


Grade 8 Mathematics

Algebra: Lesson 5

Read aloud to the students the material that is printed in **boldface type** inside the boxes. Information in regular type inside the boxes and all information outside the boxes should **not** be read to students. Possible student responses are included in parentheses after the questions.

NOTE: The directions read to students may depend on the available materials. Read only those parts of the lesson that apply to the materials you are using.

Any directions that ask you to do something, such as to turn to a page or to hand out materials to students, will have an arrow symbol () by them.

Purpose of Lesson 5:

- In this lesson, the tutor and the students will
 - ✓ use whole number exponents in problems, and
 - ✓ recognize and use exponential expressions.

Equipment/Materials Needed:

- Copies of Student Sheets 90 and 91
- Paper and pencils
- Chalkboard
- Calculators (Optional)

Preparations before beginning Lesson 5:

- Run one copy of Student Sheets 90 and 91 for each student.
- Have paper and pencils available.
- Borrow calculators from one of the teachers if you decide to use them.

Lesson 5: Algebra

📏 Give students Student Sheet 90.

Say:

Using the grid paper on Part A of Student Sheet 90, draw a square that is two blocks long and two blocks wide. How many blocks are in the square? (4) Draw a 3 ´ 3 square? How many blocks are in the square? (9) Draw a 4 ´ 4 square. How many blocks are in the square? (16) When you multiply a number by itself, the result is called the *square* of the number. 25 is the square of 5. 81 is the square of 9. 64 is the square of what number? (8) Let’s look at 3 ´ 3. In algebra, there is a shorthand method for writing 3 ´ 3. It can be written as 3².

📏 Draw this figure on the board.

base → 3² ← exponent or power

Say:

The *base* is the number you are multiplying. The *exponent*, or *power*, is the number of times you use the base as a factor.

$$3 \times 3 = 3^2$$

3² is called “3 squared.” Why do you think it is called this name? (If you think of drawing it, you would draw a square. The length and width are the same.) What is 6²? (36) What is 10²? (100) 49 is the square of what number? (7)

Say:

Look at Figure A in Part B of Student Sheet 90. What kind of figure is this? (cube) What are the length, width, and height of this cube? (2 units × 2 units × 2 units) How many blocks are in this cube? (8) Look at Figure B. What are the dimensions of this cube? (3 × 3 × 3) How many blocks are in the cube? (27) Look at Figure C. What are the dimensions of this cube? (4 × 4 × 4) How many blocks are in the cube? (64) You could write 4 ´ 4 ´ 4 in exponential form. You are using 4 as a factor 3 times. You could write this as 4³. 4 is the base; 3 is the exponent, or power. 4³ can be read as “4 cubed” or “4 to the third power.” 64 is the cube of 4. 27 is the cube of 3. 8 is the cube of 2.

Say:

Squares and cubes are easy to visualize because we live in a three-dimensional world. As exponents get larger, you can't draw pictures of them, but you can follow the rules for squares and cubes.

$3 \cdot 3 \cdot 3 \cdot 3 = 3^4$. 3 is the base, and 4 is the exponent. It can be read "3 to the fourth power." How could you write $4 \cdot 4 \cdot 4 \cdot 4 \cdot 4$? (4^5) How would you read this number? (4 to the fifth power) What does 4^5 equal? (1024) How could you write 2^4 another way? ($2 \times 2 \times 2 \times 2$) What is the value of 2^4 ? (16) On many calculators, the (y^x) key allows you to work with exponents. To find the value of 2^4 , enter " $2 y^x 4 =$ " The result is 16.

Say:

Suppose you write x^2 . What does this mean? ($x \times x$; the letter x squared; the letter x to the second power; the letter x times itself) If x is a variable, then you can substitute numbers for x and find the value of x^2 . Suppose $x = 5$, what is x^2 ? (25) Suppose $x = 7$, what is x^2 ? (49) Suppose $x = 9$, what is x^2 ? (81) Suppose $x = -2$, what is x^2 ? (4) This operation is difficult for students. They need to realize that they are substituting x with -2 and that this action gives $(-2)^2$ or -2×-2 . Students must square -2 , not just 2. This concept is critical. If $x = -3$, then $x^2 = 9$, not -9 . The only time you could get -9 is when the expression is written $-(3)^2$. This expression is read as the opposite of 3^2 or -9 .

Give students Student Sheet 91.

Answers:


1. 32 2. 36 3. 1 4. 121 5. 512
6.

x	$x - 1$	$2x$	x^2	$-x^2$	x^3	$-x^3$
3	2	6	9	-9	27	-27
2	1	4	4	-4	8	-8
1	0	2	1	-1	1	-1
0	-1	0	0	0	0	0
-1	-2	-2	1	-1	-1	1
-2	-3	-4	4	-4	-8	8
-3	-4	-6	9	-9	-27	27

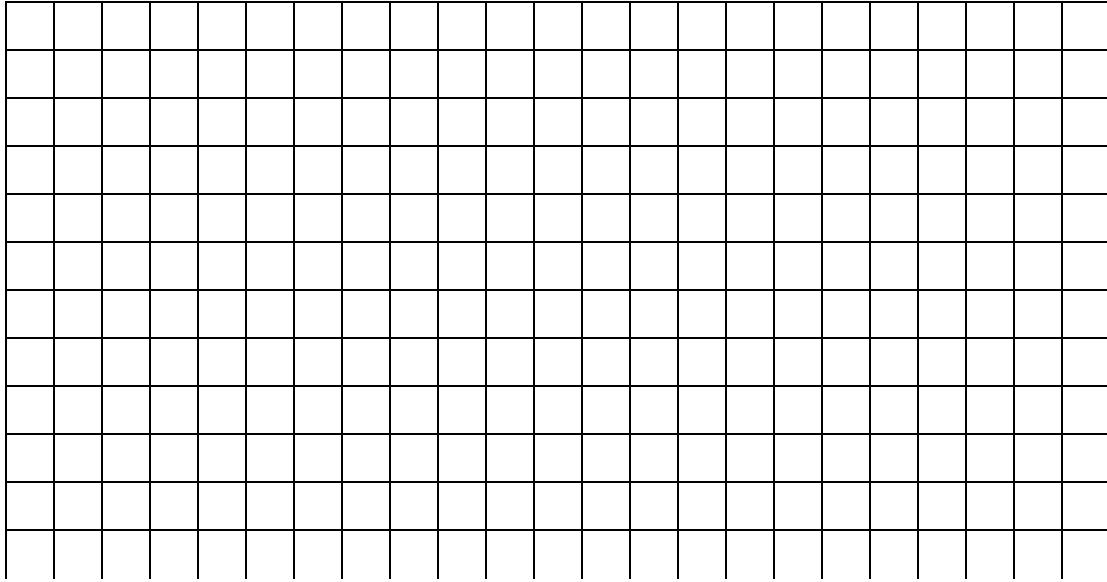
7. There are many, many patterns. Here are just a few.

- a. The numbers in the $x - 1$ column are decreasing by one.

- b. The numbers in the $2x$ column are doubles of the x column and are decreasing by two.
 - c. All of the numbers in the x^2 column are positive. The answers for 3 and -3 are the same. The answers for 2 and -2 are the same. The answers for 1 and -1 are the same.
 - d. The numbers in the $-x^2$ column are the opposites of the numbers in the x^2 column. The answers for 3 and -3 are the same. The answers for 2 and -2 are the same. The answers for 1 and -1 are the same.
 - e. The numbers in the x^3 column and the $-x^3$ column are opposites.
8. No. 2^3 is $2 \times 2 \times 2$ or 8 and 3^2 is 3×3 or 9.
9. $2 \times 4 = 8$ and 2^4 is $2 \times 2 \times 2 \times 2$ or 16.
10. B
11. B
12. 16 square meters
13. 3025 square feet

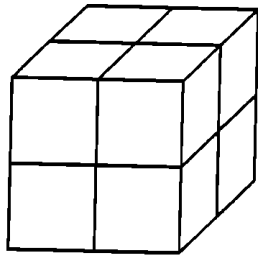
 Have one student summarize today's lesson. When working with exponents, remember that the exponent tells you how many times to use a base as a factor.

Student Sheet 90 (Algebra: Lesson 5) Part A

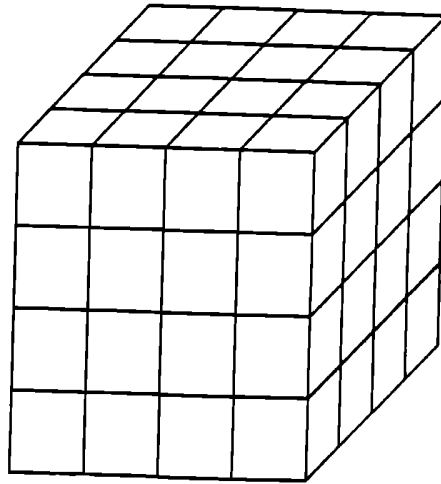


Part B

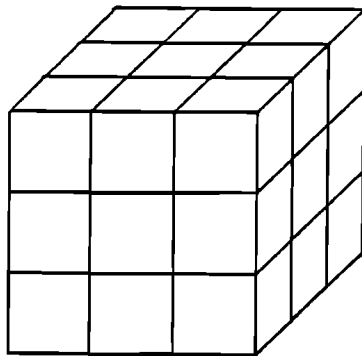
A.



C.



B.



Student Sheet 91 (Algebra: Lesson 5)

Find each of the following squares.

1. 2^5
2. 6^2
3. 1^3
4. 11^2
5. 8^3
6. Fill in the chart for the values of x .

x	$x - 1$	$2x$	x^2	$-x^2$	x^3	$-x^3$
3						
2						
1						
0						
-1						
-2						
-3						

7. What patterns do you notice in the chart?
8. Is 2^3 the same as 3^2 ? Explain.
9. How is 2×4 different from 2^4 ?
10. Which equals $2 \times 2 \times 2 \times 2 \times 2$?
A. 25 B. 2^5 C. 5^2 D. 2×5
11. Which equals 8^3 ?
A. 83 B. $8 \times 8 \times 8$
C. $3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$ D. 24
12. The length of a square patio measures four meters on each side. What is the area of the patio?
13. The Washington Monument in Washington D.C. has a square base. It is approximately 55 feet on each side. What is the area of the base of the monument?