



MATH

STUDENT BOOK

▶ **11th Grade | Unit 2**

MATH 1102

NUMBERS, SENTENCES, AND PROBLEMS

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Numbers, Sentences, and Problems

Introduction

Someone has said, “Numbers make expressions, expressions make sentences, and sentences solve problems.” Our ultimate goal in the study of math, and particularly of algebra, is to *symbolize* a problem and solve it. Many skills at all levels are needed to accomplish this task. This LIFEPAAC[®] consists of a review of some basic skills relating to numbers, methods of solving equations and inequalities of one variable, and the application of the sentence to problem solving.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAAC. When you have finished this LIFEPAAC, you should be able to:

1. Evaluate expressions involving absolute values and integers.
2. Solve linear equations of one variable.
3. Solve and graph linear inequalities.
4. Solve and graph compound sentences.
5. Solve application problems.

Survey the LIFEPAK. Ask yourself some questions about this study and write your questions here.

1. NUMBERS

Numbers referred to here are called the set of rational numbers. They include positive and negative integers and fractions. In this section, you will study properties of order, absolute values of numbers and their graphs, and rules for adding and multiplying signed numbers.

Section Objectives

Review this objective. When you have completed this section, you should be able to:

1. Evaluate expressions involving absolute values and integers.

ORDER AND ABSOLUTE VALUE

This part of Section 1 will deal with solving and graphing equations involving absolute values. Because absolute value terms yield positive and negative numbers, properties of order will first be considered.

DEFINITION

Trichotomy: Given any two numbers, a and b , exactly one of the following is true:

$$a < b \qquad a = b \qquad a > b$$

$a < b$ means that the number a is to the left of b on the number line.

$a = b$ means that the number a is at the same place as b on the number line.

$a > b$ means that the number a is to the right of b on the number line.

DEFINITION

Transitive Property:

A. If $a < b$ and $b < c$, then $a < c$.

B. If $a > b$ and $b > c$, then $a > c$.

On the number line, b is between a and c . In the first case, the numbers are in order a, b, c from left to right. In the second case, the order is c, b, a .

$|a| = K$ means that $a = K$ or $a = -K$.

Model 1: $|a| = 5$ means $a = 5$ or $a = -5$

Model 2: $|a + 2| = 6$ means $a + 2 = 6$ or $a + 2 = -6$
 $a = 4$ or $a = -8$

Check: Replace a with 4

$$|4 + 2| = 6 \quad \text{True}$$

Replace a with -8

$$|-8 + 2| = |-6| = 6 \quad \text{True}$$

Model 3: Solve for x : $|x| = 10$

In set notation, we write

$$x = 10 \text{ or } x = -10$$

$$x = \{-10, 10\}$$

Model 4: Graph $|x| = 2$.

The solution is $x = 2$ or $x = -2$.

The graph is shown here.



Model 5: Graph $x > 2$.

The solution is any number to the right of 2, not including 2.

The graph is shown here.

(The circle on 2 means that the graph does *not* include 2.)



Model 6: If $a = 6$ and $b = 7$, find a number c such that $a < c < b$.

c can be any number between 6 and 7.

$$\text{Let } c = 6\frac{1}{2}.$$

Then $6 < 6\frac{1}{2} < 7$ is a true statement.



Evaluate each of the following expressions.

1.1 $|-3|$ _____

1.3 $|-7| + 3|4|$ _____

1.5 $2|-1|$ _____

1.7 $3|-4|$ _____

1.9 $-|-8 - 2|$ _____

1.2 $|6| + |-4|$ _____

1.4 $|8 + 3|$ _____

1.6 $-|0|$ _____

1.8 $4|-2| - 3|-3|$ _____

1.10 $4 - |-4|$ _____

Write the solution set for each of the following expressions.

1.11 $|a| = 4$ _____

1.13 $|x - 1| = 3$ _____

1.15 $|x| = x$ _____

1.17 $|p| = \frac{2}{3}$ _____

1.19 $|R - 3| = 10$ _____

1.12 $|a + 1| = 4$ _____

1.14 $|K| = -5$ _____

1.16 $|x| + |7| = 10$ _____

1.18 $2|x| = 20$ _____

1.20 $|2x + 6| = 12$ _____

Replace the question mark with one of the following symbols that will make the statement true.

$<$ $=$ $>$ \leq \geq

The variables represent real numbers.

1.21 $6 ? 8$ _____

1.23 $|-a| ? |a|$ _____

1.25 $-|y| ? |-y|$ _____

1.27 $3 ? 4 ? 5$ _____

1.22 $\frac{1}{2} ? \frac{1}{3}$ _____

1.24 $|x| + 1 ? |x|$ _____

1.26 $|-x| ? 0$ _____

1.28 $|-4| ? -|-4|$ _____

Graph each of the following expressions on a number line.

1.29 $|x| = 2$ 

1.30 $|x + 1| = 2$ 

1.31 $|x - 1| = 3$ 

1.32 $|2x| = 6$ 

1.33 $|2x - 1| = 7$ 

1.34 $|x| = 0$ 

1.35 $|2 - x| = 4$ 

SUMS AND PRODUCTS

This part of Section 1 treats the addition and multiplication of signed numbers. Subtraction and division are derived from the principal operations.

To add two numbers of the *same* sign, add their absolute values and use the common sign.

$$\begin{array}{l} \text{Models:} \quad (+7) + (+4) = |7| + |4| \\ \quad \quad \quad = 7 + 4 \\ \quad \quad \quad = 11 \\ \\ \quad \quad \quad (-10) + (-15) = -10 - 15 \\ \quad \quad \quad = -25 \end{array} \qquad \begin{array}{l} (-7) + (-4) = -(|-7| + |-4|) \\ \quad \quad \quad = -(7 + 4) \\ \quad \quad \quad = -11 \end{array}$$

To add two numbers of *opposite* signs, find the difference of their absolute values and attach the sign of the larger absolute value.

$$\begin{array}{l} \text{Models:} \quad (+7) + (-4) = |7| - |-4| \\ \quad \quad \quad = 7 - 4 \\ \quad \quad \quad = 3 \\ \\ \quad \quad \quad (-8) + (+5) = |5| - |-8| \\ \quad \quad \quad = 5 - 8 \\ \quad \quad \quad = -3 \end{array} \qquad \begin{array}{l} (-7) + (+4) = |4| - |-7| \\ \quad \quad \quad = 4 - 7 \\ \quad \quad \quad = -3 \\ \\ \quad \quad \quad (+10) + (-20) = |10| - |-20| \\ \quad \quad \quad = 10 - 20 \\ \quad \quad \quad = -10 \end{array}$$

The product and quotient of two numbers having *like* signs is *positive*.

$$\begin{array}{l} \text{Models:} \quad (+3) \cdot (+2) = (+6) \\ \quad \quad \quad (-3) \cdot (-2) = (+6) \\ \quad \quad \quad (+10) \div (+2) = (+5) \\ \quad \quad \quad (-10) \div (-2) = (+5) \end{array}$$

The product and quotient of two numbers having *opposite* signs is *negative*.

$$\begin{array}{l} \text{Models:} \quad (+8) \cdot (-3) = (-24) \\ \quad \quad \quad (-24) \div (+3) = (-8) \end{array}$$

Note: Parentheses are used only to identify signs and do not affect the order of operations.

Simplify each expression.

1.36 $2 + 5$ _____

1.38 $-2 + 5$ _____

1.40 $-3 + (-4)$ _____

1.42 $10 - 8$ _____

1.44 $20 - 12 - 8$ _____

1.46 $3 + 10 - 8 - 20 - 2$ _____

1.48 $200 - 12 - 8 + 4$ _____

1.50 $15 - 12 + 20 + 1$ _____

1.52 $-10.5 - 20.1$ _____

1.54 $3.85 - 2.61$ _____

1.56 $(-6)(-2)$ _____

1.58 $6(-4)$ _____

1.60 $-15(10)$ _____

1.62 $(-16) \div (-4)$ _____

1.64 $8 \div (-2) \cdot (-6)$ _____

1.37 $2 + (-5)$ _____

1.39 $-2 + (-5)$ _____

1.41 $8 - 2$ _____

1.43 $12 - 14$ _____

1.45 $13 + 2 - 5 - 15$ _____

1.47 $13 - 4 - 10 + 2$ _____

1.49 $72 - 81 - 10 + 4$ _____

1.51 $2.3 - 8.4$ _____

1.53 $-8.6 + 2.3 + 1$ _____

1.55 $7.25 - 4.96 - 8.23$ _____


1.57 $(-10)(-8)$ _____

1.59 $8(2)$ _____

1.61 $(-24) \div (8)$ _____

1.63 $(-105) \div (-5)$ _____

1.65 $(-8)(-\frac{1}{2})$ _____

 **Review the material in this section in preparation for the Self Test.** The Self Test will check your mastery of this particular section. The items missed on this Self Test will indicate specific areas where restudy is needed for mastery.



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