

# Chemistry 2102A

## Stoichiometry

### Curriculum Guide

**Prerequisites:** Chemistry 1102

**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 2102A

Chemistry 2102A is the second course in the Chemistry Concentration in the Adult Basic Education program. **Chemistry 1102 is a pre-requisite to Chemistry 2102A.**

In Chemistry 1102, students studied chemistry in a qualitative sense. They learned how to name and write formulas for ionic and molecular compounds. This course is an introduction to the quantitative aspect of chemistry. Stoichiometry is the mole to mole relationship in a balanced equation.

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

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

Unit Number - Unit Title		Unit Number - Unit Title	
<b>Outcomes</b>  Specific curriculum outcomes for the unit.	<b>Notes for Teaching and Learning</b>  Suggested activities, elaboration of outcomes, and background information.	<b>Suggestions for Assessment</b>  Suggestions for assessing students' achievement of outcomes.	<b>Resources</b>  Authorized and recommended resources that address outcomes.

## To the Instructor

### 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).*

*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](http://www.ed.gov.nl.ca/edu/sp/chem_2202.htm)

## To the Instructor

### V. Recommended Evaluation

Written Notes	10%
Labs/Assignments	20%
Test(s)	20%
Final Exam ( <i>entire course</i> )	<u>50%</u>
	100%

**The overall pass mark for the course is 50%.**





# **Stoichiometry**

## Unit 1 - The Mole and Molar Mass

### Outcomes

1.1 Define isotope and use isotopic notation (carbon-12 or  ${}^{12}_{6}\text{C}$ )

1.2 Explain the relative nature of atomic mass.

1.2.1 Define atomic mass unit (u).

1.2.2 Define average atomic mass.

1.3 Identify the Avogadro constant as the factor for converting between the mole and the number of atoms, ions, formula units or molecules.

1.3.1 Recognize that moles are not a directly measurable quantity.

1.3.2 Define the mole as the number of atoms (Avogadro's number) in exactly 12 g of the carbon-12 isotope.

1.4 Perform calculations converting between the number of particles and the number of moles for elements and compounds.

### Notes for Teaching and Learning

Instructors should note that Chapter 1, *Studying Matter and Its Changes*, of the text book for this course is not covered in Chemistry 2102A. The material in Chapter 1 was covered in Science 1102. It is essential that students understand the concepts and that they are familiar with the terminology covered in Chapter 1. Therefore, they **must complete Science 1102 before starting Chemistry 2102A**. If students have previously completed 1102, it will be necessary to review the material from Chapter 1 of MHR Chemistry.

## Unit 1 - The Mole and Molar Mass

### Suggestions for Assessment

Questions 1.1 - 1.9 in the Study Guide should be assigned to cover Outcomes 1.1 - 1.4. Students will find the answers to these questions and the methods for solving problems in Sections 2.1 - 2.2 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*.

Instructors could direct students to the text website. It contains Study Quizzes for Chapter 2 that students could use for self assessment.

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

For additional practice, instructors could copy and give students Blackline Master 2-1.

The Center for Distance Learning and Innovation (CDLI) website provides lessons designed for students in high school who will take the Chemistry 2201 course through distance learning. Much of the material available on this site would be useful for use in delivery of this Adult Basic Education course. Instructors who wish to access this site must obtain a username and password.

### Resources

MGH Chemistry, pages 42 - 55.

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](http://www.ed.gov.nl.ca/edu/science_ref/chem2202.htm)

The center for distance learning and innovation (CDLI) website:

<http://www.cdli.ca/>

Blackline Master 2-1, 'The Mole Box/Skill Builder'.

## Unit 1 - The Mole and Molar Mass

### Outcomes

1.5 Define molar mass and perform mole-mass inter-conversions for pure substances.

1.5.1 Define molar mass.

1.5.2 Calculate the molar mass of compounds.

1.5.3 Define STP and the molar volume of a gas at STP.

1.5.4 Perform calculations converting between the number of particles, moles, volume of gas at STP and mass of various substances.

1.6 Demonstrate an understanding of empirical and molecular formulas.

1.6.1 Define empirical formula.

1.6.2 Define molecular formula.

1.6.3 Given a molecular formula, write the empirical formula.

1.6.4 Given the empirical formula and molar mass of a compound, write the molecular formula.

### Notes for Teaching and Learning

Instructors might look at calculations for the correct use of units and organization/planning of responses.

Significant figures are addressed and expected to be mastered in level 1 mathematics and Physics 1106.

Correct use of significant figure is important, but time should be spent on understanding problem solving as opposed to time on significant figure rules.

Since it is not required for students to study Avogadro's Law, it is suggested that they use the ratio method for solving gas problems.

Students will need a basic understanding of empirical and molecular formulas; what they are and how to determine a molecular formula from the empirical formula and the molar mass.

## Unit 1 - The Mole and Molar Mass

### Suggestions for Assessment

Questions 1.10 - 1.17 in the Study Guide should be assigned to cover Outcome 1.5.1 - 1.5.2. Students will find the answers to these questions and the methods for solving problems in Sections 2.3 of the text.

Questions 1.18 - 1.21 in the Study Guide should be assigned to cover Outcome 1.5.3 - 1.5.4. Students will find the answers to these questions and the methods for solving problems in Sections 2.4 of the text.

Questions 1.22 - 1.25 in the Study Guide should be assigned to cover Outcome 1.6. Students will find the answers to these questions and the methods for solving problems in Sections 3.2 and 3.3 of the text.

Instructors could assign selected questions from Chapter 2 and Chapter 3 Review to assess students' mastery of the material covered so far.

Instructors could provide Blackline Master 2-2, 'Chapter 2 Test', to check students understanding of the concepts and skills learned in Chapter 2.

Instructors could also use some of the material available on the CDLI site for review and assessment.

Students have now covered about half of the course. Instructors may give a test here that could be used as part of the evaluation for the course. The computerized assessment bank that accompanies the text provides lots of questions that could be used for testing purposes.

### Resources

MGH Chemistry, pages 55 - 64.

MGH Chemistry, pages 66 - 73.

MGH Chemistry, pages 87 - 88 and 95 - 97.

Blackline Master 2-2,  
'Chapter 2 Test'.

Chemistry 11/12  
Computerized Assessment  
Banks.

## Unit 2 - Quantities in Chemical Reactions

### Outcomes

2.1 Identify mole ratios of reactants and products from balanced chemical equations.

2.1.1 Identify the mole ratios of reactants and products in a chemical reaction as the coefficients in a balanced equation.

2.1.2 Define mole ratio, and use mole ratios to represent the relative amounts of reactants and products involved in a chemical reaction.

2.1.3 Explain how the Law of Conservation of Mass allows chemists to write chemical equations and make accurate predictions using chemical equations.

2.1.4 Define stoichiometry.

2.1.5 Given the mass of a reactant and the balanced equation, determine the mass or volume of other reactants and products.

### Notes for Teaching and Learning

It is essential that students know how to recognize properly written and balanced chemical equations in order to complete Unit 2 of this course. Writing and balancing equations was covered in Science 1102. It will be necessary for most students to do some review before going further. **However, students will not be expected to write and balance equations for their work in stoichiometric calculations. Instructors should provide the balanced equations for the problems that are assigned in this unit.** (See outcome 2.1.5.)

Because of the many types of calculations possible, stoichiometric problem-solving may be a difficult task for students to master. Basically, all stoichiometry problems have three steps (some of which may not even be necessary). Step one: calculate the moles of the known substance. Of course, this depends on what information is given. Step two: predict moles of the unknown (mole ratio). Step three: calculate the amount of the unknown required (depends on what the problem asks).

## Unit 2 - Quantities in Chemical Reactions

### Suggestions for Assessment

Questions 2.1 - 2.8 in the Study Guide should be assigned to cover Outcome 2.1. Students will find the answers to these questions and the methods for solving problems in Sections 4.1 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*.

Instructors could direct students to the text website. It contains Study Quizzes for Chapter 4 that students could use for self assessment.

Instructors could also use some of the material available on the CDLI site for review and assessment.

### Resources

MGH Chemistry, pages 110 - 127.

## Unit 2 - Quantities in Chemical Reactions

### Outcomes

2.2 Perform calculations involving limiting reactants in chemical equations.

2.2.1 Define limiting reactant and excess reactant.

2.2.2 Identify the limiting reactant in a chemical reaction.

2.2.3 Predict the quantity of product in chemical reactions when the amount of the reactants is fixed.

2.3 Perform an investigation to predict and observe a limiting reactant.

2.4 Identify a practical problem (the study of gypsum) that involves technology where chemical equations are used.

### Notes for Teaching and Learning

Instructors should direct students to read through ThoughtLab, *'The Limiting Item'*, page 129, as a concrete example of limiting reactant.

The concept of limiting and excess reactants is examined qualitatively in Investigation 4-A, *'Limiting and Excess Reactants'*. If instructors want to complete the applications section of the investigation, they can use Blackline Master 4-1, *'Magnesium and Hydrochloric Acid Demonstration'*. Instructors should refer to the Teacher's Resource for tips on the lab.



## Unit 2 - Quantities in Chemical Reactions

### Suggestions for Assessment

Questions 2.9 - 2.11 in the Study Guide should be assigned to cover Outcome 2.2. Students will find the answers to these questions and the methods for solving problems in Sections 4.2 of the text.

Outcome 2.3 is covered by completion of Investigation 4-A, '*Limiting and Excess Reactants*'. Instructors should make it clear to students what is expected for the write-up of the lab. The mark assigned for the lab report should be used as part of the evaluation for the course.

Students should write a comprehensive final exam for the course. The exam should be worth at least 50% of the final mark.

### Resources

MGH Chemistry, pages 128 - 135.

**Core Lab:** Investigation 4-A, '*Limiting and Excess Reactants*', p. 132.

Chemistry 11/12  
Computerized Assessment  
Banks.