3-5 Zero and Negative Exponents

Name _____

Objective: I can apply the Zero Exponent Property and the Negative Exponent Property.

Part 1 Intro   Zero Exponent Property

$$\frac{4^3}{4^3} = \frac{4 \cdot 4 \cdot 4}{4 \cdot 4 \cdot 4} = \frac{64}{64}$$

$$= \frac{1}{1} = 1$$

$$= 1$$

By subtracting exponents

$$4^{3-3} = 4^0$$

$$4^0.$$

$$\frac{4^3}{4^3} = 4^0 = 1$$

Zero Exponent Property:

Any nonzero base to an exponent of zero __equals 1__ .

Part 1 Examples

Simplify each expression. Assume all variables ≠ 0.

a. $\dfrac{18x^{20}}{18x^{20}}$

$18 \div 18 = 1 \qquad 1 \cdot 1 = 1$

$x^{20-20} = x^0 = 1$

①

b. $\dfrac{w^8 z^{15}}{w^8 z^8}$

$w^{8-8} = w^0 = 1$

$z^{15-8} = z^7$

$1 \cdot z^7 = \boxed{z^7}$

c. $\dfrac{9x^5 y^{12}}{3x^2 y^{12}}$

$9 \div 3 = 3$

$x^5 - x^2 = x^3$

$y^{12} - y^{12} = y^0 = 1$

$3 \cdot x^3 \cdot 1$

$\boxed{= 3x^3}$

d. $5x^0$

$x^0 = 1$

$5 \cdot 1$

$\boxed{= 5}$

Part 2 Intro   Power of a Quotient

$$\frac{8^3}{8^5} = \frac{8 \cdot 8 \cdot 8}{8 \cdot 8 \cdot 8 \cdot 8 \cdot 8}$$

$\dfrac{1}{8^2}$

$8^{3-5} = 8^{-2}$

$8^{-2} = \dfrac{1}{8^2}$

Negative Exponent Property:

Any nonzero base to a negative exponent __becomes a fraction with a numerator of 1.__

Part 2 Examples

Simplify each expression using positive exponents.

a. $\dfrac{2^8}{2^{11}}$

$2^{8-11} = 2^{-3}$

$2^{-3} = \boxed{\dfrac{1}{2^3}}$

b. $\dfrac{100b^{50}}{200b^{75}}$

$\dfrac{100 \div 100}{200 \div 100} = \dfrac{1}{2}$

$b^{50-75} = b^{-25}$

$b^{-25} = \dfrac{1}{b^{25}} \quad \boxed{\dfrac{1}{2b^{25}}}$

c. $\dfrac{a^{-3} b^7 c^5}{a^5 b^2 c^7}$

$a^{-3-5} = a^{-8} = \dfrac{1}{a^8}$

$b^{7-2} = b^5$

$c^{5-7} = c^{-2} = \dfrac{1}{c^2}$

$\boxed{\dfrac{b^5}{a^8 c^2}}$

d. $(2x^3 y^{-5})^{-2}$

$2^{-2} \quad x^{3 \cdot -2} \quad y^{-5 \cdot -2}$

$\downarrow \qquad \downarrow \qquad \downarrow$

$\dfrac{1}{2^2} \quad x^{-6} \quad y^{10}$

$\downarrow \qquad \downarrow$

$\dfrac{1}{4} \quad \dfrac{1}{x^6}$

$\boxed{\dfrac{y^{10}}{4x^6}}$

Part 3 Example

Classify each expression as *greater than 1, equal to 1,* or *less than 1.*

$$2^{-3} \qquad 3^2 \qquad 2^0 \qquad 2^3 \qquad 3^{-2} \qquad 3^0$$

$$\frac{1}{2^3} = \frac{1}{8} \qquad 9 \qquad 1 \qquad 8 \qquad \frac{1}{3^2} = \frac{1}{9} \qquad 1$$

Less than 1	Equal to 1	Greater than 1
2^{-3}	2^0	3^2
3^{-2}	3^0	2^3
negative exponents	zero exponent	positive exponents

Sample Homework Problems (If you have time)

Simplify this expression. Assume that x is nonzero.

$$x^{-7} \cdot x^2 \qquad x^{-7+2} = x^{-5} = \boxed{\frac{1}{x^5}}$$

$x^{-7} \cdot x^2 = \boxed{}$ (Type exponential notation with positive exponents.)

Simplify this expression. Use 9 as the base.

$$\frac{9^3}{9^7} \qquad 9^{3-7} = 9^{-4} = \boxed{\frac{1}{9^4}}$$

$\frac{9^3}{9^7} = \boxed{}$ (Type exponential notation with positive exponents.)

Reasoning Simplify $(-5)^{-8}$. Use -5 as the base. Use pencil and paper. Is the result the same as the result of simplifying -5^{-8}? Do $(-5)^{-9}$ and -5^{-9} simplify to the same value? Explain.

← no, because without parentheses. it is the negative result of 5^{-8}

$(-5)^{-8} = \boxed{}$ (Type exponential notation with positive exponents.)

$$\frac{1}{(-5)^8}$$

Think About the Process To simplify this expression first find the base of the exponential term. Then simplify the expression. Assume that x is nonzero.

$2x^{-3}$

$$2 \qquad x^{-3}$$
$$\downarrow \qquad \downarrow$$
$$2 \qquad \frac{1}{x^3}$$

The base of the exponential term is ___X___

$$2x^{-3} = \boxed{\frac{2}{x^3}}$$