Unit I Notes

Exponents

Tentative Schedule

Day	Date	Class Work	Assignment
1	Wed. 9/3 Thurs. 9/4	Problem Solving Group Work	Watch Video #1.1 – Exponential Notation, the Product of Powers and the Quotient of Powers
2	Fri. 9/5	P.S. #1.1	Watch Video #1.2 – The Power of a Power
3	Mon. 9/8 Tues. 9/9	P.S. #1.2	Watch Video #1.3 – Zero and Negative Exponents
4	Wed. 9/10	**Quiz #1.1** P.S. #1.3	Finish P.S. #1.3
5	Thurs. 9/11 Fri. 9/12	Activity	Review for Test #1
6	Mon. 9/15	**Quiz #1.2** Review for Test #1	Study
7	Tues. 9/16 Wed. 9/17	**Test #1**	Watch Video #2.1

Name: _____

Notes 1.1 - Exponential Notation and Product/Quotient of Powers

Examples involving exponential notation. Also, identify the base and exponent in each expression.

1.) $5 \times 5 \times 5 \times 5 \times 5 \times 5 =$ 5^6

Base: 5 Exponent: 6

> Did you notice that parentheses are used in 2, 3, and 4? Why do you think there are parentheses?
>
> To show the entire number that is the base.

2.) $\frac{9}{7} \times \frac{9}{7} \times \frac{9}{7} \times \frac{9}{7} =$ $\left(\frac{9}{7}\right)^4$

Base: $\frac{9}{7}$ Exponent: 4

3.) $\left(-\frac{4}{11}\right)^3 =$ $-\frac{4}{11} \times -\frac{4}{11} \times -\frac{4}{11}$

Base: $-\frac{4}{11}$ Exponent: 3

> *Vocabulary*
>
> The number x^n is called _____ raised to the _____ power, _____ is the **exponent** and _____ is the **base.**

4.) $(-2)^6 =$ $(-2)(-2)(-2)(-2)(-2)(-2)$

$-2^6 \neq 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

Base: -2 Exponent: 6

5.) $3.8^4 = (3.8)(3.8)(3.8)(3.8)$

Base: 3.8 Exponent: 4

Try these exercises on your own. Then, compare with your partner.

Exercise 1

$\underbrace{4 \times \cdots \times 4}_{7 \text{ times}} =$ 4^7

Exercise 2

$\underbrace{3.6 \times \cdots \times 3.6}_{47 \text{ times}} = 3.6^{47}$

Exercise 3

$\underbrace{(-11.63) \times \cdots \times (-11.63)}_{34 \text{ times}} =$ $(-11.63)^{34}$

Exercise 4

$\underbrace{12 \times \cdots \times 12}_{15 \text{ times}} = 12^{15}$

Exercise 5

$\underbrace{(-5) \times \cdots \times (-5)}_{10 \text{ times}} =$ $(-5)^{10}$

Exercise 6

$\underbrace{\frac{7}{2} \times \cdots \times \frac{7}{2}}_{21 \text{ times}} =$ $\left(\frac{7}{2}\right)^{21}$

Exercise 7

$\underbrace{(-13) \times \cdots \times (-13)}_{6 \text{ times}} =$ $(-13)^6$

Exercise 8

$\underbrace{\left(-\frac{1}{14}\right) \times \cdots \times \left(-\frac{1}{14}\right)}_{10 \text{ times}} =$ $\left(-\frac{1}{14}\right)^{10}$

Exercise 9

$\underbrace{x \cdot x \cdots x}_{185 \text{ times}} =$ x^{185}

Exercise 10

$\underbrace{x \cdot x \cdots x}_{n \text{ times}} = x^n$

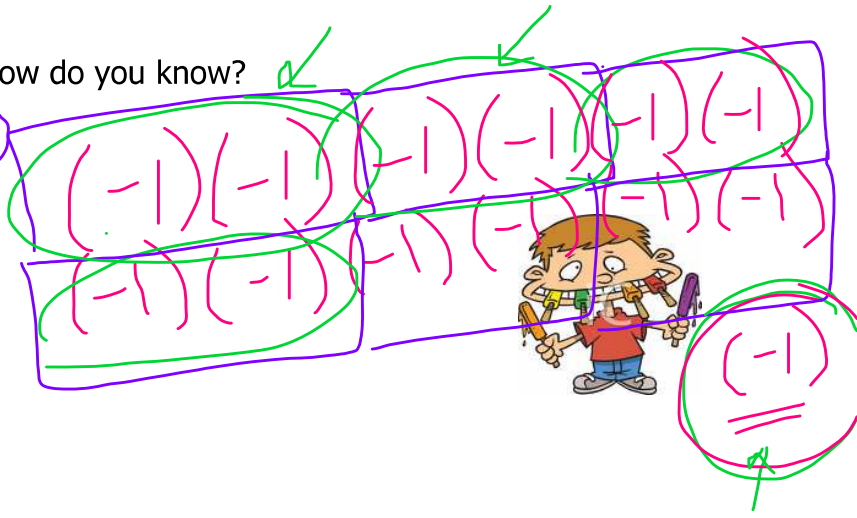
Exercise 11

Will these products be positive or negative? How do you know?

$\underbrace{(-1) \times (-1) \times \cdots \times (-1)}_{12 \text{ times}} = (-1)^{12}$

positive

Exponent is even



$\underbrace{(-1) \times (-1) \times \cdots \times (-1)}_{13 \text{ times}} = (-1)^{13}$

negative

Exponent is odd

Exercise 12

Is it necessary to do all of the calculations to determine the sign of the product? Why or why not?

$$\underbrace{(-5)\times(-5)\times\cdots\times(-5)}_{95\ times} = (-5)^{95}$$

No, it's not necessary; all you have to do is look at the exponent. The product is negative because the exponent is odd.

$$\underbrace{(-1.8)\times(-1.8)\times\cdots\times(-1.8)}_{122\ times} = (-1.8)^{122}$$

The product is positive because the exponent is even.

Exercise 13

Fill in the blanks about whether the number is positive or negative.

If n is a positive even number, then $(-55)^n$ is positive.

If n is a positive odd number, then $(-55)^n$ is negative.

Exercise 14

Josie says that $(-15)\times(-15)\times(-15)\times(-15)\times(-15)\times(-15) = -15^6$. Is she correct? How do you know?

positive

No, she is not correct because -15^6 is negative, while her product should be positive. It should say $(-15)^6$

Exercise 15

Expand and evaluate $\left(-\frac{3}{4}\right)^3$.

$\left(-\frac{3}{4}\right)\left(-\frac{3}{4}\right)\left(-\frac{3}{4}\right) = \frac{-27}{64}$

$\frac{216}{64}$

1.) Expand 10^6.

$10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$

2.) Expand 10^3.

$10 \cdot 10 \cdot 10$

$10^6 \cdot 10^3 =$

10^9

3.) Expand $10^6 \cdot 10^3$. What do you notice?

$10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$

4.) Expand a^4.

$a \cdot a \cdot a \cdot a$

5.) Expand a^5.

$a \cdot a \cdot a \cdot a \cdot a$

6.) Expand $a^4 \cdot a^5$. What do you notice?

$a^4 \cdot a^5$

$a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a = a^9$

When you find the product of two algebraic expressions with the same base, you can add their exponents and use this exponent with the same base.

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

Simplify each expression. Write your answer in exponential notation.

7.) $(-4)^2 \cdot (-4)^3 =$ $(-4)^5$

8.) $3^6 \cdot 3 =$ 3^7

9.) $a^{23} \cdot a^9 =$ a^{32}

10.) Expand 5^6.

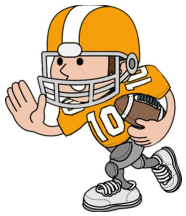
$5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5$

11.) Expand 5^2.

$5 \cdot 5$

12.) Expand $5^6 \div 5^2$. What do you notice?

$\frac{5^6}{5^2} = \frac{5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5}{5 \cdot 5} = 5^4$



13.) Expand y^7.

$y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y$

14.) Expand y^4.

$y \cdot y \cdot y \cdot y$

15.) Expand $y^7 \div y^4$. What do you notice?

$\frac{y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y}{y \cdot y \cdot y \cdot y} = y^3$

When you find the quotient of two algebraic expressions with the same base, you can subtract their exponents and use this exponent with the same base.

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

Simplify each expression. Write your answer in exponential notation.

16.) $2^9 \div 2^6 =$

2^3

17.) $(-7)^5 \div (-7) =$

$(-7)^4$

18.) $\frac{35x^4y^7}{5x^2y^3} = 7x^2y^4$

6 coefficients

Notes 1.2 - Power of a Power

Simplify each expression. Write your answer in exponential notation.

1.) $\frac{4^2 \cdot 4^7 \cdot 4}{4^8} = \frac{4^{10}}{4^8} = 4^2$

2.) $\frac{\left(\frac{1}{4}\right)^3 \cdot \left(\frac{1}{4}\right)^1 \cdot \left(\frac{1}{4}\right)^2}{\left(\frac{1}{4}\right)^1 \cdot \left(\frac{1}{4}\right)^1 \cdot \left(\frac{1}{4}\right)^1} = \frac{\left(\frac{1}{4}\right)^6}{\left(\frac{1}{4}\right)^3} = \left(\frac{1}{4}\right)^3$

3.) $\frac{3x^4 \cdot 5y^3 \cdot 6x^6}{2y \cdot 3x^2 \cdot 5y^3} = \frac{90x^{10}y^3}{30x^2y^4} = 3x^8y^{-1}$

4.) $\frac{6^7 \cdot 6^3 \cdot 6^2}{6^1 \cdot 6^4 \cdot 6^5} = \frac{6^{12}}{6^{10}} = 6^2$

5.) $\frac{b^5 \cdot 4a^4 \cdot 9a^3}{2a^2 \cdot b^2 \cdot 6a^2} = \frac{36a^7b^5}{12a^4b^2} = 3a^3b^3$

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

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

7.) What does $(n^2)^5$ mean?

$(n^2)(n^2)(n^2)(n^2)(n^2) = n^{10}$

$\frac{x^3 \cdot x^5}{(x^3)^5} = \frac{x^8}{x^{15}}$

8.) What do you notice?

When you have a power raised to a power, you must multiply the exponents.

> When you raise a power to a power, keep the base and multiply the exponents.
>
> $(a^m)^n = a^{mn}$

Simplify each expression. Write your answer in exponential notation.

9.) $(15^3)^9$ → 15^{27}

10.) $((-2)^5)^8$ → $(-2)^{40}$

11.) $(a^{17})^4$ → a^{68}

Notes 1.3 – Zero and Negative Exponents

1.) Use the power of a quotient property to simplify each expression. Write the quotient as an exponent.

Expression	Exponent
$\frac{3^5}{3^2}$	3^3
$\frac{3^5}{3^3}$	3^2
$\frac{3^5}{3^4}$	3^1
$\frac{3^5}{3^5}$	3^0

subtract exponents

What expression did you write for $\frac{3^5}{3^5}$? What exponent did you use?

$3^0 \rightarrow$ 0 is the exponent.

2.) Using factored form, find the value of $\frac{3^5}{3^5}$.

$\frac{3\cdot3\cdot3\cdot3\cdot3}{3\cdot3\cdot3\cdot3\cdot3} = 1 = 3^0$

$(1)3^2 = (1)3\cdot3$

$(1)3^1 = (1)\cdot3$

$(1)3^0 = 1$

3.) Based on your findings, what can you conclude about the value of 3^0?

1

4.) Make a prediction about the value of any number raised to the zero power.

Anything raised to the 0th power is 1.

5.) Use a calculator to check your prediction for several numbers. Is your prediction right?

A nonzero number raised to the zero power is equal to 1.

$a^0 =$ 1

Simplify each

$7^0 = 1$ $7^1 = 7$

expression and evaluate where applicable.

6.) $7^3 \cdot 7^0$ → $7^3 \cdot 1 = 7^3$

$7 \cdot 7 \cdot 7 = 7^3$

7.) $3 \cdot 10^2 + 2 \cdot 10^1 + 8 \cdot 10^0$

8.) $\frac{4^2 \cdot 4^6}{4^8} = \frac{4^8}{4^8} = 4^0 = 1$

9.) $(a^4 \div a^0) \cdot a^3$ → $(a^4)(a^3) = a^7$

$(a^4 \div 1) \cdot a^3$

$a^4 \cdot a^3 = a^7$

10.) Use the quotient of powers property to simplify each expression. Write the quotient in exponential notation.

Expression	Exponent
$\frac{4^5}{4^3}$	4^2
$\frac{4^5}{4^4}$	4^1
$\frac{4^5}{4^5}$	$4^0 (=1)$
$\frac{4^5}{4^6}$	4^{-1}
$\frac{4^5}{4^7}$	4^{-2}

5-6

What expression did you write for $\frac{4^5}{4^6}$? What exponent did you use?

4^{-1} exponent: -1

11.) Using factored form, find the value of $\frac{4^5}{4^6}$.

$\frac{4 \cdot 4 \cdot 4 \cdot 4 \cdot 4}{4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4} = \frac{1}{4}$

$4^{-1} = \frac{1}{4^1}$

12.) Using factored form, find the value of $\frac{4^5}{4^7}$.

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

$4^{-2} = \frac{1}{4^2}$

$\frac{4^{-1}}{1} = \frac{1}{4^1}$

$a^{-n} = \frac{1}{a^n}$

*flip
*reciprocal

13.) How would you write a^{-3} using a positive exponent?

reciprocal

$\frac{a^{-3}}{1} = \frac{1}{a^3}$

Simplify each expression. Write your answer using a positive exponent.

14.) $13^{-4} \cdot 13^{7}$ $= 13^3$

$\frac{1}{13^4} \cdot \frac{13^7}{1} = \frac{13^7}{13^4} = 13^3$

15.) $\frac{x^{-7}}{x^4}$

16.) $4^8 \cdot 4^{-10}$ $= 4^{-2} = \frac{1}{4^2}$

$\frac{4^8}{1} \cdot \frac{1}{4^{10}} = \frac{4^8}{4^{10}} = \frac{1}{4^2}$

17.) $x^{-7} \div x^{-4}$

$-7 + -4 = -3$

$x^{-3} = \frac{1}{x^3}$

18.) $\left(\frac{8n^5}{32n^0}\right)^{-1}$

19.) $14a^{-5} \div (7a \cdot 2a^{-4})$

Simplify each expression and evaluate where applicable.

flip

20.) $\frac{(-6)^3}{(-6)^4} = (-6)^{-1} = \frac{1}{-6}$

21.) $\frac{3^{-5} \cdot 3}{5^3 \cdot 5^{-8}}$

$\frac{1}{-6}$