

## Warm-up

1. Describe the graph of the inequality:

$$5a + 8 > y$$

2. Find the solution to the system:

$$2x - 4y = -2$$

$$6x + 3y = 9$$

3.  $-3(2x + 4) = 12$

4.  $5^2 \quad a^2 \quad (5a)^2$

## Laws of Exponents

- ♦ a **Monomial** algebraic expression is either a number, a variable, or a product of a number and one or more variables.
- ♦ a monomial with no variables is called a **constant**
- ♦ the number in a monomial expression that does contain variables is called the **coefficient**
- ♦ the product of two or more of the same variable can be expressed using an **exponential expression**

### **Examples**

Label each monomial below.

4

5m

2xy

$4m^2$

## Laws of Exponents

Write each term as a product of factors.

a.  $2^3 \cdot 2^2 =$

Multiply monomials by:  
multiplying the coefficients  
or keep the constant and  
add the exponents

b.  $5^1 \cdot 5^3 =$

c.  $10^2 \cdot 10^4 =$

d.  $3^2 \cdot 3^2 =$

What patterns do you notice?

Can you simplify  $x^m x^n$ ?

### Product Rule #1

### Product of Powers Rule

For all real numbers  $x$  and all integers  $m$  and  $n$ ,

$$x^m \cdot x^n = x^{m+n}$$

### Examples:

$$x^2(x^4)$$

$$3a(4a^5)$$

$$x^2y^4(x^3y^2)$$

$$(-2x^3y^5)(4x^2y^3)$$

Practice Problems

**Simplify.**

**Set #1**

1.  $y(y^5)$

2.  $n^2 \cdot n^7$

3.  $(-7x^2)(x^4)$

4.  $x(x^2)(x^4)$

5.  $m \cdot m^5$

6.  $(-x^3)(-x^4)$

7.  $(2a^2)(8a)$

8.  $(rs)(rs^3)(s^2)$

9.  $(x^2y)(4xy^3)$

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**Set #2**

10.  $\frac{1}{3}(2a^3b)(6b^3)$

11.  $(-4x^3)(-5x^7)$

12.  $(-3j^2k^4)(2jk^6)$

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**Set #3**

13.  $(5a^2bc^3)\left(\frac{1}{5}abc^4\right)$

14.  $(-5xy)(4x^2)(y^4)$

15.  $(10x^3yz^2)(-2xy^5z)$

Complete the assignment:

- What did one snowman say to the other?
- Check your work at that Solution Station

Go to Khan Academy

- practice on Multiplying Monomials and multiply powers.
- watch the videos on multiplying monomials to find area.

## **Warm Up**

**1)  $(5xy^2)(3x^4y^2)$**

**2) Simplify:  $6^2(6^8)(6^3)$**

**3) Find the slope:  $(2, 5)$   $(6, 8)$**

## Laws of Exponents

- ♦ a **Monomial** is either a number, a variable, or a product of a number and one or more variables.
- ♦ a monomial with no variables is called a **constant**
- ♦ the number in a monomial expression that does not contain variables is called the **coefficient**
- ♦ the product of two or more of the same variable can be expressed using an **exponential expression**

### Examples

Label each monomial below.

	coefficient		exponential expression	
4	5m	2xy	4m <sup>2</sup>	exponent (power)
constant			base	



## Product Rule #2

### Power of a Power Rule

For all real numbers  $x$  and all integers  $m$  and  $n$ ,

$$(x^m)^n = x^{mn}$$

What does  $(2^3)^4$  mean?

$$(2^3)(2^3)(2^3)(2^3) = 2^{12}$$

Examples:

$$(x^4)^2$$

$$(3^2)^4$$

$$(y^3)^5$$

### Product Rule #3

### Power of a Product Rule

For all real numbers  $x$  and  $y$  and all integers  $m$ ,

$$(xy)^m = x^m y^m$$

$$(2^3)^4 = 2^{12}$$

How does  $(2^3)^4$  differ  
from  $(2a^3)^4$ ?

$$(2a^3)^4 = 2^4 \cdot (a^3)^4 = 16a^{12}$$

### Power of product process:

- ♦ Raise each product in the parenthesis to the power outside of the parenthesis.  
(Remember to multiply the exponents)

Examples:

$$(2m^2)^3$$

$$4(x^2y^3)^5$$

$$(2x^3)^4(y^2)^2$$

## Exercises

Simplify. **Set #1**

1.  $(y^5)^2$

2.  $(n^7)^4$

4.  $-3(ab^4)^3$

5.  $(-3ab^4)^3$

7.  $(4a^2)^2(b^3)$

8.  $(4x)^2(b^3)$

10.  $(2a^3b^2)(b^3)^2$

11.  $(-4xy)^3(-2x^2)^3$

**Set #2**

3.  $(x^2)^5(x^3)$

6.  $(4x^2b)^3$

9.  $(x^2y^4)^5$

12.  $(-3j^2k^3)^2(2j^2k)^3$

**Set #3**

13.  $(25a^2b)^3\left(\frac{1}{5}abc\right)^2$

14.  $(2xy)^2(-3x^2)(4y^4)$

15.  $(2x^3y^2z^2)^3(x^2z)^4$

$$\textcircled{1} (4x^2y^3)^2 = 16x^4y^6$$

$$\textcircled{2} (3a^2b^4c^6)^3 = 27a^6b^{12}c^{18}$$

$$\textcircled{3} (-2m^4n^3)^3 = -8m^{12}n^9$$

$$\textcircled{4} (3a^2b^4)^2 (2ab^2) = 18a^5b^6$$

$$\textcircled{5} (5x^2y^5)^2 = 25x^4y^{10}$$

Complete the assignment:

- What did one snowman say to the other?
- Check your work at the Solution Station

Go to Khan Academy

- practice powers of powers.
- watch the videos on exponent properties with parentheses.

## Warm-Up

Determine whether each expression is a monomial. Write *yes* or *no*. Explain your reasoning.

1.  $-5x^2$

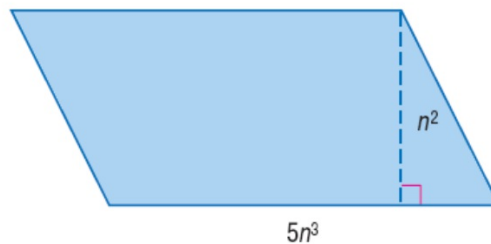
2.  $x^3 - y^3$

Simplify.

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

4.  $(2x^5y^4)^2$

5. Find the area of the parallelogram.



6. **Standardized Test Practice** What is the value of  $4(x)^3 - 1$  when  $x = 1.5$ ?



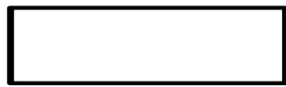
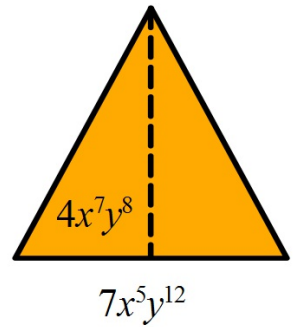
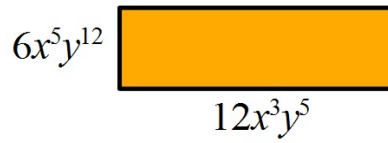
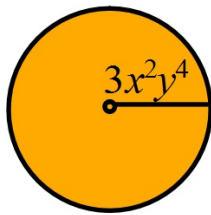
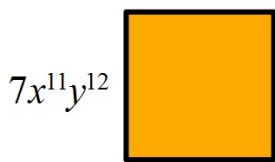
***Warm Up***

**1) Simplify:  $(3^2)^5(3^4)$**

**2) Simplify:  $(2x^5)^3$**

**3) If a line has a slope of -2 and a y-intercept of 5, what is the equation of the line in slope intercept form?**

### Practice: Using Rules of Exponents with Area Models



$49x^{22}y^{24}$

$72x^8y^{17}$      $28.3x^4y^8$

$18.8x^4y^8$

$60x^8y^{17}$

$14x^{22}y^{24}$

$9x^4y^8$

$28x^{12}y^{20}$

$14x^{12}y^{20}$



## **Dividing Monomials**

Write each term as a product of factors. Then use the definitions of exponents and powers to write each product below as a single power.

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

b.  $\frac{5^6}{5^1}$

c.  $\frac{10^7}{10^2}$

What pattern do you see?

## Quotient Rule #1

### Quotient of Powers Rule

For all real numbers  $x$  and all integers  $m$  and  $n$ ,

$$\frac{x^m}{x^n} = x^{m-n}$$

Quotient of powers process:

- ♦ Divide the coefficients
- ♦ Subtract the exponents

*Example:*  $\frac{10m^5}{2m^3}$

## Quotient Rule #2

### Power of a Quotient Rule

For all real numbers  $x$  and  $y$  and all integers  $m$ ,

$$\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}$$

**Example:**

Power of quotient process:

- ♦ Raise each part of the quotient in the parenthesis to the power outside of the parenthesis. (Remember to multiply the exponents)

## Guided Practice

### Exercises

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**Simplify. Assume that no denominator is equal to zero.**

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

2.  $\frac{m^6}{m^4}$

3.  $\frac{p^5n^4}{p^2n}$

4.  $\frac{a^2}{a}$

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

6.  $\frac{-2y^7}{14y^5}$

7.  $\frac{xy^6}{y^4x}$

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

9.  $\left(\frac{4p^4q^4}{3p^2q^2}\right)^3$

10.  $\left(\frac{2v^5w^3}{v^4w^3}\right)^4$

11.  $\left(\frac{3r^6s^3}{2r^5s}\right)^4$

12.  $\frac{r^7s^7t^2}{s^3r^3t^2}$

### Negative Exponent Rule

$$\frac{2^3}{2^5} = \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

Negative exponents represent the reciprocal of a rational expression. ●●

**Rule:** For every real number  $x$  and integer  $m$ ,

$$x^{-m} = \frac{1}{x^m} \text{ and } \frac{1}{x^{-m}} = x^m$$

### Zero Exponent Rule

$$\frac{2^3}{2^3} = \frac{\quad \cdot \quad}{\quad} = \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

$$\frac{x^3}{x^3} = \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

**Rule:** For every real number  $x$ ,  $x^0 = 1$  ●●

**You Try**

1)  $8^{-2}(8^6)$

6)  $\frac{28x^{12}y^5}{7x^4y}$

2)  $x^{-3}$

3)  $3^{-2}$

4)  $x^{-1}(y^4)$

5)  $2^{-3}$

M-4-2-1 Activity

M  $\frac{(-2mx^{-3})^{-4}}{8m^{-5}x^0}$

$$\frac{(-8x^2y^2)^2}{(4x^3y)^3}$$

4

2  $\frac{(3r^3s^5)^3}{(-3r^2s^7)^2}$

$$\frac{2x^3y^5}{5(x^4y^2)^3}$$

1

## Algebra 1 Warm-Up

Obj. 1.01a

1. Simplify this expression:  $\frac{8x^2y^{-2}}{x^{-2}y} \cdot \frac{(4xy^2)^{-1}}{x^2y}$

2. Create a problem that uses a product rule **OR** quotient rule **AND** negative or zero exponents that has the following solution:

$$8a^3b^2$$

### Scavenger Hunt

Number your paper 1 - 20. Leave space to work each problem. 1-10 on the front. 11-20 on the back.

Pick any letter to start at, write that letter next to #1. Solve the problem on the inside of that letter. Your answer will be on the front of another letter, write that letter next to #2. Continue until you finish all 20.



