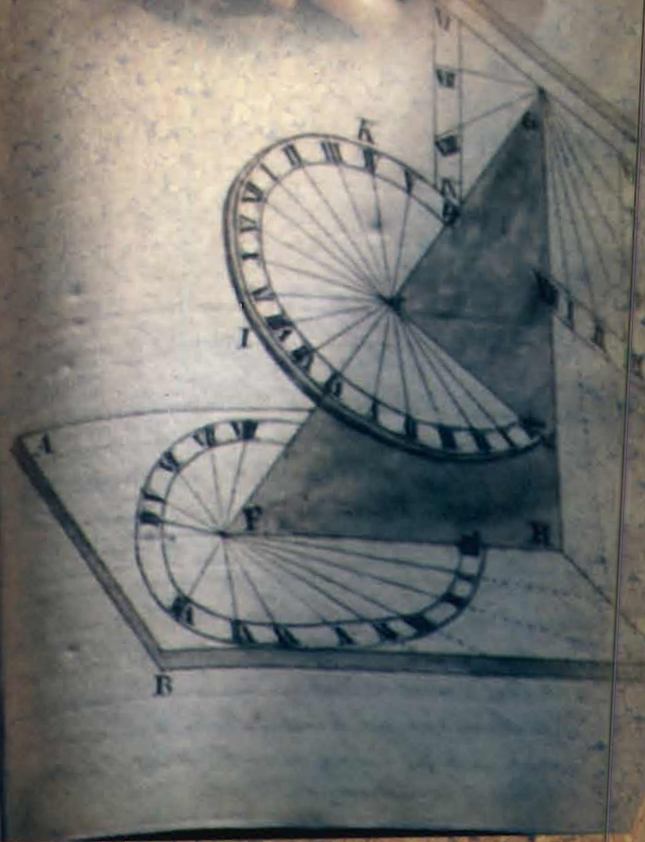


Building up MATHEMATICS



9th
Grade
Basic Education



Republic of Lebanon

Ministry of Education and Higher Education

■
**BUILDING UP
MATHEMATICS**
■

Basic Education
Grade Nine

Educational Center for Research and Development



New Curricula



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BUILDING UP MATHEMATICS

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The National Textbook Project

By issuing the textbooks for the third year of each educational cycle, the Educational Center for Research and Development will have completed the third and last installment of 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 learning, using sophisticated educational means and up-to-date methodology that encourage and reinforce individual thinking and research, acquisition of skills, 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-aids 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 qualities. Yet the textbooks of the last two years contained some negative aspects. Such is the nature of human work, no matter how good the intentions or how great the effort extended. Here constructive criticism constitutes a real contribution to raising the standard of authorship, minimizing errors and filling gaps. We say that, with all due appreciation and respect to all those who have contributed to the success of this project.

The Educational Center for Research and Development is embarking this year on a process of evaluating the New Curricula and related textbooks, teacher training courses and student achievement. This is a natural and necessary step now that the new system has been put into effect. This process aims at identifying the curricular objectives that have been achieved as well as those that have not been achieved, with a view to proceeding with the positive aspects and correcting the negative ones.

As part of this correction process, we plan to review the versions that have been issued in order to secure good textbooks for our students, who always deserve the best.

March 13, 2000

President, Educational Center for
Research and Development

Nemer FRAYHA

Preface

"We do not narrate mathematics... we construct it..."

We believe that this teaching concept reflects the will to respect the student as a human being; it is no longer a matter of imposing information on him but presenting him with the one he demands. Our main objective in this book is to direct the student to become an information seeker.

Material covered in the following chapters includes:

- The **Introduction**, in which the student is reminded of what he has learned and what he will learn.
- The **Activities**: In this phase, the student is confronted with situations that urge him to pose questions, conclude, and exchange ideas with his classmates and defend them.
We think that this is the most important phase of using the national textbook.
The role of the teacher is clearly defined in the Pedagogical Guide.
- The **Text**: This is the phase of systematization where teaching is put into order through the ideas proposed by student groups.
- The **Focus**: This is a place where students can find the main points of the chapter summarized.
- The **Exercises**: Devised to consolidate the already-acquired notions.
- The **Self-evaluation**: A set of questions, put by students, after their acquisition of new material. Answers to the proposed questions are given at the end of the book. At this stage, the student is held responsible for his work. It is only up to him to judge the degree of comprehension of the notions presented so far.
- The **Problems**: Place of relocating the student's new and old acquisitions. It is a wide and varied field of applications.
- **Just for fun**: Place where the posed problems are less classical and more extracurricular. The essential interest is not in the solution of these problems but in the attempts made towards their solution in a lively atmosphere.

At the end of this work, we hope to reach most of the goals that we set for ourselves. Nevertheless, the results depend heavily on how the teachers will use this book.

The authors

How to use the book

This is the title of the chapter

I find out what it is all about

I discover

What I already know

What will I learn

To refresh my memory

For a good start

This is the teacher's corner.
I take what he gives

In this part of the chapter, I find
all the definitions ..
all the properties..
proofs of these properties..
some illustrative examples.

I learn the essentials..

In this part, I find :
a summary of the text..
of explanations..
of methods of solving..
of geometric constructions.

9 The real numbers



Introduction ... To complete the numbers 1/

Using the preceding parts on these most mighty kinds of numbers, integers, decimals, fractions, rationals ...

You have learned that integers and decimals are not like fractions. You have also learned that you can identify a rational function 'plotted' in the form of a fraction.

The ancient Greek mathematicians can be represented as finding the 1/2 (square) theorem possible to express the lengths of segments of a line as a number that cannot be expressed as a fractional form.

To find out more about how ancient Greek mathematicians used rational numbers, that were not rational ones!

Many other ancient Greek mathematicians were known by their names as part of the history of mathematics.

At the beginning of this chapter, I will learn to:

- 1. compare rational numbers greater than 1 two-point form, compare a rational number.
- 2. compare rational numbers with rational numbers.
- 3. use rational numbers in fractions or expressions.

At the end of this chapter, I will be able to:

- 1. identify a particular aspect of a number in the form of a fraction.
- 2. add the concept of an irrational number.
- 3. understand the development of a rational fraction.
- 4. use mathematical techniques to calculate rational and irrational numbers.

Recall Activity

Story of the sign and the increase!

If the number of seats is x , then the law of constant $y = 3x + 1$

1) Complete the table

x	1	2	3	4	5
y	4	7	10	13	16

2) In the same way, plot the law of constant $y = 2x + 1$

3) Complete the table concerning the second law

x	1	2	3	4	5
y	3	5	7	9	11

4) Which law represents an 'increasing' and which is 'decreasing'? How can you see this each graphically? Using algebra?

Preparatory Activity

Investigate a house similar to the one on the figure on the left, in which there are all the necessary parts.

Below, a plan of the front view of this house is presented with some measurements.

The adjacent figure represents the roof with an inclination of 30° . The construction works must have a horizontal AB and CD .

How high should AB and CD be, so as to have a roof inclination of 30° ?

How to identify an inscribed quadrilateral?

1. Drawing from angles

If a quadrilateral $ABCD$ has two opposite angles \hat{A} and \hat{C} or \hat{B} and \hat{D} supplementary, then we can state that it is inscribed.

We can state the following:

CONVERSE 1 - Quadrilateral in which two opposite angles are supplementary is inscribed.

2. Drawing from diagonals

If in a quadrilateral $ABCD$ the angles \hat{BAC} and \hat{BDC} formed by the diagonals and two opposite sides are equal, then the quadrilateral is inscribed.

We can state:

CONVERSE 2 - Quadrilateral in which the angles formed by the diagonals and two opposite sides are equal is inscribed.

Focus

Inscribed quadrilateral

- A quadrilateral is said to be inscribed if there is a circle passing through its vertices.
- In an inscribed quadrilateral, the two opposite angles are supplementary.
- In an inscribed quadrilateral, two angles formed by the diagonals and two opposite sides are equal.

How to prove that a quadrilateral is inscribed?

To show that quadrilateral $ABCD$ is inscribed, it is sufficient to show that one of the following properties is verified:

- Angles \hat{A} and \hat{C} are supplementary.
- Angles \hat{B} and \hat{D} are supplementary.
- Angles \hat{BAC} and \hat{BDC} are equal (same angle).
- Angles \hat{CAD} and \hat{CBD} are equal (same angle).
- Angles \hat{ACD} and \hat{ABD} are equal (same angle).
- Angles \hat{ADC} and \hat{ABC} are equal (same angle).

How to draw a circle passing through the vertices of an inscribed quadrilateral?

If $ABCD$ is an inscribed quadrilateral, then construct the perpendicular bisectors of two adjacent sides. The intersection point of these two perpendicular bisectors is the center of the circle passing through A, B, C and D .

1. Preparation and tables

In each of the following tables, we can obtain the second factor multiplying the first line by a constant.

From	$\times 10$	$\times 20$	$\times 30$	$\times 40$	$\times 50$	$\times 60$	$\times 70$	$\times 80$	$\times 90$
10000	10000	20000	30000	40000	50000	60000	70000	80000	90000

1.1. Preparation and Algebraic relation

Obtain now up the three preceding tables as follows:

Notes	Conclusions	Relations
1. numerical	1. average speed	$d = v \times t$
2. algebraic relation	2. average speed	$v = \frac{d}{t}$
3. algebraic relation	3. average speed	$t = \frac{d}{v}$
4. algebraic relation	4. average speed	$d = v \times t$
5. algebraic relation	5. average speed	$v = \frac{d}{t}$
6. algebraic relation	6. average speed	$t = \frac{d}{v}$

Applying the relation $d = v \times t$, we can easily calculate the value of d for every corresponding value of v and t considered.

Now: $d = v \times t = 10 \times 10 = 100$

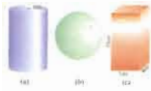
So, the prepared quantities d and t satisfy a relation of the form $d = v \times t$, where v is a constant of the first proportion.

Exercises

- Find the area of the surface obtained by rotating a rectangle along one of its sides a given number of times.
- The circumference of a sphere and one plane is given as follows:
 - The solid obtained by rotating a line along one of its diameters is a full sphere (ball).
 - The solid obtained by rotating a circle along one of its diameters is an orange (sphere).



Calculate the total area and the volume of this solid when $n = 1$ time, and when $n = 10$ times.



- Calculate the area and the volume of the following solids:
 - A cylinder of diameter 10 cm.
 - A sphere of radius 10 cm.
 - A rectangular prism of length 10 cm, width 10 cm, and height 10 cm.

- Calculate the area and the volume of the solid formed by a cylinder of height 10 cm and diameter 10 cm, surrounded by two semi-spheres.
 - The intersection of a ball and a plane passing through its center is a disc whose area is 100π cm².
 - Calculate the area of the ball.



I practice

In this part of the chapter, I find :
 miscellaneous revision exercises..
 direct application exercises..
 training exercises.

This is my own corner!

In this part, I find :
 some exercises treating the essentials;
 the student selects appropriate ones for himself to solve.
 The solutions are given at the end of the book.
 I can always ask the teacher for explanations.

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In the adjacent figure, P is the midpoint of AB and Q is the midpoint of AC .

1. Show that triangles BPQ and CQP are similar and write the ratio of similarity (scale factor).

2. Show that the triangles BPQ and CQP are similar and write the ratio of similarity.

3. What is the value of the ratio of similarity?

Self-evaluation

A In the adjacent figure, P is the midpoint of AB and Q is the midpoint of AC . $AP = 3$ cm and $AQ = 4$ cm. Show that triangles BPQ and CQP are similar. Write down the ratio of similarity. What is the value of this ratio?

B In the adjacent figure, the points P , Q , R , and S are the midpoints of the sides AB , BC , CA , and DA respectively. Prove that triangles SPQ and RQS are similar. Write down the similarity ratio. What is the value of this ratio?

C In the adjacent figure we have $EA = 3$, $EC = 4$, $ED = 5$ and $EB = 7$. Show that triangles EAC and EDB are similar. Write down the similarity ratio. What is the value of this ratio?

A challenge? I accept it.

In this part of the chapter, I find :
 problems relating to the text,
 problems for everyday application,
 problems using the properties already seen.

Problems

- In the left-hand diagram in the figure, what is the height of the dome if the radius of the dome is 10 cm and the diameter of the base is 10 cm?
- Check the law of conservation of mass. (Density is proportional to temperature.)
 (a) If the volume of a gas is 1 m^3 at 10°C , what is its volume at 20°C ?
 (b) How does a barometer measure the pressure of a gas on terms of its temperature?
- What is the weight of 100 kg of hydrogen knowing that 1 gram of this gas occupies 11.1 liters?
- In a 100 kg mixture of hydrogen and oxygen, calculate the quantity of gas contained in a mixture of this kind.
 (a) The quantity of the soft drink used is proportional to the mass of the container (10 kg) and the temperature (10°C).
 (b) How does the soft drink use the container (10 kg) and the temperature (10°C) to calculate the quantity of gas contained in a mixture of this kind?
 (c) How does the soft drink use the container (10 kg) and the temperature (10°C) to calculate the quantity of gas contained in a mixture of this kind?



Between us, Mathematics is sometimes lots of fun!

In this part, we find :
 interesting problems that require collective thinking.

18. What is the locus of the center of a variable circle which touches tangents to a fixed parabola?

19. A circle is tangent to a variable line which passes through a fixed point. What is the locus of the center of the circle?

20. A circle is tangent to a fixed line and a fixed point. What is the locus of the center of the circle?

21. A circle is tangent to a fixed line and a fixed point. What is the locus of the center of the circle?

22. A circle is tangent to a fixed line and a fixed point. What is the locus of the center of the circle?

Try this!
 What is the locus of the center of a circle which touches tangents to a fixed parabola?

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