



Alg1Lesson36

Algebra I
Unit 4
01/26-27/16

Lesson 36 – Process**Learning and Social Objective(s)**

1. Students will be able to use negative power, zero power, power of a power, power of a product, and power of a quotient properties to simplify expressions with exponents.

Agenda [103 minutes]

1. Warm-Up [10 min]
2. Review Lesson 35 [10 min]
3. Agenda/Objectives [3 min]
4. Unit 4 Pre-Assessment Grading [5 min]
5. Guided Notes and Practice [60 min]
6. Wrap-Up [5 min]

Apple word

- Process: a series of actions taken to produce a specific result.

Homework (Due 01/28-29/16)

SB pages 292-293 #5(a-d), Try These A (a-c), 6-15

SB pages 294-296 #3, 6, 8, Try These A-B (a-e), 9-17(odd)

Lesson Notes

Have students add to the table created together last class to use as a reference for the properties of exponents. Making observations in the warm-up will be used to finish the table started in Lesson 35 Key Notes.

Use warm-up problem 5, Negative Power Property: $\frac{1}{a^n} = a^{-n}$, where $a \neq 0$.

Use warm-up problem 6, Zero Power Property: $a^0 = 1$, where $a \neq 0$.

Use warm-up problem 7, Power of a Power Property: $(a^m)^n = a^{m \cdot n}$.

Use warm-up problem 8, Power of a Product Property: $(ab)^m = a^m \cdot b^m$.

Use warm-up problem 9, Power of a Quotient Property: $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$, where $b \neq 0$.

After completing both properties, work on several examples with students and have the "I do" be one of their homework problems. Note that they should never write negative exponents in their final answer after simplifying.

Negative Power Property: Examples 1-2, SB page 292 #5(a-c)

Zero Power Property: Example 3 SB page 292 #5(c-d)

Power of a Power Property: Example 4, SB pages 294-296 #3, Try These A-B (a)

Power of a Product Property: Example 5, SB pages 295-296 #6, Try These A-B (a-b)

Power of a Quotient Property: Example 6, SB pages 295-296 #8, Try These A-B (c)

Name:

Class Period:

Lesson 36 Guided Notes

Warm-Up

Directions: Simplify each of the expressions below and be prepared to share your answers. When you finish, write down today's homework from the Daily Bulletin into your Assignment Log.

1. $w^5 \cdot w^{11}$

2. $\frac{u^8}{u^3}$

3. $\frac{q^{4/7}}{q^{3/7}}$

4. $p^{1/3} \cdot p^{4/9}$

5. $\frac{3^3}{3^2}$

6. $\frac{k}{k}$

7. $x^3 \cdot x^3$

8. $s^5 \cdot t^5$

9. $\frac{c^6}{d^6}$

Negative Power**Example 1**

Simplify without writing negative exponents

$$\frac{y^2}{y^7}.$$

Example 2

Simplify $\frac{x^{15}y^{-4}}{x^3}$.

Zero Power**Example 3**

Simplify $\frac{2d^6t^{-2}}{4d^6}$.

Power of a Power**Example 4**

Simplify $(2g^{1/3})^2(h^5)^{-4}$.

Power of a Product**Example 5**

Simplify $(a^{-1}b^2)^{-2}(ab)^4$.

Power of a Quotient**Example 6**

Simplify $\left(\frac{j^{-5}r^{3/4}}{z^{1/3}}\right)^3$.

Lesson35Key

Thursday, January 28, 2016 11:52 AM



Lesson35Key

Name:

key

Class Period:

Lesson 35 Guided Notes

Warm-Up

Directions: Simplify each expression below and be prepared to share your answers. When you finish, write down today's homework from the Daily Bulletin into your Assignment Log.

$$1. 2 + 2 = 4$$

$$2. 2 + x = 2 + x$$

$$3. x + x = 2x$$

$$4. 2x + x = 3x$$

$$5. 2x + 3x = 5x$$

$$6. 2 \cdot 2 = 4$$

$$7. 2 \cdot x = 2x$$

$$8. x \cdot x = x^2$$

$$9. 2x \cdot x = 2x^2$$

$$10. 2x \cdot 3x = 6x^2$$

$$11. 2x \cdot 3x + 2x = 6x^2 + 2x$$

$$12. 2x + 3x \cdot 3x = 2x + 9x^2$$

$$13. 2 - 2 = 0$$

$$14. 2 - x = 2 - x$$

$$15. x - x = 0$$

$$16. 2x - x = x$$

$$17. 2x - 3x = -x$$

$$18. 2 \div 2 = 1$$

$$19. 2 \div x = \frac{2}{x}$$

$$20. x \div x = 1$$

$$21. 2x \div x = 2$$

$$22. 2x \div 3x = \frac{2}{3}$$

$$23. 2x - 3x \div 2x = 2x - \frac{3}{2}$$

$$24. 2x \div 3x - 3x = \frac{2}{3} - 3x$$

Order of Operations

Parentheses $()$

Exponents 2^x

Multiply $a \cdot b$

Divide $\frac{a}{b}$

Add $a + b$

Subtract $a - b$

Use PEMDAS if you are performing multiple operations.

Property of Exponents	Verbal Description	Symbolic Form	Example
Product of Powers	multiply same base, add exponents	$a^m \cdot a^n = a^{m+n}$	$2 \cdot 2 = 2^2 = 4$
Quotient of Powers	divide same base, subtract exponents	$\frac{a^m}{a^n} = a^{m-n}$ $a \neq 0$	$\frac{x^2}{x} = x^1 = x$
Negative Power			
Zero Power			
Power of a Power			
Power of a Product			
Power of a Quotient			

Product of Powers

Example 1

Simplify $3^1 \cdot 3^2$.

$$3^1 \cdot 3^2 = 3^3 = 3 \cdot 3 \cdot 3 = 27$$

Example 2

Simplify $x^2 \cdot x^4$.

$$x^2 \cdot x^4 = x^6$$

Example 3

Simplify $d^5 \cdot t^2$.

$$d^5 \cdot t^2 = d^5 t^2$$

Example 4

Simplify $p^{2/3} \cdot p^{4/3}$.

$$p^{2/3} \cdot p^{4/3} = p^{6/3} = p^2$$

Quotient of Powers

Example 5

Simplify $2^4 \div 2^1$.

$$\frac{2^4}{2^1} = 2^3 = 2 \cdot 2 \cdot 2 = 8$$

Example 6

Simplify $\frac{z^{11}}{y^7}$.

$$\frac{z^{11}}{y^7} = \frac{z^{11}}{y^7}$$

Example 7

Simplify $\frac{x^{23}}{x^{12}}$.

$$\frac{x^{23}}{x^{12}} = x^{11}$$

Example 8

Simplify $\frac{q^{5/8}}{q^{3/8}}$.

$$\frac{q^{5/8}}{q^{3/8}} = q^{2/8} = q^{1/4}$$

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ACTIVITY 19

continued

My Notes

Lesson 19-2 Negative and Zero Powers

4. Based on the pattern you observed in Item 3, fill in the box below to complete the **Zero Power Property** of exponents.

$$a^0 = \boxed{}, \text{ where } a \neq 0$$

5. Use the properties of exponents to evaluate the following expressions.

a. 2^{-3}

b. $\frac{10^2}{10^{-2}}$

c. $3^{-2} \cdot 5^0$

d. $(-3.75)^0$

When evaluating and simplifying expressions, you can apply the properties of exponents and then write the answer without negative or zero powers.

Example A

Simplify $5x^{-2}yz^0 \cdot \frac{3x^4}{y^4}$ and write without negative powers.

Step 1: Commutative Property $5x^{-2}yz^0 \cdot \frac{3x^4}{y^4}$
 $= 5 \cdot 3 \cdot x^{-2} \cdot x^4 \cdot y^1 \cdot y^{-4} \cdot z^0$

Step 2: Apply the exponent rules.
 $= 5 \cdot 3 \cdot x^{-2+4} \cdot y^{1-4} \cdot z^0$

Step 3: Simplify the exponents.
 $= 15 \cdot x^2 \cdot y^{-3} \cdot 1$

Step 4: Write without negative exponents.
 $= \frac{15x^2}{y^3}$

Solution: $5x^{-2}yz^0 \cdot \frac{3x^4}{y^4} = \frac{15x^2}{y^3}$

Try These A

Simplify and write without negative powers.

a. $2a^2b^{-3} \cdot 5ab$

b. $\frac{10x^2y^{-4}}{5x^{-3}y^{-1}}$

c. $(-3xy^{-5})^0$

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Lesson 19-2

Negative and Zero Powers

ACTIVITY 19

continued

Check Your Understanding

Simplify each expression. Write your answer without negative exponents.

6. $(z)^{-3}$

7. $12(xyz)^0$

8. $\frac{6^{-4}}{6^{-2}}$

9. $2^3 \cdot 2^{-6}$

10. $\frac{4x^{-2}}{x^3}$

11. $\frac{-5}{(ab)^0}$

LESSON 19-2 PRACTICE

12. For what value of v is $a^v = 1$, if $a \neq 0$?
13. For what value of w is $b^{-w} = \frac{1}{b^9}$, if $b \neq 0$?
14. For what value of y is $\frac{3^3}{3^y} = \frac{1}{9}$?
15. For what value of z is $5^8 \cdot 5^z = 1$?
16. Determine the values of n and m that would make the equation $7^n \cdot 7^m = 1$ a true statement. Assume that $n \neq m$.
17. For what value of x is $\frac{3^x \cdot 2^2}{3^4} = \frac{4}{3}$?
18. **Reason abstractly.** What is the value of $2^0 \cdot 3^0 \cdot 4^0 \cdot 5^0$? What is the value of any multiplication problem in which all of the factors are raised to a power of 0? Explain.

My Notes

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ACTIVITY 19

continued

Lesson 19-3

Additional Properties of Exponents

My Notes

Learning Targets:

- Develop the Power of a Power, Power of a Product, and the Power of a Quotient Properties.
- Simplify expressions involving exponents.

SUGGESTED LEARNING STRATEGIES: Note Taking, Look for a Pattern, Create Representations, Think-Pair-Share, Sharing and Responding, Close Reading

1. Write each expression in expanded form. Then write the expression using a single exponent with the given base. The first one has been done for you.

Original Expression	Expanded Form	Single Power
$(2^2)^4$	$2^2 \cdot 2^2 \cdot 2^2 \cdot 2^2 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	2^8
$(5^5)^3$		
$(x^3)^4$		

2. Based on the pattern you observed in Item 1, write the missing exponent in the box below to complete the **Power of a Power Property** for exponents.

$$(a^m)^n = a^{\boxed{}}$$

3. Use the Power of a Power Property to write $\left(x^{\frac{6}{5}}\right)^{25}$ as a single power.

4. Write each expression in expanded form and group like terms. Then write the expression as a product of powers. The first one has been done for you.

Original Expression	Expanded Form	Product of Powers
$(2x)^4$	$2x \cdot 2x \cdot 2x \cdot 2x = 2 \cdot 2 \cdot 2 \cdot 2 \cdot x \cdot x \cdot x \cdot x$	2^4x^4
$(-4a)^3$		
$(x^3y^2)^4$		

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Lesson 19-3

Additional Properties of Exponents

ACTIVITY 19

continued

My Notes

5. Based on the pattern you observed in Item 4, write the missing exponents in the boxes below to complete the **Power of a Product Property** for exponents.

$$(ab)^m = a^{\square} \cdot b^{\square}$$

6. Use the Power of a Product Property to write $\left(c^{\frac{1}{2}}d^{\frac{1}{4}}\right)^8$ as a product of powers.

7. **Make use of structure.** Use the patterns you have seen. Predict and write the missing exponents in the boxes below to complete the **Power of a Quotient Property** for exponents.

$$\left(\frac{a}{b}\right)^m = \frac{a^{\square}}{b^{\square}}, \text{ where } b \neq 0$$

8. Use the Power of a Quotient Property to write $\left(\frac{x^3}{y^6}\right)^{\frac{1}{3}}$ as a quotient of powers.

You can apply these power properties and the exponent rules you have already learned to simplify expressions.

Example A

Simplify $(2x^2y^5)^3(3x^2)^{-2}$ and write without negative powers.

Step 1: Power of a Power Property

$$(2x^2y^5)^3(3x^2)^{-2} = 2^3x^{2 \cdot 3}y^{5 \cdot 3} \cdot 3^{-2} \cdot x^{2 \cdot -2}$$

Step 2: Simplify the exponents and the numerical terms.

$$= 8 \cdot x^6y^{15} \cdot \frac{1}{3^2} \cdot x^{-4}$$

Step 3: Commutative Property

$$= 8 \cdot \frac{1}{9}x^6 \cdot x^{-4}y^{15}$$

Step 4: Product of Powers Property

$$= \frac{8}{9}x^{6-4}y^{15}$$

Step 5: Simplify the exponents.

$$= \frac{8}{9}x^2y^{15}$$

Solution: $(2x^2y^5)^3(3x^2)^{-2} = \frac{8}{9}x^2y^{15}$

MATH TIP

Create an organized summary of the properties used to simplify and evaluate expressions with exponents.

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ACTIVITY 19

continued

My Notes

Lesson 19-3

Additional Properties of Exponents

Example B

Simplify $\left(\frac{x^2y^{-3}}{z}\right)^2$.

Step 1: Power of a Quotient Property

$$\left(\frac{x^2y^{-3}}{z}\right)^2 = \frac{x^{2 \cdot 2}y^{-3 \cdot 2}}{z^2}$$

Step 2: Simplify the exponents.

$$= \frac{x^4y^{-6}}{z^2}$$

Step 3: Negative Power Property

$$= \frac{x^4}{y^6z^2}$$

Solution: $\left(\frac{x^2y^{-3}}{z}\right)^2 = \frac{x^4}{y^6z^2}$

Try These A–B

Simplify and write without negative powers.

a. $(2x^2y)^3(-3xy^3)^2$

b. $-2ab(5b^2c)^3$

c. $\left(\frac{4x}{y^3}\right)^{-2}$

d. $\left(\frac{5x}{y}\right)^2\left(\frac{y^3}{10x^2}\right)$

e. $(3xy^{-2})^2(2x^3yz)(6yz^2)^{-1}$

Check Your Understanding

Simplify each expression. Write your answer without negative exponents.

9. $(4x^3y^{-1})^2$

10. $\left(\frac{5x}{y^2}\right)^3$

11. $(-2a^2b^{-2}c)^3(3ab^4c^5)(xyz)^0$

12. $(4fg^3)^{-2}(-4fg^3h)^2(3gh^4)^{-1}$

13. $\left(\frac{2ab}{a^2b^{-2}}\right)^{-3}$

14. $\left[(-7nm^2)^{-3}\right]^0$

LESSON 19-3 PRACTICE

Simplify.

15. a. $\left(\frac{2}{3}\right)^2$

b. $\left(\frac{2}{3}\right)^{-2}$

16. a. $(3x)^3$

b. $(3x)^{-3}$

17. a. $(2^5)^4$

b. $(2^5)^{-4}$

18. **Model with mathematics.** The formula for the area of a square is $A = s^2$, where s is the side length. A square garden has a side length of x^4y . What is the area of the garden?

Lesson36Key

Thursday, January 28, 2016 11:41 AM



Lesson36Key

Name:

Key

Class Period:

Lesson 36 Guided Notes

Warm-Up

Directions: Simplify each of the expressions below and be prepared to share your answers. When you finish, write down today's homework from the Daily Bulletin into your Assignment Log.

1. $w^5 \cdot w^{11} = w^{16}$

2. $\frac{u^8}{u^3} = u^5$

3. $\frac{q^{4/7}}{q^{3/7}} = q^{1/7}$

4. $p^{1/3} \cdot p^{4/9} = p^{3/9} \cdot p^{4/9} = p^{7/9}$

5. $\frac{3^3}{3^2} = 3^1 = 3$

6. $\frac{k}{k} = 1$

7. $x^3 \cdot x^3 = x^6$

8. $s^5 \cdot t^5 = s^5 \cdot t^5$

9. $\frac{c^6}{d^6} = \frac{c^6}{d^6}$

Negative Power

Example 1

Simplify without writing negative exponents

$$\frac{y^2}{y^7} = y^{-5} = \frac{1}{y^5}$$

Example 2

Simplify $\frac{x^{15}y^{-4}}{x^3}$.

$$\frac{x^{15}y^{-4}}{x^3} = \frac{x^{12}}{y^4}$$

Zero Power

Example 3

Simplify $\frac{2d^6t^{-2}}{4d^6}$.

$$\frac{2d^6t^{-2}}{4d^6} = \frac{1}{2t^2}$$

Mr. Turner

Power of a Power

Example 4 *mistake: remove*

Simplify $(g^{1/3})^2(h^5)^{-4}$.

$$(g^{1/3})^2(h^5)^{-4} = g^{2/3}h^{-20} = \frac{g^{2/3}}{h^{20}}$$

Power of a Product

Example 5

Simplify $(a^{-1}b^2)^{-2}(ab)^4$.

$$(a^{-1}b^2)^{-2}(ab)^4 = a^2b^{-4}a^4b^4 = a^6$$

Power of a Quotient

Example 6

Simplify $\left(\frac{j^{-5}r^{3/4}}{z^{1/3}}\right)^3$.

$$\left(\frac{j^{-5}r^{3/4}}{z^{1/3}}\right)^3 = \frac{j^{-15}r^{9/4}}{z^1} = \frac{r^{9/4}}{zj^{15}}$$

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Algebra I