10.4 Zero and Negative Exponents

Learning Targets

- Evaluate expressions with Zero Exponents
- Evaluate expressions with Negative Exponets
- Write expressions using only Positive Exponents

Zero Exponents

Any number raised to the Zero power = 1

$x^0 = 1$

$3^0 = 1$

$(-14)^0 = 1$

$\left(\frac{2}{7}\right)^0 = 1$

$-12,874^0 = -1$

$(4y)^0 = 1$

$-$ of $12,874^\circ$

$-1 \cdot 12,874^\circ$

Here is one explanation "why"

Using the "rule" for Quotient of Powers Property

The "rule" $\frac{8^9}{8^4} = 8^{9-4} = 8^5$

SO . . . $\frac{8^7}{8^7} = 8^{(7-7)} = 8^0$

And if we know that $\frac{8^7}{8^7} = 1$ then,

$8^0 = 1$

Negative Exponents

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

A base with a negative exponent can be rewritten as the reciprocal of that number raised to a positive exponent.

$\frac{4}{1}$

Negative Exponents

$$\frac{5^{-3}}{1} = \frac{1}{5^3}$$

$$\frac{1}{125}$$

$$\frac{1}{9^{-7}} = \frac{9^7}{1}$$

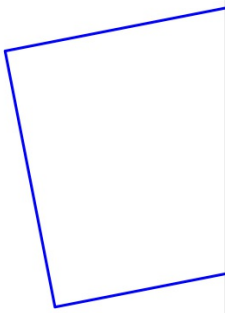
Note: a negative exponent does not make the number negative!

Evaluating Expressions

means "find an answer"
(don't keep in exponential form)

$$4^{-3}$$

$$\frac{4^{-3}}{1} = \frac{1}{4^3} = \frac{1}{4 \cdot 4 \cdot 4} = \frac{1}{64}$$



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

$$= -\frac{1}{64}$$

Evaluating Expressions

$$(-6)^{-4} * (-6)^{4}$$

1st Strategy

$(-6)^{-4} * (-6)^{4}$ Rule

$(-6)^{-4+4}$

$(-6)^{0} = 1$

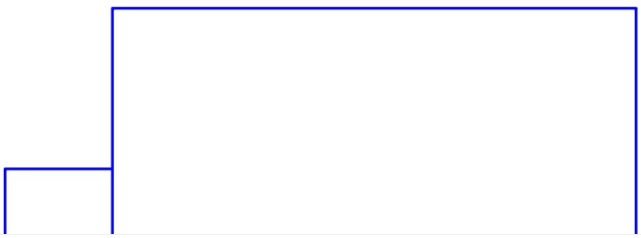
$\frac{(-6)^{-4}}{1}$

2nd Strategy

$(-6)^{-4} * (-6)^{4}$

$\frac{1}{(-6)^{4}} * \frac{(-6)^{4}}{1}$

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



Evaluating Expressions

$$\frac{2^6}{2^9}$$

1st Strategy

$\frac{2^6}{2^9}$ Rule

$2^{6-9} = 2^{-3}$

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

2nd Strategy

$\frac{2^6}{2^9}$

$\frac{\cancel{2}\cdot\cancel{2}\cdot\cancel{2}\cdot\cancel{2}\cdot\cancel{2}\cdot\cancel{2}}{\cancel{2}\cdot\cancel{2}\cdot\cancel{2}\cdot\cancel{2}\cdot\cancel{2}\cdot\cancel{2}\cdot 2\cdot 2\cdot 2} = 1$

$\frac{1}{2\cdot 2\cdot 2} = \frac{1}{8}$

Evaluating Expressions

$$\frac{4^5 * 4^{-3}}{4^2}$$

1st Strategy

$\frac{4^5 * 4^{-3}}{4^2}$

$\frac{4^{5+(-3)}}{4^2} = \frac{4^2}{4^2}$

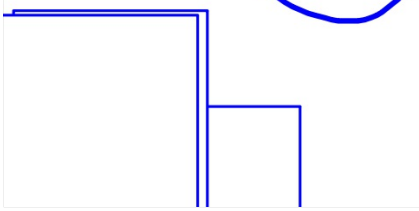
1

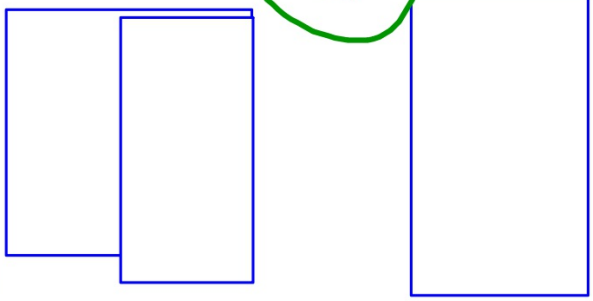
2nd Strategy

$\frac{4^5 * 4^{-3}}{4^2}$

$\frac{4^5}{4^2 \cdot 4^3} = \frac{4^5}{4^5}$

1





Evaluate Each Expression

1. 4^{-2}

$\frac{1}{16}$

2. $(-2)^{-5}$

$-\frac{1}{32}$

3. $6^{-8} \cdot 6^{8}$

1

4. $\frac{(-3)^5}{(-3)^6}$

$-\frac{1}{3}$

$\frac{1}{-3}$

5. $\frac{1}{5^7} \cdot \frac{1}{5^{-4}}$

$\frac{1}{125}$

Simplifying Expressions

Express using only positive exponents

a. $-5x^0$

$-5 \cdot x^0$

$-5 \cdot 1$

-5

b. $\dfrac{9y^{-3}}{y^5}$

$9 \cdot y^{-8}$

$9 \cdot y^{-3}$ over y^5

$\dfrac{9}{y^5 \cdot y^3} = \dfrac{9}{y^8}$

Simplify. Write the expression using only positive exponents.

7. $8x^{-2}$

$$\frac{8 \cdot x^{-2}}{1}$$

$$\frac{8}{1 \cdot x^{2}}$$

8. $\frac{1^{0} \cdot b^{-10}}{1}$

$$\frac{1}{b^{10}}$$

9. $\frac{z^{6}}{15z^{9}}$

$$\frac{z^{6}}{15 \cdot z^{9}}$$

$$\frac{1}{15z^{3}}$$

Express using only positive exponents

$\frac{6x^4}{3x^7}$	$\frac{12y}{36y^{-5}}$	$\frac{4^{-3} \bullet g^4 \bullet h^0}{5 \bullet g^{-2} \bullet h^{-5}}$
$\frac{6}{3} \cdot \frac{x^4}{x^7}$	$\frac{12}{36} \cdot \frac{y}{y^{-5}}$	$\frac{4^{-3}}{5} \cdot \frac{g^4}{g^{-2}} \cdot \frac{h^0}{h^{-5}}$
$\frac{2}{1} \cdot \frac{1}{x^3}$	$\frac{1}{3} \cdot \frac{y \cdot y^5}{1}$	$\frac{1}{5 \cdot 4^3} \cdot \frac{g^4 \cdot g^2}{1} \cdot \frac{h^5}{1}$
$\frac{2}{x^3}$	$\frac{y^6}{3}$	$\frac{g^6 h^5}{320}$

Homework

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