

Name KEY

Period _____

Secondary 2 Honors

Exponent Rules

Notes 3.1

What do Exponents mean? Pick the correct expression.

1. $4 \times 4 \times 4 \times 4 \times 4 \times 4$ 2. 3×3 3. $2 \times 2 \times 2 \times 2 \times 2$
 a. 4^6 a. 2^3 a. 5^2
 b. 6^4 b. 3^9 b. 2^2
 c. 4^4 c. 3^2 c. 2^5

4. A student evaluated 4^3 to be 12. What was the student's error? What would you do to help this student understand?
they did $4 \cdot 3$ instead of $4 \cdot 4 \cdot 4$

Understanding exponents with zero power and negative power:

Fill in the boxes below and then answer questions 6-9.

x	x^3	x^2	x^1	x^0	x^{-1}	x^{-2}	x^{-3}
2	8	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$
3	27	9	3	1	$\frac{1}{3}$	$\frac{1}{9}$	$\frac{1}{27}$
4	64	16	4	1	$\frac{1}{4}$	$\frac{1}{16}$	$\frac{1}{64}$

5. What do negative exponents do?

Flips it into a fraction.

- * 6. Explain why $anything^0 = 1$
Anything divided by itself is 1.

$\frac{x^2}{x^2} = x^0 = 1$ Exponent Rules.

7. What does $\frac{1}{x^2}$ equal to using negative exponents?

x^{-2}

product
 The ~~Power~~ Product Rule: Write out the following expressions in expanded form and then evaluate or simplify.

#	Expression	Expand	Simplify
8.	2^4	$2 \times 2 \times 2 \times 2$	16
9.	$(-2)^4$	$-2 \cdot -2 \cdot -2 \cdot -2$	16
10.	(-2^4)	$-(2 \cdot 2 \cdot 2 \cdot 2)$	-16
11.	$(5^2)(5^7)$	$5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5$	$5^9 = 1,953,125$
12.	$ab^5 \cdot 8a^2b^5$	$a \cdot b \cdot b \cdot b \cdot b \cdot 8 \cdot a \cdot a \cdot b \cdot b \cdot b \cdot b \cdot b$	$8a^3b^{10}$

13. What is the rule for multiplying expressions with exponents?

Add exponents that have similar bases.

The Quotient Rule: Expand the numerator and denominator of each algebraic fraction then simplify.

#	Fractions	Expand	Simplified Form
14.	$\frac{3^3}{3^2}$	$\frac{3 \times 3 \times 3}{3 \times 3}$	3
15.	$\frac{b^9}{b^6}$	$\frac{b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b}{b \cdot b \cdot b \cdot b \cdot b \cdot b}$	b^3
16.	$\frac{3x^6}{6x^{10}}$	$\frac{3 \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x}}{6 \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x}}$	$\frac{1}{2x^4}$ or $\frac{x^{-4}}{2}$

17. What is the rule for dividing expressions with exponents?

Subtract exponents that have like bases $\frac{a^m}{a^n} = a^{m-n}$

18. Explain how it is different when the exponent on the bottom is bigger. How does that relate to negative exponents?

you get a negative exponent. The variable stays on the bottom. It stays a fraction.

The Power Rule: Write out the following expressions in expanded form and then simplify. Do not evaluate.

#	Expression	Expand	Simplify
19.	$(3^2)^4$	$(3 \times 3)^4 = (3 \times 3)(3 \times 3)(3 \times 3)(3 \times 3)$	3^8
20.	$(ac^2)^3$	$(ac^2)(ac^2)(ac^2) = a \cdot c \cdot c \cdot a \cdot c \cdot c \cdot a \cdot c \cdot c$	$a^3 c^6$
21.	$(-3c^5)^2$	$-3 \cdot c \cdot c \cdot c \cdot c \cdot c \cdot -3 \cdot c \cdot c \cdot c \cdot c \cdot c$	$9 c^{10}$
22.	$-3(c^5)^2$	$-3 \cdot c \cdot c \cdot c \cdot c \cdot c \cdot c \cdot c \cdot c \cdot c \cdot c$	$-3c^{10}$
23.	$\left(\frac{2x}{3y^2}\right)^3$	$\frac{2x}{3y \cdot y} \cdot \frac{2x}{3y \cdot y} \cdot \frac{2x}{3y \cdot y}$	$\frac{8x^3}{27y^6}$

24. Show how you would simplify: $\left(\frac{x^4 y^3}{z^2}\right)^5$

$\frac{x^{20} y^{15}}{z^{10}}$

25. What is the rule for raising a power to a power?

The outside exponent applies to everything inside.

Let's formulate all of these exponent rules:

Product of Powers: $x^a \cdot x^b$ x^{a+b} Numerical Example: $x^4 \cdot x^5 = x^{4+5} = x^9$	Quotient of Powers: $\frac{x^a}{x^b}$ x^{a-b} Numerical Example: $\frac{x^2}{x} = x^{2-1} = x$	Negative Exponents: x^{-a} $\frac{1}{x^a}$ Numerical Example: $x^{-7} = \frac{1}{x^7}$
Power of a Power: $(x^a)^b$ $x^{a \cdot b}$ Numerical Example: $(c^2)^6 = c^{2 \cdot 6} = c^{12}$	Zero Exponents: x^0 1 Numerical Example: $\frac{a^2}{a^2} = a^{2-2} = a^0 = 1$	Powers of a Quotient: $\left(\frac{x}{y}\right)^a$ $\frac{x^a}{y^a}$ Numerical Example: $\left(\frac{3a}{b}\right)^2 = \frac{9a^2}{b^2}$

Guided Practice: Simplify each expression. Use only positive exponents in your answers.

1. $x^3 \cdot x^8$

x^{11}

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

y^3

3. $8x^0y^{-3}$

$\frac{8}{y^3}$

4. $3y^8 \cdot 2y^2$

$6y^{10}$

5. $\left(\frac{c^5}{b^7}\right)^{10}$

$\frac{c^{50}}{b^{70}}$

6. $(-2a^2w^3y)^3$

$-8a^6w^9y^3$

7. $\left(\left(\frac{3x^3y^{17}z}{12a^{115}b}\right)^5\right)^0$

1

8. $\left(\frac{1}{2}w^{-3}\right)^2(w^4)^2$

$\frac{1}{4}w^{-6} \cdot w^8$
 $\frac{1}{4}w^2$

9. $\left(\frac{-18a^{-3}}{6(x^{-2}a^{-3})(x^{-3}a^3)}\right)^2$

~~$\frac{(-18a^{-3})^2}{(6 \cdot x^{-2} \cdot a^{-3} \cdot x^{-3} \cdot a^3)^2}$~~

~~$\frac{324a^{-6}}{36x^{-5}a^{-6}x^{-6}a^6}$~~

$\frac{(-18a^{-3})^2}{6^2x^{-4}a^{-6}x^{-6}a^6}$

$\frac{324x^4a^6x^6}{36a^6a^6}$

$\frac{9x^{10}}{a^6}$