Adult Basic Education
Science

Chemistry 2102B

From Structures to Properties

Study Guide

Prerequisite: Chemistry 1102
Chemistry 2102A

Credit Value: 1

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

Chemistry Concentration

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

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To the Student

I. Introduction to Chemistry 2102B

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

This course studies bonding in detail. It examines the different forces of attraction involved in matter and how they influence properties. You will investigate the structure and properties of atoms, ions, and molecules, and the natural and synthetic products that result from their interactions.

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

To the Student

II. Use of Science Study Guides

Before beginning this course, ensure you have the text and any other resources needed *(see the information in the Introduction to this course for specifics)*.

As you work through the Study Guide, you will see that it is divided according to the Units listed in the Table of Contents. When you open a unit it will have the following components:

Reading for this Unit:
Here you will find the chapters, sections and pages of the text you will use to cover the material for this unit. Skim the sections of the textbook, look at the titles of the sections, scan the figures and read any material in the margins. Once you have this overview of the unit, you are ready to begin. Do not be intimidated by the content. You will work through the text, section by section, gaining knowledge and understanding of the material as you go.

References and Notes	**Work to Submit**
This left hand column guides you through the material to read from the text. Read any highlighted notes that follow the reading instructions. The symbols ▶▶ direct you to the questions that you should complete when finished a reading assignment..	You come across three (3) headings in this right hand column. **Writing:** This section comprises your notes for the unit. Here you will find either written questions or references to specific questions or problems from your text. You may want to write out each question followed by the answer. This material should be checked by your instructor before moving on to the next unit. Mathematical problems should have their solutions checked as you go. **Laboratory:** This section indicates if there is a Core Lab that should be completed for the unit. Let the instructor know in advance that you will be ready for the lab. A lab report should be submitted for each Core Lab. Your instructor will provide guidelines as to how s/he wants the report written. **Assignment:** This section indicates if there is an assignment that should be completed for the Unit. The information in the "References and Notes" column will indicate how you obtain the assignment. These assignments frequently relate the science content to technology, society and the environment.

III. 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%.

Unit 1 - Chemical Bonding

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit: *Chemistry*

Chapter 5:	Introduction:	page 158
	Section 5.1:	pages 159 - 164
	Section 5.2:	pages 165 - 172
	Section 5.3:	pages 174 - 180

References and Notes

Read pp. 158 - 160. Then complete questions 1.1 - 1.3 ▶▶

Work to Submit

Writing:

1.1 Name three (3) metals that exist in nature as a single element and briefly describe some properties of each.

1.2 Into what two (2) groups can compounds be classified?

1.3 Copy and complete the table below:

Property	Ionic Compound	Molecular Compound
state at room temperature		
melting point		
electrical conductivity		
solubility in water		
conducts electricity when dissolved in water		

Unit 1 - Chemical Bonding

References and Notes	Work to Submit
Read pages 162 and 163 carefully. Then complete questions 1.4 - 1.9 ▶▶	**Writing:** 1.4 What is a chemical bond? 1.5 Define valence electrons. 1.6 What are Lewis structures? 1.7 Draw Lewis structures for lithium, nitrogen, argon, cesium, barium, iodine, and radium. 1.8 Complete practice problems 1 and 2 , p. 164. 1.9 Which electrons, paired or unpaired, are likely to participate in bonding?
Read pages 165 - 166 carefully and study Figures 5.5, 5.6, and 5.7. Then answer questions 1.10 - 1.13 ▶▶	1.10 Why do noble gases **not** form bonds? 1.11 a) Explain the octet rule. b) Why does the octet rule **not** apply to hydrogen? 1.12 Using the octet rule and the group number, predict the ionic charge for ions in the following groups: 1 (IA) 2 (IIA) 16 (VIA) 17 (VIIA) 1.13 Complete Practice Problem 3, page 167.
Notes: *Remember that an **empirical formula** shows the lowest whole number ratio of atoms of each element in a compound.* *It is incorrect to say "molecules of NaCl". The terms molecule and molecular are **never** used in reference to ionic compounds.*	

Unit 1 - Chemical Bonding

References and Notes

Read 'What is an Ionic Bond?', pp. 167 - 168 and study figures 5.8 and 5.9. Then answer questions 1.14 and 1.15 ▶▶

Note:
*An **empirical formula** for an ionic compound is called a **formula unit**. Any time you see the term formula unit, you know it refers to an ionic compound.*

Read pages 167 - 169. Study carefully Figures 5.11 - 5.14 and the Sample Problem, 'Drawing Lewis Structures'. Then complete question 1.16 ▶▶

Note:
*Remember that **molecular compounds** contain atoms of **non-metal elements** only.*

Read page 171 and study Figure 5.15. Then answer questions 1.17 - 1.18 ▶▶

Work to Submit

Writing:

1.14 Define ionic crystal lattice.

1.15 Why are chemical formulas for ionic compounds referred to as empirical formulas?

1.16 a) Define covalent bond.
b) Define bonding electron pairs and lone pairs.
c) Define:
single covalent bond,
double covalent bond,
triple covalent bond.

1.17 Complete Practice Problems 4 - 6, page 170.

1.18 a) What is a structural formula?
b) Draw the structural formula for each of the following:
CH_4
O_2
CO_2
N_2
Cl_2

Unit 1 - Chemical Bonding

References and Notes

Read pages 171 - 172. Then answer questions 1.19 - 120 ▶▶

Read pages 174 - 180 and study carefully Figures 5.17 - 5.21. Then answer questions 1.21 - 1.27 ▶▶

Note:
Make sure that you understand the notation used in the margin on page 177.

Answers to the 'Practice Problems' and 'Section Review' are on pages 182 - 183. Check your answers and make sure you are clear on how to do each type of problem before you move on.

See your instructor to discuss any additional work, including review, that may be required for this unit.

Work to Submit

Writing:

1.19 Define metallic bond.

1.20 Describe the "free electron" model for metallic bonding.

1.21 Define electronegativity.

1.22 a) Describe the trends in electronegativity within periods and families of the periodic table.
b) How are the trends in electronegativity in the periodic table related to the trends in size?

1.23 Define polar and non-polar covalent bonds.

1.24 Define bond dipole.

1.25 Complete Practice Problems 7-9, page 178.

1.26 Define bond energy.

1.27 Complete questions 3 and 4 in Section Review, page180.

Unit 2 - Structure and Properties of Substances

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit:	*Chemistry*	
	Chapter 6:	Introduction: page 184
		Section 6.1: pages 185 - 196
		Section 6.2: pages 202 - 210
	Chapter 7:	Introduction: page 236
		Section 7.1: pages 237 - 241
		Section 7.2: pages 243 - 254

References and Notes	**Work to Submit**
	Writing:
Read the Introduction to Chapter 6 and 'Covalent Bonds and Molecules', pages 184 - 186. Referring to the instructions for drawing Lewis structures on page 186, complete questions 2.1 - 2.4 from the column on the right ▶▶	2.1 Draw Lewis structures for each of the following molecules: HBr ICl OF_2 2.2 a) Draw the Lewis structure for H_2O. b) How many bonding pairs does water have? c) How many lone pairs does water have? 2.3 Complete Practice Problem 1, (a), (b), (c), (f),(g). 2.4 Complete Practice Problem 3. (**Hint:** There is a single electron pair between the 2 carbon atoms. Join the 2 carbon atoms first.)
Read pages 189 - 191. Answer question 2.5 ▶▶	2.5 a) What is the fundamental principle of the Valence- Shell Electron-Pair Repulsion (VSEPR) theory? b) How can you summarize the order of deceasing repulsion in the VSEPR theory?

References and Notes

Using table 6.1, 'Summary of Molecular Shapes', answer question 2.6 ▶▶

Read pages 194 - 196. Then answer question 2.7 - 2.8 ▶▶

Then, using Table 6.2, answer question 2.9 ▶▶

Note:
When you check the answer given on page 227 for Practice Problem 8(a), you will notice an error. The cental atom should be C, not S.

Read pages 202 -206. Then answer questions 2.10 - 2.14 ▶▶

Work to Submit

Writing:

2.6 Complete Practice Problems 6 (e) and 7 (a). (**Hint:**Be sure to draw the Lewis structures first.)

2.7 a) What is the shape of a water molecule?
b) Are water molecules polar or non-polar? Explain your answer.

2.8 a) What is the shape of a carbon dioxide molecule?
b) Are carbon dioxide molecules polar or non-polar? Explain your answer.

2.9 Complete Practice Problems 8(a) and 9, page 196. (**Hint:** You will need to draw Lewis structures and determine the molecular shape before you can decide the polarity.)

2.10 a) Explain the difference between intramolecular and intermolecular forces.
b) How do intermolecular and intramolecular forces compare in covalent compounds?

2.11 Define dipole-dipole forces.

Unit 2 - Structure and Properties of Substances

References and Notes	Work to Submit
Note: *Dispersion forces are often referred to as* ***London dispersion forces.*** ***Dispersion forces, unlike other intermolecular forces, act between any particles, polar or otherwise.***	**Writing:**
Study Table 6.3, 'Comparing Types of Bonding', page 209, to answer question 2.15 ▶▶	2.12 a) Define ion-dipole forces. b) Explain how ion-dipole forces dissolve **some** ionic solids in water. 2.13 Define dispersion forces. 2.14 Define hydrogen bond. 2.15 Arrange the following bond types in order from strongest to weakest: dispersion dipole-dipole hydrogen bond ion-dipole metallic covalent ionic
See your instructor to discuss any additional work, including review, that may be required for this unit.	