Adult Basic Education

Science

Chemistry 3102A

Thermodynamics & Rates

Study Guide

Prerequisite: **Chemistry 2102C**

Credit Value: 1

Text: *Chemistry*. Mustoe 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 3102A

The purpose of this course is to introduce you to how energy is related to physical and chemical changes. With this understanding, you will then study how the rate (the speed) of a chemical change is affected by various factors and what chemists think is happening on the molecular level. These molecular changes involve energy requirements! There are a lot of calculations in this course. It is a course that is helpful not only for further chemistry courses, but is also helpful for post-secondary physics.

In addition to your study guide and text, you will need a scientific calculator. As you work through each page of your study guide, you should ensure that your answers to the problems are correct before proceeding to the next page.

You will have a lab for this course. Let your instructor know in advance that you are getting close to needing to do the lab. The lab will require a written lab report, which will be evaluated as part of your course mark.

The textbook for this course is *Chemistry*, McGraw-Hill, Ryerson, 2004.

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 onto 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 she or 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 - Temperature Change and Heat

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

Reading for this unit: *Chemistry*
Chapter 16: Introduction: pages 624 - 626
Section 16.1: pages 627 - 637

References and Notes	Work to Submit
Read pages 626 - 630. Then answer questions 1.1 - 1.9. ▶▶	**Writing:** 1.1 Define thermochemistry. 1.2 State the law of conservation of energy 1.3 Explain the difference between system and surroundings. 1.4 State the First Law of Thermodynamics and express the law as an equation. 1.5 Define open, closed, and isolated systems. 1.6 Define kinetic energy and potential energy. 1.7 What is the S.I. unit for energy? 1.8 Define temperature (T) and heat (q).
Study ***ThoughtLab - Factors in Heat Transfer****, page 631. Then complete 1.10.* ▶▶	1.9 What does a temperature change indicate? 1.10 Answer *Procedure* questions 1 and 2, and *Analysis* question 3 on page 631.

Unit 1 - Temperature Change and Heat

References and Notes	Work to Submit
Read page 632 -634. Study Figure 16.6 and the Sample Problem on page 633-634. Then answer questions 1.11-1.13. ▶▶	**Writing:** 1.11 Define specific heat capacity. 1.12 What is the mathematical expression for heat? Explain what each variable represents.
Note: *You will find the answers to the Practice Problems for Chapter 16 on page 659.* *You may want to use the glossary for definitions.*	1.13 Define the terms: joule, heat capacity and specific heat capacity.
Study carefully the information and Sample Problem on page 633 - 634. Then answer question 1.14 ▶▶	1.14 Complete Practice Problems 1 - 4, page 634.
Study carefully the Sample Problem, "Calculating Specific Heat Capacity", on page 635. Then answer question 1.15 ▶▶	1.15 Complete Practice Problems 5-9, page 636.
Read "Heat Capacity" on page 636 - 637. Then answer question 1.16-1.18. ▶▶	1.16 Complete Practice Problems 5 - 10, page 636. 1.17 What is the mathematical expression for heat capacity. Explain what each variable represents. 1.18 Complete Practice Problems 11 - 14, page 637.
***See your instructor to find out which questions you should complete for review of this unit.*	

Unit 2 - Enthalpy Changes

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

Reading for this unit: *Chemistry*
Chapter 16: Section 16.2: pages 639-650
Section 16.3: pages 653-655

References and Notes	Work to Submit
Read pages 639 - 640 to the end of Figure 16.10. Then answer questions 2.1-2.3 ▶▶ **Note:** *Make sure that you understand that chemical changes and phase changes involve changes in* ***potential energy*** *only and that* ***temperature*** *of the system undergoing the change* ***remains constant.*** *Read "Representing Enthalpy Changes" on pages 640-641 and "Enthalpy of Reaction" on pages 641-643. Then answer questions 2.4-2.11.* ▶▶	**Writing:** 2.1 Define enthalpy and enthalpy change (ΔH). 2.2 Define potential energy. 2.3 Copy and complete the following statements: (i) **Breaking a bond** is a process that _____ energy. (ii) **Creating a bond** is a process that _____ energy. 2.4 Define endothermic reaction and exothermic reaction. 2.5 How is enthalpy of reaction represented? 2.6 What are 3 ways of representing an enthalpy change? 2.7 What is a thermochemical equation? 2.8 What is an enthalpy diagram? 2.9 Define standard molar enthalpy of formation. What is its symbol?

Unit 2 - Enthalpy Changes

References and Notes	Work to Submit
	Writing: 2.10 Define standard molar enthalpy of combustion. What is its symbol? 2.11 Complete Practice Problems 15 - 18 on page 643. **Note:** For 15 (e), represent the molar enthalpy of formations as enthalpy diagrams.
Read "Calculating Enthalpy Changes", pages 643-644. Study Figure 16.14 and the Sample Problem on page 644-645. Then answer questions 2.12-2.13. ▶▶	2.12 What is the mathematical expression relating heat and enthalpy change? 2.13 Complete Practice Problems 19 - 23 on page 645.
Read "Enthalpy Changes and Changes of State" pages 645-647, and study Figure 16.16. Then answer questions 2.14-2.15. ▶▶	2.14 How does the energy change for physical changes compare to energy changes for chemical reactions? 2.15 For each of the following; state the phase change, the symbol for its molar enthalpy, and its sign (negative or positive) (i) freezing (ii) melting (iii) vaporization (iv) condensation (v) sublimination (2 meanings)

Unit 2 - Enthalpy Changes

References and Notes	Work to Submit
Read "Enthalpy of Solution" on pages 647-648. Then answer questions 2.16-2.17. ▶▶	**Writing:** 2.16 What is molar heat of solution? What is its symbol? 2.17 Complete problems 24-29 on pages 648-649.
Read "Total Heat Absorbed or Released by a System" on pages 653-654. Carefully study the sample problem on page 654 - 655. Then answer question 2.18. ▶▶	2.18 Complete problems: 30(b), 31(b), 32(b), 33(b), 34 (c) on page 655.
Note: *For Practice Problems 30-34, break the problem into steps e.g. 30(b)* $H_20(\ell)@25.2^0\ C \rightarrow H_20(\ell)@100^0C\ q_1 = ?$ $H_20(\ell)@100^0\ C \rightarrow H_20(g)@100^0\ Cq_2 = ?$	
See your instructor to find out which questions you should complete for review of this unit.	

Unit 3 - Calorimetry and Hess's Law

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

Reading for this unit: *Chemistry*
Chapter 17: Section 17.1: pages 661-667
Section 17.2: pages 677-681

References and Notes	Work to Submit
Read pages 661-667 of Section 17.1. Then answer questions 3.1-3.5. ▶▶	**Writing:** 3.1 What is a calorimeter? 3.2 What is calorimetry?
Note: *Recall that the Law of Conservation of Energy states that energy can be changed into different forms, but it cannot be created or destroyed.*	3.3 What assumptions are made in calorimetry experiments?
	3.4 What equation applies to calorimetry experiments?
	3.5 What equation is used to calculate the change in kinetic energy caused by a process? Explain what each variable represents.
Study the sample problem on pages 663-664. Then answer question 3.6 ▶▶	3.6 Complete Practice Problem 1(a) and 2(a) on page 664.
Let your instructor know you are ready to complete Investigation 17-A on pages 668-669. ▶▶	**Laboratory:**
Note: *Check with your instructor to find out what you are expected to submit in your lab report.*	3.7 Complete the lab and submit your report to your instructor.

Unit 3 - Calorimetry and Hess's Law

References and Notes	Work to Submit
Read pages 677-681 of Section 17.2. Then answer questions 3.9-3.10. 	**Writing:** 3.8 What is Hess's Law of heat summation? 3.9 Complete problems 11-12 on page 681.
See your instructor to find out which questions you should complete for review of this unit.	

Unit 4 - Collision Theory, Reaction Mechanisms, and Catalysts

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

Reading for this unit: *Chemistry*
Chapter 12: Introduction: page 462
Section 12.1: pages 463-468
Section 12.2: pages 469 - 484

References and Notes	Work to Submit
Read Section 12.1, pages 462-467. Then answer questions 4.1 - 4.3. ▶▶	**Writing:** 4.1 a) Define reaction rate. b) How do chemists express reaction rate? 4.2 List properties that can be monitored to measure reaction rate. 4.3 List the factors that affect reaction rate.
Read page 469-471. Then answer questions 4.4 - 4.6. ▶▶	4.4 State the Kinetic Molecular Theory (KMT) of matter. 4.5 State the collision theory. 4.6 Using collision theory, briefly explain how each of the following affects the rate of reaction: (i) concentration/pressure (ii) surface area (iii) nature of reactants (iv) temperature
Read "Reactions and Activation Energy" on page 472. Then answer questions 4.7 - 4.9. ▶▶	4.7 Define activation energy. 4.8 What happens to the number of molecules with kinetic energy greater than E_a as temperature increases? 4.9 What happens to the reaction rate if temperature is increased by 10^0 C ?

Unit 4 - Collision Theory, Reaction Mechanisms, and Catalysts

References and Notes	Work to Submit
Read "Reactions and Orientations of Reactants" on page 472-473. Then answer question 4.10. ▶▶	**Writing:** 4.10 What two conditions are necessary for a collision to result in a reaction?
Read "Transition State Theory" on pages 473-475. Carefully study Figures 12.9 and 12.10. Then answer questions 4.11 - 4.13 ▶▶	4.11 What is a potential energy diagram? 4.12 Define: a) transition state. b) activated complex.
Study the sample problem on page 475-476. Then answer questions 4.13 - 4.14.▶▶	4.13 Complete Practice Problems 1 - 4 on page 476. 4.14 Complete problem #136 in the *Supplemental Practice Problems,* page 830.
Read "Catalysts" on page 481-482. Then answer question 4.15. ▶▶	4.15 a) Define catalyst (Use glossary) b) Explain how a catalyst works.