

## What We Are Learning

## Exponents

## VOCABULARY

These are the math words we are learning:

**scientific notation**

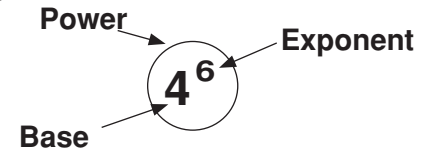
a method of writing numbers that may be very large or very small

*Dear Family,*

This section is the beginning point for another phase of algebra. Students have completed the topics involving linear functions, but before they can proceed to non-linear functions, they need to master some fundamental skills.

Given the expression  $4^6$ , 4 is the base and 6 is the exponent.

$$4^6 = 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 = 4096$$



The student will be introduced to powers involving *integer exponents*, including 0 and negative numbers. The student will also use exponent patterns to discover rules for calculating with very large and very small numbers.

**POWERS WITH ZERO EXPONENTS**

Any nonzero number raised to the zero power equals 1.

**Evaluate.**

A.  $4^0 = 1$       B.  $\left(\frac{5}{6}\right)^0 = 1$       C.  $(-9.75)^0 = 1$

**POWERS WITH NEGATIVE EXPONENTS**

Powers involving a negative exponent can be rewritten using a positive exponent by using the reciprocal.

**Write each power using a positive exponent.**

A.  $4^{-6} = \frac{1}{4^6}$       B.  $\frac{1}{3^{-4}} = 3^4$

The student will apply these rules to simplify and evaluate expressions involving exponents.

**Evaluate  $9s^{-4}$  for  $s = 3$ .**

$$9s^{-4} = \frac{9}{s^4} = \frac{9}{3^4} = \frac{9}{3 \cdot 3 \cdot 3 \cdot 3} = \frac{9}{81} = \frac{1}{9}$$

As students progress through this section, they will also study patterns involving powers of 10 and explore the use of scientific notation. Students will appreciate this useful short-hand approach to writing very large and very small numbers.

The table shows the relationships between several powers of 10.

		$\times 10$	$\times 10$	$\times 10$	$\times 10$	$\times 10$	
		$\curvearrowright$	$\curvearrowright$	$\curvearrowright$	$\curvearrowright$	$\curvearrowright$	
<b>Power</b>	$10^{-3}$	$10^{-2}$	$10^{-1}$	$10^0$	$10^1$	$10^2$	$10^3$
<b>Value</b>	$\frac{1}{1000} = 0.001$	$\frac{1}{100} = 0.01$	$\frac{1}{10} = 0.1$	1	10	100	1000
		$\curvearrowleft$	$\curvearrowleft$	$\curvearrowleft$	$\curvearrowleft$	$\curvearrowleft$	$\curvearrowleft$
		$\div 10$	$\div 10$	$\div 10$	$\div 10$	$\div 10$	$\div 10$

- Each time you *multiply* by 10, the exponent increases and the decimal point moves one place to the right.
- Each time you *divide* by 10, the exponent decreases and the decimal point moves one place to the left.

When a decimal point is moved to follow the first nonzero number, the resulting number and power of 10 is said to be in **scientific notation**.

$$250 = 250 \times 10^0 = 25.0 \times 10^1 = 2.50 \times 10^2, \text{ or } 2.5 \times 10^2$$

**Write the distance 3,900,000 km using scientific notation.**

The decimal moves 6 places left.

$$3,900,000 \text{ km} = 3.9 \times 10^6 \text{ km}$$

The student will use patterns to deduce properties involving multiplying and dividing exponential expressions. It is helpful for the student to make flash cards of these six properties (see the textbook):

**Product of Powers**

**Power of a Power**

**Power of a Product**

**Quotient of Powers**

**Positive Power of a Quotient**

**Negative Power of a Quotient**

The cards should be reviewed until students master each property, as the properties are important for upcoming concepts.

*Sincerely,*

**CHAPTER**  
**7** **At-Home Practice**  
**Exponents**

Evaluate each expression for the given value(s) of the variable(s).

1.  $x^{-3}$  for  $x = 4$                       2.  $a^5$  for  $a = -2$                       3.  $t^{-3}u^2$  for  $t = 5$  and  $u = 8$

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**Simplify.**

4.  $6d^{-4}$                       5.  $\frac{y^3}{x^{-4}}$                       6.  $-5p^0r^{-4}$

\_\_\_\_\_

7. Write  $10^{-5}$  in standard notation. \_\_\_\_\_  
8. Write 10,000,000,000 as a power of 10. \_\_\_\_\_

**Simplify.**

9.  $3^4 \cdot 3^3$                       10.  $4^{-2} \cdot 4^5$                       11.  $(q^4s^2)^4$                       12.  $(ab^3)^4 \cdot (a^2b)^2$

13.  $\frac{5^5}{5^3}$                       14.  $\frac{6c^4d^3}{18cd^5}$                       15.  $\left(\frac{3}{4}\right)^{-3}$

**Simplify each quotient and write the answer in scientific notation.**

16.  $(9 \times 10^5) \div (3 \times 10^3)$                       17.  $(4 \times 10^3) \div (12 \times 10^5)$                       18.  $(6 \times 10^4) \div (8 \times 10^8)$

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**Simplify each expression. All variables represent nonnegative numbers.**

19.  $49^{\frac{1}{2}}$                       20.  $\sqrt{x^6y^2z^8}$                       21.  $25^{\frac{3}{2}}$

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**Answers:** 1.  $\frac{1}{64}$ ; 2.  $-32$ ; 3.  $\frac{125}{64}$ ; 4.  $\frac{6}{5}$ ; 5.  $x^4y^3$ ; 6.  $\frac{r^4}{5}$ ; 7. 0.00001; 8.  $1.0 \times 10^{10}$ ; 9. 2187; 10. 64;  
11.  $q^6s^8$ ; 12.  $a^8b^{14}$ ; 13. 25; 14.  $\frac{3d^2}{c^3}$ ; 15.  $\frac{27}{64}$ ; 16.  $3 \times 10^2$ ; 17.  $3.3 \times 10^{-3}$ ; 18.  $7.5 \times 10^{-5}$ ; 19. 7;  
20.  $x^3yz^4$ ; 21. 125

## CHAPTER

**Family Fun****7****Power War**

**Objective:** To evaluate expressions containing zero and integer exponents

**Materials:** Deck of cards  
Calculator (optional)

**Directions:**

Each player picks two cards from the deck to form a power. The power with the greatest value wins the hand.

- Shuffle the cards and place the deck face down on a table.
- Each player chooses 1 card. That card is the base of the power.
- The player then chooses a second card. That card is the exponent on the base.
- Each player evaluates his or her power. The player with the greatest value takes all of the cards in that round.
- If the values of the expressions are equal, then war is declared.

**Card Values**

Each number card Ace through 10 is used at face value.

Red cards are negative

Black cards are positive

Face cards— kings, queens, jacks— are equal to zero.

**WAR**

- Each player draws three cards face down and one card face up.
- The player that can make the largest power with any two of the original cards and the face up card takes all the cards.
- If still tied, repeat war.

**Example**

Player A and B both draw a black 2 and a black 4. Each value is  $2^4 = 16$ , so war is declared.

Player A selects three cards face down and turns up a red 3. Player A now has cards of value 2, 4, and  $-3$ . The largest power using two of these cards is  $(-3)^4 = 81$ .

Player B does the same and turns up a black King. Player A now has cards of value 2, 4, and 0. The largest power using two of these cards is still 16, so player A takes the cards.

- The player who ends up with all of the cards is the winner.

## What We Are Learning

## Polynomials

## VOCABULARY

These are the math words we are learning:

**binomial** a polynomial with 2 terms

**degree of a monomial** the sum of the exponents of the variables

**degree of a polynomial** the degree of the term with the greatest degree

**leading coefficient** the coefficient of the first term

**monomial** a number, a variable, or a product of numbers and variables with whole number exponents

**perfect square trinomial** a trinomial that is the result of squaring a binomial

**polynomial** a monomial or a sum or difference of monomials

**standard form of a polynomial** terms are written in order from greatest degree to least degree

**trinomial** a polynomial with 3 terms

*Dear Family,*

In this section, the algebraic expressions the student encounters will seem complicated. Expressions may contain any number of terms, terms may or may not be combined, and terms may include powers with various types of exponents.

Students have already learned most of the algebraic skills needed to be successful in this section, but they may not yet have a way to approach these types of expressions systematically, nor the terminology needed to describe them. This is the main objective of this section of material.

The student will learn that terms such as the ones shown below are called **monomials**.

$$3x \quad 22 \quad \frac{p^2}{4} \quad -9h \quad \frac{5}{7}mn \quad 4x^2y$$

Monomials may be:

- a number
- a variable
- a product of numbers and variables with whole number exponents

See if the student can explain to you why  $\sqrt{25x}$  is not a monomial.

A polynomial is a monomial or a sum or difference of monomials. Below are examples of some polynomials and the meaning of the terms associated with polynomials.

$$3x - 2sx \quad 4xy \quad 9x^2 - 3x + 12 \quad -2y^4 - \frac{1}{2}y^2 + 17y - 8$$

The **degree of a polynomial** is the degree of the term with the greatest degree. The degree of each term is the sum of the exponents of the variables. The degree of  $12 + 9x^2 - 3x$  is 2.

A **polynomial written in standard form** is written with its terms in order from greatest degree to least degree. The polynomial  $12 + 9x^2 - 3x$  in standard form is  $9x^2 - 3x + 12$ .

Some polynomials have special names based on their degree or the number of terms they have. The student will need to remember this table in order to classify polynomials.

Degree	Name
0	Constant
1	Linear
2	Quadratic
3	Cubic
4	Quartic
5	Quintic
6 or more	6th degree, 7th degree, etc.

Terms	Name
1	Monomial
2	Binomial
3	Trinomial
4 or more	Polynomial

**Classify**  $-2y^4 - \frac{1}{2}y^2 + 17y - 8$  according to its degree and number of terms.

It has degree 4 and there are 4 terms, so it is a quartic polynomial.

In Lesson 1-7, students learned about like terms. In this chapter, they learned about properties of powers. They now apply these concepts to adding, subtracting, and multiplying polynomials.

**Simplify**  $(5r^2 + 6r^3) + (10r^3 - 3r^2)$ .

$(6r^3 + 10r^3) + (5r^2 - 3r^2)$  Rearrange so like terms are together.

$16r^3 + 2r^2$

Combine like terms.

**Multiply the polynomials.**

a.  $6h^4 \cdot 3h^5 = 18h^{(4+5)} = 18h^9$

b.  $4ab(-2b - 4a^2b) = -8ab^2 - 16a^3b^2$

Students should be able to explain to you which power property was used to obtain each product. As students become proficient in multiplying polynomials, they will be shown a few short-cuts for finding products of some specific types of binomials. Ask students to show you these short cuts and have them explain when they can and cannot use them.

*Sincerely,*

**CHAPTER**  
**7**

**At-Home Practice**  
**Polynomials**

Write each polynomial in standard form and give the leading coefficient.

1.  $5x + 8x^5 - 9x^2 + 2$

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2.  $7 + 8y + 5y^2 + y^3$

\_\_\_\_\_

3.  $-r^2 + 5r + 3 + r^3$

\_\_\_\_\_

Classify each polynomial according to its degree and number of terms.

4.  $6c^2$

\_\_\_\_\_

5.  $-4x^3 + 8x + 1 + 2x^5$

\_\_\_\_\_

6.  $7x + 6x^3$

\_\_\_\_\_

Add or subtract.

7.  $(6b + 8b^2) + (3b^3 - 5b)$

\_\_\_\_\_

8.  $(9f + 6 - 4f^2) - (4f + 4f^2)$

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9.  $(a^2 - 9a) + (9a + 5a^2)$

\_\_\_\_\_

Multiply.

10.  $(5a + 3)(a + 6)$

\_\_\_\_\_

11.  $3yz^4 \cdot 7y^3z^2$

\_\_\_\_\_

12.  $(4sr^2)(-5s^3r + s - 8r^3)$

\_\_\_\_\_

13.  $(4a + 5)^2$

\_\_\_\_\_

14.  $(c - 7)(c + 7)$

\_\_\_\_\_

15.  $(2b + 5c)^2$

\_\_\_\_\_

Tell whether the given number is a root of the polynomial.

16.  $2x^2 - 8$ ; 2

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17.  $x^2 + 4x - 21$ ; 3

\_\_\_\_\_

18.  $5x^2 - 64$ ; 8

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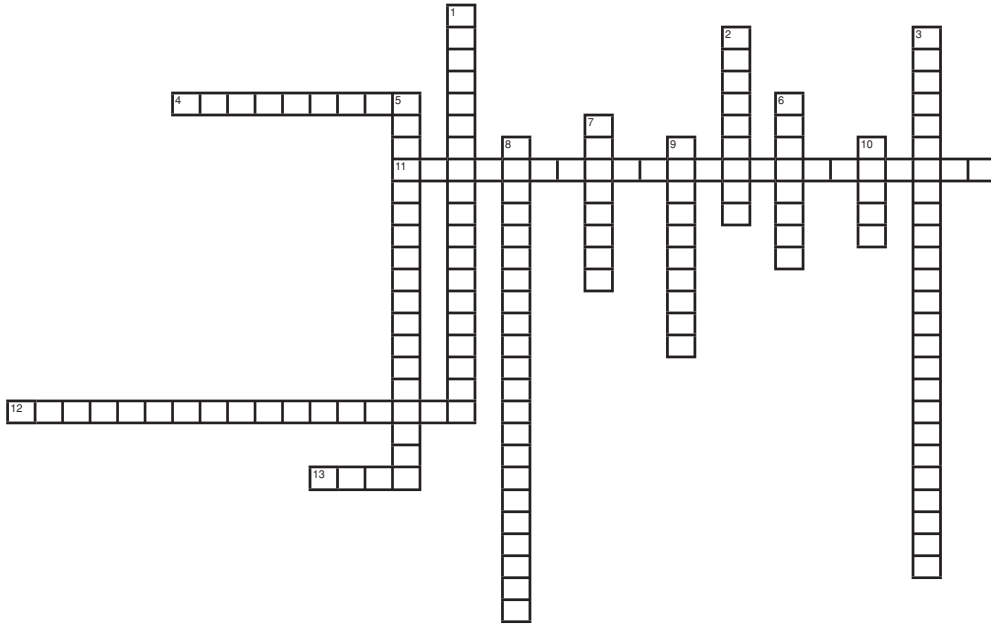
**Answers:** 1.  $8x^5 - 9x^2 + 5x + 2$ ; 2.  $y^3 + 8y + 7$ ; 3.  $r^3 - r^2 + 5r + 3$ ; 4. quadratic monomial; 5. quintic polynomial; 6. cubic trinomial; 7.  $3b^3 + 8b^2 + b$ ; 8.  $-8f^2 + 5f + 6$ ; 9.  $6a^2$ ; 10.  $5a^2 + 33a + 18$ ; 11.  $21y^4z^6$ ; 12.  $-20s^4r^3 + 4s^2r^2 - 32sr^5$ ; 13.  $16a^2 + 40a + 25$ ; 14.  $c^2 - 49$ ; 15.  $4b^2 + 20bc + 25c^2$ ; 16. yes; 17. yes; 18. no

**LESSON**  
**7**

**Family Letter**  
**Crossword Puzzle**

**Objective:** To practice math vocabulary.

**Directions:** Use the math vocabulary from this section to solve the crossword puzzle.



Across	Down
<p><b>4.</b> a name for this polynomial: <math>x^2 + 2x + 1</math></p>	<p><b>1.</b> the term in a polynomial with the greatest degree determines this</p>
<p><b>11.</b> the method used to factor this binomial: <math>x^2 - 36</math></p>	<p><b>2.</b> <math>18x^2 + 3x + 1</math> is an example of a _____ polynomial</p>
<p><b>12.</b> the sum of the exponents of the variables</p>	<p><b>3.</b> When <math>8x^2 + 4 + x^3</math> is written as <math>x^3 + 8x^2 + 4</math></p>
<p><b>13.</b> the value of the variable when the polynomial equals 0</p>	<p><b>5.</b> The "8" in 3 <i>down</i> is called the _____</p>
	<p><b>6.</b> <math>5x - 2</math> is this type of polynomial</p>
	<p><b>7.</b> <math>3x^2</math>, 4 and <math>8y</math> are examples of this type of polynomial</p>
	<p><b>8.</b> What is special about this type of polynomial <math>x^2 + 10x + 25</math>?</p>
	<p><b>9.</b> These expressions <math>5x - 4</math>, <math>x^4 + x + 3x</math>, and <math>18x^3</math> are various types of _____.</p>
	<p><b>10.</b> <math>8x^3 + 5x^2 + 1</math> can be classified as a _____ trinomial .</p>

**Answers:** Across: **4.** trinomial; **11.** difference of two squares; **12.** degree of a monomial; **13.** root;  
Down: **1.** degree of a polynomial; **2.** quadratic; **3.** standard form of a polynomial; **5.** leading coefficient;  
**6.** binomial; **7.** monomial; **8.** perfect square trinomial; **9.** polynomial; **10.** cubic