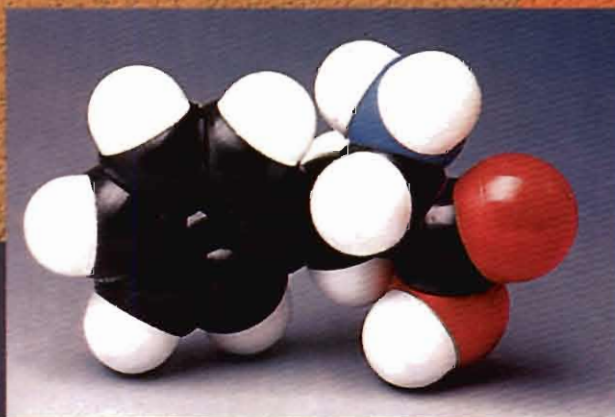


# Chemistry

**Secondary Education  
S e c o n d   y e a r  
S c i e n c e s   S e c t i o n**

## PART 1



**SPECIMEN**

Nati

Center for Educational Research and Development



National  
Textbook

## How Good?



**Republic of Lebanon**

Ministry of Education and Higher Education

**CHEMISTRY**

**Secondary Education**

Second Year

Sciences Section

Center for Educational Research and Development





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# CHEMISTRY



**Secondary Education**

Second Year

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# The National Textbook Project

This is the second installment of textbooks completed by the Center as part of a three-stage effort to produce the books called for by the New Curricula. We are placing these books in the hands of students with the great hope that we are moving, step by step, toward the goal of acquiring sound and modern learning, using sophisticated educational means and up-to-date methodology that encourage and reinforce individual thinking and research, the acquisition of skills, the development of ethical and national attitudes, the feeling of national belonging as well as the feeling of belonging to humanity at large.

The on-going revolution in information, communication and educational technology has undoubtedly limited the role of the textbook and lowered the rank it used so recently to occupy. However, in our society and in many other societies, the textbook remains the basic means of education, and it is our duty to exert our utmost effort and care to come up with the best product as to form and content. Yet we should not lose sight of the fact that the textbook is not sufficient by itself but should rather be used as a stepping stone to access other sources of information. What is important is to keep a clear vision and maintain the right course toward our objective. The means should not turn into the end and the student should always remain the focus of the learning/teaching process.

No one ignores or denies the fact that textbook writing requires very high academic and educational qualifications and very wide field experience. The authors committees undeniably possess such qualifications and qualities, yet last year's textbooks did contain some faults and gaps which were duly pointed out by researchers in many articles, and, indeed, we have benefited from some of them. Such is the nature of human work, no matter how good the intentions or how great the effort exerted.

Constructive criticism is a real contribution to raising the standard of authorship, minimizing errors and filling gaps. We only hope that criticism will always be objective and motivated by a desire to enhance educational reform in order to achieve better products.

A favorite adage handed down from our old scholars: "He who criticizes you is as helpful as a co-author". Let all criticism directed at the Center be of this caliber.

In closing, we hope that we all will have benefited from our experience and that the textbooks of the third and final stage be closer to realizing our hopes and more beneficial to our students. We are now preparing ourselves to assess the parts so far achieved of the new curricula and to assure that our educational movement is proceeding on the right track for achieving the best results.

June 2, 1999

**President, National Center for Educational  
Research and Development**

**Nemer FRAYHA**



## **Note to teachers and students:**

Due to unexpected circumstances, the Chemistry textbook is split into two parts:

Part I which constitutes six chapters that will take you until January 2000 to cover.

Part II which constitutes ten chapters, the rest of the material, will be out by that date.

**General Coordinator**



# Foreword

The chemistry curriculum of the second year of the secondary education – scientific series is fundamentally composed of two main parts. The first deals with conceptual chemistry: thermochemistry, electrochemistry, atomic orbitals and organic chemistry. The second deals with industrial chemistry and pollution: industrial inorganic chemistry, petroleum and natural gas, metallurgy, and pollution, with a major goal: to show that chemistry is a concrete science, and to emphasize its importance in the economy of a country as well as its applications in everyday life.

The curriculum takes into account that the student is acquainted with basic chemistry, in the first secondary year and in previous years, and that, according to the scientific series, he can be motivated to a diversified content.

However, in order to attain the planned pedagogical objectives which are: To help the student to understand scientific concepts and the acquisition of experimental work, as well as a scientific culture and considering the industrial part of the curriculum; our concern was to adopt a simple language, to ensure sufficient illustration (photos, schemes ....) and to follow the organization of the book.

## Organization of the book

The book is divided into sixteen chapters all having similar pattern.

Each chapter is introduced by an illustration and a commentary related to the topic to be discussed. In this introduction page the objectives, the prerequisites, and the chapter contents are given.

The illustration given in each chapter is conceived as an essential pedagogic support especially in the chapters of industrial chemistry and pollution where laboratory investigations generally are not considered. In the chapters concerning the conceptual parts of the curriculum, these investigations, illustrated in the text, play the role of pedagogical support. They are an experimental and concrete introduction to the studied concepts. The interpretation of their results leads to the understanding of the concepts.

The solved exercise is a direct application of scientific notions, which precedes it. The chapter review is its summary. It includes the principle notions discussed. The method sheets are a supplement, sometimes necessary to complete the treated topics. The laboratory work sheets, which are more elaborated than the laboratory investigations, are complete experimental applications related to the subject of the chapter.

The documentary activities are numerous and diversified, written in a simple style constitute a supplementary information to the student. This diversity and the easy style will provoke his interest.

The different forms of exercises (fill in the blanks, multiple choice, classical exercises and exercises taken from daily life), help the student to understand and assimilate the scientific subjects studied.

Finally, all suggestions that our colleagues will kindly communicate to us will be received with our great attention and interest.

*The authors*



# Features of the book

## Unit Opener

- Picture introducing the chapter

- Commentary introducing the chapter



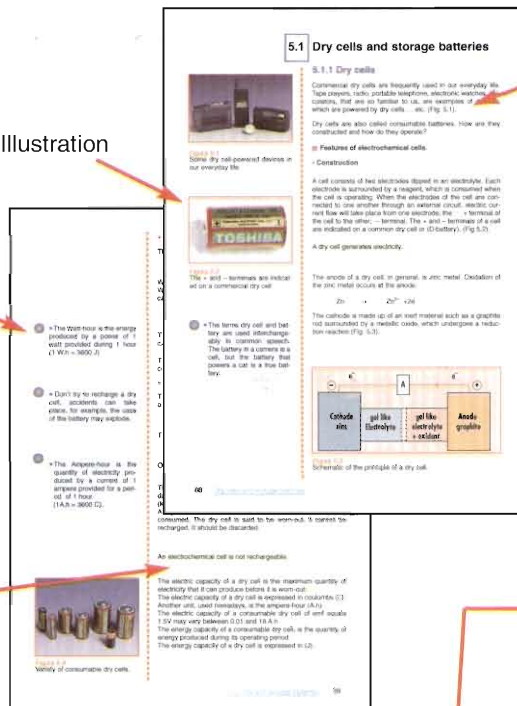
- Title
- Objectives
- Prerequisites
- chapter Contents

## Course

- Remarks and supplementary information

- Presents definitions, results and conclusions

- Illustration



- Introduction to the chapter

## Documentary activities



- To widen the students knowledge concerning all fields of applications



# Experimental activity

# Laboratory investigation

- Title
- Objective
- Procedure
- Observation
- Questions to be answered
- Interpretation

### 3.1 Oxidation-reduction potential

#### 3.1.1 The Daniell cell

**Activity 1 Construction of an electrochemical cell**

**Objective**  
To construct an electrochemical cell and observe the electric current.

**Equipment**  
A 250 mL beaker, 1 M zinc sulfate solution, 1 M copper sulfate solution, a salt bridge, a voltmeter, connecting wires.

**Procedure**  
1. Prepare the zinc half-cell: Dissolve 10 g of zinc in 100 mL of 1 M zinc sulfate solution. 2. Prepare the copper half-cell: Dissolve 10 g of copper in 100 mL of 1 M copper sulfate solution. 3. Connect the two half-cells using a salt bridge. 4. Connect the voltmeter across the two half-cells. 5. Observe the voltmeter reading and the color change in the solutions.

**Observation**  
The voltmeter indicates a current flow from the zinc half-cell to the copper half-cell. The color of the copper half-cell changes from blue to colorless.

**Interpretation**  
The cell is an electrochemical cell. The zinc half-cell is the anode and the copper half-cell is the cathode. The cell reaction is:  $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$ .

- Elaborated experimental work applied to subject presented

### LABORATORY INVESTIGATION

#### Identification test of some metallic cations in solution

**Objective**  
To identify the presence of some metallic cations in solution.

**Equipment**  
Test tubes, test tube holder, Bunsen burner, 1 M solutions of  $AgNO_3$ ,  $FeCl_3$ ,  $FeSO_4$ ,  $NaOH$ ,  $H_2O_2$ ,  $HCl$ ,  $HNO_3$ ,  $H_2SO_4$ ,  $KSCN$ .

**Procedure**  
1. Identification test of  $Ag^+$ : Add a few drops of 1 M  $AgNO_3$  to a test tube. Add a few drops of 1 M  $HCl$ . Observe the formation of a white precipitate. 2. Identification test of  $Fe^{3+}$ : Add a few drops of 1 M  $FeCl_3$  to a test tube. Add a few drops of 1 M  $KSCN$ . Observe the formation of a blood-red color.

- Chapter review

### Chapter review

• An oxidation-reduction reaction involves an electron transfer between two reactants. The oxidizing agent gains electrons and the reducing agent loses electrons. Oxidation is a loss of electrons. Reduction is a gain of electrons.

• The reducing agent of a redox reaction is the species that is oxidized. The oxidizing agent of a redox reaction is the species that is reduced.

• The electrochemical classification arranges the reducing agents of  $M^+/M$  couples according to an increasing order of reducing power and the oxidizing agents of these couples according to an increasing order of oxidizing power.

**Safety sheet**

**A - Safety recommendations for the preparation of acid solution**

Concentrated acid solutions are dangerous to the body. They attack the skin, burn the eyes, etc. They should be handled with care by following the safety rules:

1. Always sufficient protection by wearing a laboratory apron and eye goggles and gloves.
2. Use pipet bulb when withdrawing concentrated acid into the flask.
3. Don't pour water into concentrated acid, but always pour acid into water. Stir continuously. Cool if needed.
4. Work under a hood.

**B - Calculation for the preparation of an acid solution from a stock (commercial) solution**

Preparation of one liter of 1 M  $HCl$  solution from a stock solution of 27% (mass percentage) commercial solution. Molar mass of hydrochloric acid:  $M_{HCl} = 36.5 \text{ g/mol}$ . Density of the solution:  $\rho = 1.18 \text{ g/mL}$ .

Mass of acid in one liter of 1 M  $HCl$  solution:  $m_{HCl} = 36.5 \text{ g}$ .

Mass of the commercial solution containing this mass of acid:  $m_{sol} = \frac{m_{HCl}}{\rho} = \frac{36.5}{1.18} = 30.93 \text{ g}$ .

Volume of the solution containing this mass of acid:  $V_{sol} = \frac{m_{sol}}{\rho} = \frac{30.93}{1.18} = 26.21 \text{ mL}$ .

So 26.21 mL of the commercial solution must be taken to prepare one liter of 1 M  $HCl$  solution.

- Method sheet

## Exercises

- Solved exercise direct application to the proceeded notion

### Solved exercise 2

**Given**  
The heat of combustion of glucose,  $C_6H_{12}O_6$ , is  $\Delta H_c^\circ = -2801 \text{ kJ/mol}$ . The heat of formation of glucose,  $C_6H_{12}O_6$ , is  $\Delta H_f^\circ = 1273 \text{ kJ/mol}$ . The heat of formation of carbon dioxide,  $CO_2$ , is  $\Delta H_f^\circ = -393.5 \text{ kJ/mol}$ . The heat of formation of water,  $H_2O$ , is  $\Delta H_f^\circ = -285.8 \text{ kJ/mol}$ .

**1. Write the thermochemical equation of the reaction.**

$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$

**2. Calculate the heat of reaction.**

$\Delta H_r^\circ = \sum \Delta H_f^\circ(\text{products}) - \sum \Delta H_f^\circ(\text{reactants})$

$\Delta H_r^\circ = 6(-393.5) + 6(-285.8) - 1273 = -2801 \text{ kJ/mol}$

**3. Verify if the reaction is in its standard state.**

The reaction is in its standard state because all reactants and products are in their standard states.

- MCQ classical questions and applications to everyday life

### Exercises

1. Complete the following sentences:

The heat of formation of a compound is the heat released or absorbed when one mole of the compound is formed from its elements in their standard states.

2. Answer the following questions:

a) The heat of formation of a compound is a state function.

b) The heat of formation of a compound is a thermodynamic property.

c) The heat of formation of a compound is a function of the standard state.

d) The heat of formation of a compound is a function of the temperature.

e) The heat of formation of a compound is a function of the pressure.

f) The heat of formation of a compound is a function of the volume.

3. Calculate the heat of reaction for the following reaction:

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

$\Delta H_f^\circ(H_2O) = -285.8 \text{ kJ/mol}$

$\Delta H_r^\circ = 2(-285.8) = -571.6 \text{ kJ/mol}$



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