column Spread

Unit Number - Unit Title	Unit Number - Unit Title

Outcomes Specific curriculum outcomes for the unit.	**Notes for Teaching and Learning** Suggested activities, elaboration of outcomes, and background information.	**Suggestions for Assessment** Suggestions for assessing students' achievement of outcomes.	**Resources** Authorized and recommended resources that address outcomes.

III. Study Guides

The Study Guide provides the student with the name of the text(s) required for the course and specifies the sections and pages that the student will need to refer to in order to complete the required work for the course. It guides the student through the course by assigning relevant reading and providing questions and/or assigning questions from the text or some other resource. Sometimes it also provides important points for students to note. (See the *To the Student* section of the Study Guide for a more detailed explanation of the use of the Study Guides.) The Study Guides are designed to give students some degree of independence in their work. Instructors should note, however, that there is much material in the Curriculum Guides in the *Notes for Teaching and Learning* and *Suggestions for Assessment* columns that is not included in the Study Guide and instructors will need to review this information and decide how to include it.

IV. Resources

Essential Resources

Text: Chemistry; Mustoe, Jansen, et al; McGraw-Hill Ryerson; 2004.

Recommended Resources

Teacher's Resource for McGraw-Hill Ryerson Chemistry (including CD-Rom).

To the Instructor

Website for the text:
http://www.mcgrawhill.ca/school/booksites/chemistry/index.php

Chemistry 11/12 Computerized Assessment Banks.

Other Resources

Center for Distance Learning and Innovation:
http://www.cdli.ca/

Department of Education website:
http://www.ed.gov.nl.ca/edu/sp/chem_2202.htm

V. Recommended Evaluation

Written Notes	10%
Labs/Assignments	20%
Test(s)	20%
Final Exam *(entire course)*	50%
	100%

The overall pass mark for the course is 50%

Solutions
and Organic Chemistry

Unit 1 - Introduction to Solutions

Outcomes

1.1 Identify examples of solutions and name their solutes and solvents.

- 1.1.1 Define solution, solvent, and solute.
- 1.1.2 Differentiate between a concentrated and a dilute solution.
- 1.1.3 Define aqueous solution.
- 1.1.4 Define miscible and immiscible.
- 1.1.5 Differentiate between a saturated and unsaturated solution.
- 1.1.6 Explain the difference between soluble, insoluble, and slightly soluble.

1.2 Explain solution formation in terms of intermolecular forces between polar, ionic, and non-polar substances.

- 1.2.1 List the factors that affect the rate of dissolving.
- 1.2.2 Explain why most ionic solids dissolve in water.
- 1.2.3 List factors that affect solubility.

Notes for Teaching and Learning

This section introduces fundamental terms related to solutions. Some students may already be familiar with these terms.

Students need to understand the difference between rate of dissolving and solubility and the factors that affect each.

This unit includes an introduction to solubility curves. Students should be able to read information from a graph that shows solubility of various substances plotted against the temperature of the solution.

Unit 1 - Introduction to Solutions

Suggestions for Assessment

Questions 1.1 - 1.6 in the Study Guide should be assigned to cover Outcome 1.1. Students will find the answers to these questions in Section 7.1 of the text.

Students should make a list of the new vocabulary words that they are expected to know from this unit.

Questions 1.7 - 1.13 in the Study Guide should be assigned to cover Outcome 1.2. Students will find the answers to these questions in Section 7.2 of the text.

Resources

MGH Chemistry, pages 236 - 241.

Chemistry 11/12 Computerized Assessment Bank for MGH Chemistry.

Unit 2 - Solutions and their Concentrations

Outcomes

2.1 Use solution data and data treatments to facilitate interpretation of solubility.

2.1.1 Define concentration in terms of molarity (moles per litre of solution).

2.1.2 Calculate, from empirical data, the concentration of solutions in moles per litre, and determine mass or volume from such concentrations.

2.1.3 Calculate, from empirical data, the concentration of diluted solutions, and the quantities of a solution and water to use when diluting.

Notes for Teaching and Learning

Full solutions for all *Practice Problems* are in the *Solutions Manual* on the *Teacher's Resource* CD-ROM.

Instructors should emphasize that concentration is expressed in terms of solute dissolved in the solution.

Unit 2 - Solutions and their Concentrations

Suggestions for Assessment

Questions 2.1 - 2.7 in the Study Guide should be assigned to cover Outcome 2.1. Students will find the answers to these questions in Sections 7.2 and 7.3 of the text.

Students may be directed to page 279 to find the answers to Practice Problems and Section Review Questions so that they can check their answers. Instructors should check their workings to make sure they are doing the problems correctly.

Resources

MGH Chemistry, pages 255 - 276.

Unit 3 - Solution Stoichiometry

Outcomes

3.1 Describe and identify combinations of aqueous solutions that result in the formation of precipitates.

- 3.1.1 Define precipitate.
- 3.1.2 Use general solubility guidelines to predict solubility of ionic compounds in water.
- 3.1.3 Predict the formation of precipitates when aqueous solutions are mixed.
- 3.1.4 Define spectator ions and net ionic equation.
- 3.1.5 Write balanced net ionic equations for aqueous ionic reactions.

3.2 Solve stoichiometry problems that involve aqueous solutions.

- 3.2.1 Define dissociation equation.
- 3.2.2 Write dissociation equations for dissolved substances.
- 3.2.3 Use the mole ratios from dissociation equations for ionic solids to calculate the concentration of an

Notes for Teaching and Learning

Most students will need a review of some concepts that they learned in the first Chemistry course (Chemistry 1102). They will need to be reminded of the symbols that are used in chemical reactions to indicate the state of a substance. They will also need to be reminded of what is meant by a double displacement reaction and the general formula for a double displacement reaction.

Instructors should ensure that students are provided with a copy of the 'Solubility Rules for Ionic Compounds in water at 25°C' and that they know how to use it to predict the formation of a precipitate.

The calculations in this unit require students to recall concepts and techniques about the mole and stoichiometry that they learned in Chemistry 2102A. Most students will need review of these topics in order to complete the calculations.

Unit 3 - Solution Stoichiometry

Suggestions for Assessment

Questions 3.1 - 3.2 in the Study Guide should be assigned to cover Outcome 3.1.1 and 3.1.2. Students will find the answers to these questions in Section 8.1 of the text.

Questions 3.3 - 3.6 in the Study Guide should be assigned to cover Outcome 3.1.3 and 3.1.5. Students will find the answers to these questions in Section 8.2 of the text.

Students have now come to the end of the section of the course on solutions (Units 1,2, and 3). Instructors may give a test at this point. This test could be used as part of the evaluation for the course.

Resources

MGH Chemistry, pages 281 - 286.

MGH Chemistry, pages 288 - 298.

Chemistry 11/12 Computerized Assessment Bank for MGH Chemistry.

Unit 4 - Introduction to Organic Compounds

Outcomes

4.1 Explain the large number and diversity of organic compounds with reference to the unique nature of the carbon atom.

- 4.1.1 Compare organic and inorganic compounds.
- 4.1.2 Define hydrocarbon.
- 4.1.3 Explain the wide diversity of organic compounds in terms of carbon's bonding capacity, ability to form multiple bonds, and ability to bond in a variety of stable, relatively unreactive structures.
- 4.1.4 List natural sources of organic compounds.

4.2 Demonstrate ways to represent organic molecules.

- 4.2.1 Define structural diagram and draw structural diagrams (include complete structural diagram, condensed structural diagram, and line structural diagram).
- 4.2.2 Define and illustrate expanded molecular formula.
- 4.2.3 Define isomer.

Notes for Teaching and Learning

Students should recognize the diversity of organic compounds. Of the millions of compounds known to humans, the vast majority are molecular compounds of carbon. Students could be reminded of different molecules they have heard about from biology courses, food sources, pesticides, petroleum products, pharmaceuticals, and other everyday sources.

In order to better understand molecular shapes in organic molecules, instructors may have students work through the *ExpressLab*, *Molecular Shapes*, page 329.

The possibility of more than one structure for a single molecular formula is isomerism. It is a key reason for the tremendous diversity of organic compounds.

Unit 4 - Introduction to Organic Compounds

Suggestions for Assessment

Questions 4.1 - 4.6 in the Study Guide should be assigned to cover Outcomes 4.1 - 4.2. Students will find the answers to these questions in the introduction to Chapter 9 and Sections 9.1 - 9.2 of the text.

Instructors should assess the student's level of understanding by reading student answers to questions from the Study Guide and providing feedback

Instructors will find questions that may be used for review, reinforcement and/or assessment in the Section Review, Chapter Review and Unit Review in the text. There are *Additional Practice Problems* found on the *Teacher's Resource CD-Rom*.

Full solutions for all *Practice Problems* are in the *Solutions Manual* on the *Teacher's Resource* CD-ROM..

Resources

MGH Chemistry, pages 320 - 329.

Teacher's Resource for MGH Chemistry (including CD-Rom).

Website for the text: http://www.mcgrawhill.ca/school/booksites/chemistry/index.php

Department of Education website: http://www.ed.gov.nl.ca/edu/science_ref/chem2202.htm

The center for distance learning and innovation website: http://www.cdli.ca/

Unit 4 - Introduction to Organic Compounds

Outcomes

4.2.4 Recognize the common molecular shapes of organic molecules.

4.3 Demonstrate an understanding of the system for classifying organic compounds.

4.3.1 Differentiate between pure hydrocarbons and hydrocarbon derivatives on the basis of composition.

4.3.2 Differentiate between aliphatic and aromatic hydrocarbons.

4.4 Classify aliphatic compounds into alkanes, alkenes and alkynes based on their names or structures.

4.4.1 Describe the trend in boiling points of hydrocarbons as the number of C's increase.

4.4.2 Describe the solubility of these compounds in water.

4.4.3 Define and be able to give examples of saturated and unsaturated hydrocarbons.

4.4.4 Write the general formulae for alkanes, alkenes (1 double bond), alkynes (1 triple bond).

Notes for Teaching and Learning

Students should be aware of the general way of classifying organic compounds summarized in Figure 9.1 on page 331. Since this unit of Chemistry 2102C is meant to give a students an introduction to organic chemistry, students should distinguish between hydrocarbons and hydrocarbon derivatives and between aliphatics and aromatics at this point in the course. The emphasis in this unit will be on aliphatic hydrocarbons; alkanes, alkenes and alkynes since they are the simplest organic compounds. They provide a good context in which fundamental organic topics can be studied.

The outcomes for this unit are covered in Chapter 9 of the text. Since only parts of the chapter are covered, instructors should indicate to students which parts of the chapter are important. Students may become overwhelmed with the reading of the chapter if they think that they are meant to know all the material that is in there.

It is sufficient for the students to define aromatic compounds as containing at least one benzene ring.

The general formula of each compound group is listed below:

Alkanes:	C_nH_{2n+2}
Alkenes:	C_nH_{2n}
Alkynes:	C_nH_{2n-2}

Unit 4 - Introduction to Organic Compounds

Suggestions for Assessment

Questions 4.10 - 4.17 in the Study Guide should be assigned to cover the section on alkanes. Students will find the answers to these questions in Section 9.3 of the text.

Questions 4.18 - 4.22 in the Study Guide should be assigned to cover the section on alkenes. Students will find the answers to these questions in Section 9.3 of the text.

Questions 4.23 - 4.27 in the Study Guide should be assigned to cover the section on alkynes. Students will find the answers to these questions in Section 9.3 of the text.

Instructors should assess the student's level of understanding by reading student answers to questions from the Study Guide and providing feedback.

Resources

MGH Chemistry, pages 331 - 355.

Unit 4 - Introduction to Organic Compounds

Outcomes

4.5 Write the formula and provide the IUPAC name for a variety of organic compounds.

- 4.5.1 Name all the prefixes for 1 to 10 carbons in a compound or alkyl group.
- 4.5.2 Write names and molecular formulae and draw structural diagrams using the IUPAC rules for the alkanes, alkenes, and, alkynes.

4.6 Write and balance chemical equations for the complete combustion of hydrocarbons.

Notes for Teaching and Learning

Students should be able to name the prefixes for 1 to 10 carbons in a compound. They can demonstrate this by naming the first 10 straight-chain alkanes.

This course does not explore in depth the reactions of various hydrocarbons. The only chemical reaction that is examined is the complete combustion of hydrocarbons.

Unit 4 - Introduction to Organic Compounds

Suggestions for Assessment

The following questions from the Chapter 9 Review, pages 371 - 373, could be assigned to assess students' understanding of the concepts covered so far in this unit: #'s 3, 6, 10, 11 (a) and (c), 12, 13, 14, 15, 29 (b), 30 (a).

Resources

MGH Chemistry, pages 331 - 355.

Unit 5 - Hydrocarbon Derivatives

Outcomes

5.1 Classify hydrocarbon derivative compounds into alcohols, aldehydes, ketones, organic acids, esters, amines and amides based on their names or structures.

- 5.1.1 Define functional group.
- 5.1.2 Identify alcohols, aldehydes, ketones, organic acids, esters, amines and amides from their names and the functional groups in their structural formulae.
- 5.1.3 Write structural formulas for representatives of hydrocarbon derivative compounds.

5.2 Describe the relationship between intermolecular forces for organic structures investigated.

- 5.2.1 Distinguish between the melting and boiling points of hydrocarbon derivatives and hydrocarbons (of the same size).

Notes for Teaching and Learning

The outcomes for this unit are covered in Chapter 10 of the text. Since only parts of the chapter are covered, instructors should indicate to students which parts of the chapter are important. Students may become overwhelmed with the reading of the chapter if they think that they are meant to know all the material that is in there.

Hydrocarbon derivatives are generally polar compared to hydrocarbons of the same size. For this reason, hydrocarbon derivatives generally have higher melting points and boiling points compared to their hydrocarbon analogs.

The Teacher's Resource that accompanies the text has a good section on the Chemistry background needed for this unit.

Unit 5 - Hydrocarbon Derivatives

Suggestions for Assessment

Questions 5.1 - 5.10 in the Study Guide should be assigned to cover Outcomes 5.1 - 5.2. Students will find the answers to these questions in the introduction to Chapter 10 and Sections 10.1 - 10.3 of the text.

Instructors should assess the student's level of understanding by reading student answers to questions from the Study Guide and providing feedback.

Students could do question #7 (a), (d), and (f) for review and assessment of their knowledge for this unit.

A final exam that tests all the outcomes for the course should be given. It is suggested that the final exam would be worth at least 50% of the final mark for the course.

Resources

MGH Chemistry, pages 376 - 400.