

Name: KEY

Date: _____

Math 9**Lesson 2.4 ~ Exponent Laws (Part 1)****Product of Powers**

Product of Powers	Product as Repeated Multiplication	Product as a Power
$2^3 \times 2^5$	$(2 \times 2 \times 2) \times (2 \times 2 \times 2 \times 2 \times 2)$	2^8
$3^7 \times 3$	$(3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3) \times 3$	3^8
$4^2 \times 4^6$	$(4 \times 4) \times (4 \times 4 \times 4 \times 4 \times 4 \times 4)$	4^8
$5^5 \times 5^8$	$(5 \times 5 \times 5 \times 5 \times 5) \times (5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5)$	5^{13}
$6^2 \times 6^7$	$(6 \times 6) \times (6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6)$	6^9

*for example;
multiple answers

Exponent Law for a Product of Powers:

$$a^m \times a^n = a^{m+n}$$

$$a \neq 0$$

To multiply powers with the same base, add the exponents. The variable a is any integer, except 0. The variables m and n are any whole numbers.

Quotient of Powers

Quotient of Powers	Quotient as Repeated Multiplication	Quotient as a Power
$7^5 \div 7^3$	$\frac{7 \times 7 \times 7 \times 7 \times 7}{7 \times 7 \times 7}$	7^2
$8^9 \div 8^1$	$\frac{8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8}{8}$	8^8
$9^6 \div 9^3$	$\frac{9 \times 9 \times 9 \times 9 \times 9 \times 9}{9 \times 9 \times 9}$	9^3
$10^4 \div 10^4$	$\frac{10 \times 10 \times 10 \times 10}{10 \times 10 \times 10 \times 10}$	$10^0 = 1$
$11^5 \div 11^2$	$\frac{11 \times 11 \times 11 \times 11 \times 11}{11 \times 11}$	11^3

*for example;
multiple answers

Exponent Law for a Quotient of Powers:

$$a^m \div a^n = a^{m-n}$$

$$a \neq 0, m \geq n$$

To divide powers with the same base, subtract the exponents. The variable a is any integer, except 0. The variables m and n are any whole numbers; but m must be greater than n .

Example # 1: Write each expression as a single power.

$$\begin{aligned} \text{a) } 8^5 \times 8^7 &= 8^{5+7} \\ &= \boxed{8^{12}} \end{aligned}$$

$$\begin{aligned} \text{b) } (-4)^{12} \div (-4)^1 &= (-4)^{12-1} \\ &= \boxed{(-4)^{11}} \end{aligned}$$

Example # 2: Simplify and evaluate.

$$\begin{aligned} \text{a) } 3^6 \times (-3)^2 &= 729 \times 9 \\ &= \boxed{6561} \end{aligned}$$

$$\begin{aligned} \text{b) } 9^2 \times 9^5 \div 9^3 &= 9^{2+5-3} \\ &= 9^4 \\ &= \boxed{6561} \end{aligned}$$

Example #3: Simplify and evaluate.

$$\begin{aligned} \text{a) } 6^2 + 6^3 \times 6^2 & \\ &= 6^2 + 6^{3+2} \\ &= 6^2 + 6^5 \\ &= 36 + 7776 \\ &= \boxed{7812} \end{aligned}$$

$$\begin{aligned} \text{b) } (-10)^4 [(-10)^6 \div (-10)^4] - 10^2 & \\ &= (-10)^{4+(6-4)} - 10^2 \\ &= (-10)^6 - 10^2 \\ &= 1\,000\,000 - 100 \\ &= \boxed{999\,900} \end{aligned}$$

Practice

1. Write each product as a single power.

$$\text{a) } 7^6 \times 7^2 = 7^{6+2} = \boxed{7^8}$$

$$\text{c) } (-2)^1 \times (-2)^3 = (-2)^{1+3} \\ = \boxed{(-2)^4}$$

$$\text{e) } 7^0 \times 7^1 = 7^{0+1} \\ = \boxed{7^1} = \boxed{7}$$

$$\text{b) } (-4)^5 \times (-4)^3 = (-4)^{5+3} \\ = \boxed{(-4)^8}$$

$$\text{d) } 10^5 \times 10^5 = 10^{5+5} \\ = \boxed{10^{10}}$$

$$\text{f) } (-3)^4 \times (-3)^5 = (-3)^{4+5} \\ = \boxed{(-3)^9}$$

To multiply powers with the same base, add the exponents.

2. Write each quotient as a power.

$$\text{a) } (-3)^5 \div (-3)^2 = (-3)^{5-2}$$

$$\text{c) } \frac{4^7}{4^4} = 4^{7-4} \\ = \boxed{4^3}$$

$$\text{e) } 6^4 \div 6^4 = 6^{4-4} \\ = \boxed{6^0}$$

$$\text{b) } 5^6 \div 5^4 = 5^{6-4}$$

$$\text{d) } \frac{5^8}{5^6} = 5^{8-6} \\ = \boxed{5^2}$$

$$\text{f) } \frac{(-6)^8}{(-6)^7} = (-6)^{8-7} \\ = \boxed{(-6)^1} = \boxed{-6}$$

To divide powers with the same base, subtract the exponents.

3. Write as a single power.

$$\text{a) } 2^3 \times 2^4 \times 2^5 = 2^{3+4+5} \\ = \boxed{2^{12}}$$

$$\text{b) } \frac{3^2 \times 3^2}{3^2 \times 3^2} = 3^{(2+2)-(2+2)} \\ = \boxed{3^0}$$

Which exponent law should you use?

$$\text{c) } 10^3 \times 10^5 \div 10^2 = 10^{3+5-2} \\ = \boxed{10^6}$$

$$\text{d) } (-1)^9 \div (-1)^5 \times (-1)^0 \\ = (-1)^{9-5+0} \\ = \boxed{(-1)^4}$$

4. Simplify, then evaluate.

$$\begin{aligned} \text{a) } & (-3)^1 \times (-3)^2 \times 2 \\ & = (-3)^{1+2} \times 2 = (-3)^3 \times 2 \\ & = -27 \times 2 \\ & = \boxed{-54} \end{aligned}$$

$$\begin{aligned} \text{b) } & 9^9 \div 9^7 \times 9^0 = 9^{9-7+0} = 9^2 \\ & = \boxed{81} \end{aligned}$$

See if you can use the exponent laws to simplify.

$$\begin{aligned} \text{c) } & \frac{5^2}{5^0} = 5^{2-0} = 5^2 \\ & = \boxed{25} \end{aligned}$$

$$\begin{aligned} \text{d) } & \frac{5^5}{5^4} \times 5^1 = 5^{5-4+1} = 5^2 \\ & = \boxed{25} \end{aligned}$$

5. Identify any errors and correct them.

a) $4^3 \times 4^5 = 4^8$

no error

b) $2^5 \times 2^5 = 2^{25}$

2^{5+5} not $2^{5 \times 5}$
 $= 2^{10}$

c) $(-3)^6 \div (-3)^2 = (-3)^8$

$(-3)^{6-2}$ not $(-3)^{6 \div 2}$
 $= (-3)^4$

d) $7^0 \times 7^2 = 7^2$

7^{0+2} not $7^{0 \times 2}$
 $= 7^2$

e) $6^2 \oplus 6^2 = 6^4$

powers are not
being multiplied
so no laws can
be applied

f) $10^6 \div 10^1 = 10^6$

10^{6-1}
 $= 10^5$

g) $2^3 \times 5^2 = 10^5$

bases are not
the same so no
laws can be
applied