

# Physics

Secondary Education  
First year

## 3.1 NATURE DU COURANT ÉLECTRIQUE

Dans un conducteur

Dans un conducteur métallique, les électrons libres effectuent un mouvement ordonné. Ils se déplacent dans toutes les directions.

Dès qu'on applique une tension aux bornes du conducteur (par exemple en reliant une pile), les électrons, sous l'action de cette tension, prennent un mouvement d'ensemble ordonné (Figure 3.2) pour constituer un courant électrique.

Courant électrique est un déplacement ordonné de charges.

Une pile contenant une électrolyte qui induit l'électrolyse et négatifs en mouvement.

Entre les bornes d'une pile, on applique une tension (Figure 3.3). Les ions positifs et négatifs dans l'électrolyte.

Le mouvement des ions positifs et négatifs dans l'électrolyte est donc dû à un déplacement ordonné.

## LE COURANT ÉLECTRIQUE

Le déplacement des ions positifs et négatifs dans l'électrolyte est donc dû à un déplacement ordonné.

Figure 3.3.

REVISED EDITION

Center for Educational Research and Development



National  
Textbook

New Curricula

**SPECIMEN**  
غير مخصص للبيع

# Republic of Lebanon

Ministry of Education and Higher Education

## Physics

Secondary Education

First year

Educational Center for Research and Development



The Academic  
National  
Textbook

**New Curriculum**



General Coordinator  
**Moustapha Yaghi**

The translation into English of this book was reviewed and corrected by faculty members at the American University of Beirut.

# PHYSICS

**Secondary Education**

First year

**Michel Kraidy (Coordinator)**

**Ali Al-Arab**

**Elias Chalouhi**

**Sami Farah**

**Ali Haidar**

**Nassim Haidar**


**Mohammed Issa**

**Ibrahim Tannous**

Educational Center for Research and Development



**Educational Company**  
for Printing, Publishing and Distribution S.A.R.L.

**Technical Preparation:** Technical Team ■ ECRD  
**Illustrations:** Graphics Team ■ ECRD  
**Production & Distribution:**  **Educational Company**  
for Printing, Publishing and Distribution S.A.R.L.  
**Printing:** Youssef Baydoun Printing Press

© ECRD 1998, Sin-EI-Fil, Lebanon, P.O.Box: 55264  
All Rights Reserved for ECRD  
First Published September 1998  
6<sup>th</sup> impression 2010

# Together We Build Through Education!

The Center for Educational Research and Development (CERD) has embarked on an extensive workshop for assessing and developing the educational framework and curricula which have been placed into effect more than three years ago. With full realization of the fact that the educational cycle must continue normally through its components, and until the development process attains its aspired objectives, we are placing in the hands of students, teachers and directors of public schools, this corrected version of textbooks issued by CERD as part of the National Textbook Series.

This version is an interim stage incorporating the corrected typographical and linguistic errors discovered by CERD specialists as well as teachers and students through their daily dealings with the books. The process of assessment and development of the framework and curricula will take into consideration all the comments that have been made, or will be made, in this regard.

It is expected that once the curricula are developed and aligned with the general and specific objectives set for them, the textbooks will be realigned with the new curricular and framework requirements, including tying the content of a course to the number of teaching hours set for it during the school year, taking into consideration vertical alignment within the same course as well as the horizontal alignment with the rest of the courses.

I take this opportunity to invite all school administrators, teachers and students and all officials concerned in public and private schools alike, to promptly send their comments on these curricula and books as their contribution to enrichment of this momentous national process.

This workshop, which was launched under the kind sponsorship of His Excellency the Minister of Education and Higher Education in implementation of Decree No. 10227 embodying the educational curricula and their objectives, fits in with CERD's proclaimed new motto "Together We Build Through Education".

It is our earnest desire to see this national, all-inclusive workshop attracting the greatest amount of interest and participation to define the safest and soundest educational options that directly affect our children, as we vow to continually modernize education and develop its ways and means to keep abreast of modern developments and progress in science and technology.

**Dr. Leila MALEEHA**  
President CERD



This is based on the requirements of the new Lebanese physics curriculum. It consists of four parts: electricity, waves, optics, and mechanics. Each part consists of a number of chapters, each of which contains the following:

- **Objectives** for teaching the chapter, listed at its beginning.
- **Experiments** to be performed by the student or the teacher. Their results lead to physical laws.
- **Questions** and **examples** inserted at various points in the text.
- A **summary** of the main ideas to be mastered by the student.
- **Test-your-knowledge** type questions that check the student's acquisition of the basic contents of each chapter.
- Open qualitative **questions** that may summons, through class discussions, the different intellectual abilities of the student.
- **Problems** that give the student the opportunity to apply the knowledge acquired from the chapter to concrete situations.
- Notes and **historical background** readings are introduced, whenever appropriate, to help the student understand that scientists of different cultural backgrounds have gradually developed science over the years.

We hope that this book is easy to use and effectively serves the purpose for which it was designed.



Introduction	7
<b>Part I: Electricity</b>	<b>13</b>
<b>Chapter 1 Electrostatics</b>	<b>15</b>
1.1. Electrostatic interaction	16
1.2. Electric aspect of matter	17
1.3. Charging objects	18
1.4. Insulators and conductors	18
1.5. Charging by contact	18
1.6. Metal-leaf electroscope	19
1.7. Charging by induction	19
1.8. Quantity of electric charge	19
1.9. Coulomb's law	20
Electrostatics in our life	21
Home experiments	23
<b>Chapter 2 Potential difference</b>	<b>26</b>
2.1. Notion of potential difference or voltage	27
2.2. Sign and units	28
2.3. Measurement of potential difference	28
2.4. Laws of potential difference	30
2.5. Reference potential	32
Instruments for measuring potential difference	33
<b>Chapter 3 Electric current</b>	<b>42</b>
3.1. Nature of electric current	43
3.2. Conventional direction of electric current	43
3.3. Magnitude of the electric current	44
3.4. Direct current and alternating current	45
Instruments to measure a current	47
3.5. Laws of current	49
<b>Chapter 4 Resistors</b>	<b>53</b>
4.1. Resistance	54
4.2. Ohm's law	55
4.3. Types of resistors	56
4.4. Measurement of the resistance	56
4.5. Resistance of a wire resistor	56
4.6. Joule's law	57
4.7. Grouping of resistors	58
4.8. Applications. Readings	60

<b>Chapter 5 Generators and receivers</b>	<b>69</b>
5.1. Generators	70
5.2. Poles of a generator	71
5.3. Current – voltage characteristic of a generator	72
5.4. Ohm’s law for a generator	73
5.5. Receivers	74
5.6. Current – voltage characteristic of a receiver	74
5.7. Batteries in opposition	75
Batteries	77
<b>Chapter 6 Electric circuits</b>	<b>82</b>
6.1. Electric circuits	83
6.2. Drawing the diagram of an electric circuit	84
6.3. Setting up a circuit using a diagram	84
6.4. Solving an electric circuit	84
6.5. Strategy for solving electric circuits	86
<b>Part II Waves</b>	<b>90</b>
<b>Chapter 7 Vibrations and waves</b>	<b>91</b>
7.1. Vibrations	92
7.2. Characteristics of vibrations	92
7.3. Waves	94
7.4. Characteristics of a wave	95
7.5. Transverse and longitudinal waves	96
7.6. Electromagnetic waves	97
Ripple tank	99
<b>Chapter 8 Reflection and refraction of waves</b>	<b>102</b>
8.1. Wavefronts	103
8.2. Reflection of waves on plane surfaces	104
8.3. Refraction of waves on plane surfaces	105
8.4. Index of refraction	105
<b>Part III Optics</b>	<b>109</b>
<b>Chapter 9 Propagation of light</b>	<b>110</b>
9.1. Rectilinear propagation of light	111
9.2. Light beams	112
9.3. Objects and images	113

<b>Chapter 10 Reflection of light</b>	<b>115</b>
10.1 Reflection	116
10.2 Laws of reflection	117
10.3 Reversibility of light	117
10.4 Plane mirrors	118
10.5 Image formed by a plane mirror	118
10.6 Field of vision of a mirror	119
Home experiment	120
<b>Chapter 11 Refraction of light</b>	<b>124</b>
11.1. Refraction of light	125
11.2. Laws of refraction	126
11.3. Total internal reflection	128
11.4. Dispersion of white light	129
Optical fibers	130
<b>Chapter 12 Lenses</b>	<b>134</b>
12.1. Spherical lenses	135
12.2. Geometry of lenses	136
12.3. Converging and diverging lenses	136
12.4. Ray tracing	137
12.5. Objects and images	138
12.6. Descartes' formula	139
12.7. Linear magnification	141
<b>Chapter 13 The eye and the magnifier</b>	<b>145</b>
13.1. Elements of the eye	146
13.2. Accommodation	147
13.3. Far and near points of vision	147
13.4. Myopic or shortsighted eyes	148
13.5. Presbyopic eye	148
13.6. Resolving power of the eye	149
13.7. Magnifier	149
13.8. Angular magnification of a magnifier	149
Microscopes and telescopes	150

<b>Part IV: Mechanics</b>	<b>155</b>
<b>Chapter 14 Description of motion</b>	<b>156</b>
14.1 Rest and motion	157
14.2 Position vector	159
14.3 Speed and velocity	160
14.4 Acceleration	162
14.5 Air table	163
<b>Chapter 15 Rectilinear motion</b>	<b>167</b>
15.1 Uniform rectilinear motion	168
15.2 Equation of a uniform rectilinear motion	169
15.3 Uniformly accelerated rectilinear motion	170
15.4 Time equation of uniformly accelerated rectilinear motion	171
<b>Chapter 16 Force and interaction</b>	<b>177</b>
16.1 Effects of a force	178
16.2 Interaction	178
16.3 Representation of a force	179
16.4 Classification of forces	180
16.5 Forces acting on a system	180
16.6 Resultant of two forces	182
<b>Chapter 17 Newton's laws</b>	<b>187</b>
17.1 Newton's first law or the principle of inertia	188
17.2 Newton's second law or the fundamental principle of dynamics	189
17.3 Newton's third law or the principle of interaction	191
17.4 Newton's law of gravitational interaction	192
Galileo and Newton	194