Algebra I
Lesson 7-1

Standard:

N.RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values...

Learning Goal:

- I can simplify expressions involving zero and negative exponents.

Complete the table. Make a conjecture about how the value of an exponential expression changes when you decrease the exponent by 1.

2^x	10^x
$2^4 = 16$	$10^4 = 10{,}000$
$2^3 = 8$	$10^3 = 1{,}000$
$2^2 = 4$	$10^2 = 100$
$2^1 = 2$	$10^1 = 10$
$2^0 = 1$	$10^0 = 1$
$2^{-1} = \frac{1}{2}$	$10^{-1} = 0.1 = \frac{1}{10}$
$2^{-2} = \frac{1}{4}$	$10^{-2} = 0.01 = \frac{1}{100}$

$2^{-3} = \frac{1}{8}$ $\quad 10^{-3} = \frac{1}{1000}$

Properties: Zero and Negative Exponents

Zero as an Exponent:

For every nonzero number a, $a^0 = 1$

$4^0 = 1$ $(-3)^0 = 1$ $(5.14)^0 = 1$

Negative Exponent:

For every nonzero number a and integer n, $a^{-n} = \frac{1}{a^n}$

$7^{-3} = \frac{1}{7^3}$ $(-5)^{-2} = \frac{1}{(-5)^2}$

Zero as a Base

Why can't you have 0^0?

$3^0 = 1$ $2^0 = 1$ $1^0 = 1$ $\boxed{0^0 = 1}$

$0^3 = 0 \cdot 0 \cdot 0 = 0$ $\boxed{1 \cdot 0 = 0}$

0^0 is undefined

Why can't you have zero as a base with a negative exponent?

$0^{-3} = \frac{1}{0^3}$ you can't divide by zero

0^{-n} is undefined

Simplifying Powers

What is the simplified form of each expression?

9^{-2}

$\frac{1}{9^2} = \frac{1}{81}$

$(-3.6)^0$

1

Got It?

What is the simplified form of each expression?

4^{-3}

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

$(-5)^0 = 1$

3^{-2}

$\frac{1}{9}$

6^{-1}

$\frac{1}{6^1} = \frac{1}{6}$

$(-4)^{-2}$

$\frac{1}{(-4)^2} = \frac{1}{16}$

An algebraic expression is in simplest form when powers with a variable base are written with only positive exponents.

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

Simplifying Exponential Expressions

What is the simplified form of each expression?

$5a^3b^{-2}$

$5 \cdot a^3 \cdot b^{-2}$

$5 \cdot a^3 \cdot \frac{1}{b^2}$

$\frac{5a^3}{b^2}$

$\frac{1}{x^{-5}}$

$1 \div x^{-5}$

$1 \div \frac{1}{x^5} = 1 \cdot \frac{x^5}{1}$

x^5

Got It?

What is the simplified form of each expression?

x^{-9} $\frac{1}{x^9}$

$4c^{-3}b$ $\frac{4b}{c^3}$

$\frac{1}{n^{-3}}$ n^3

$\frac{2}{a^{-3}}$ $2a^3$

$\frac{n^{-5}}{m^2}$ $\frac{1}{m^2n^5}$

Pg 421
#10-36 even

Assignment

Algebra I
Lesson 7-1a

Pgs. 421 #10-36 even

Algebra I
Lesson 7-1a
Pgs. 421 #10-36 even

10. 1

12. $-\frac{1}{25}$

14. $\frac{1}{64}$

16. $-\frac{1}{12}$

18. $\frac{1}{58}$

20. $-\frac{1}{125}$

22. x^7

24. c

26. $\frac{1}{k^4}$ $j \neq 0$

28. $\frac{7a}{3b^2w}$

30. $\frac{d^7}{c^5}$

32. $\frac{7st^3}{5}$

34. $\frac{x^2}{8z^7}$

36. $\frac{14}{m^2t^5}$

When you evaluate an exponential expression, you can simplify the expression before substituting values for the variables.

Evaluating an Exponential Expression

What is the value of $3s^3t^{-2}$ for $s = 2$ and $t = -3$?

$3s^3t^{-2}$

$3s^3 \cdot \frac{1}{t^2} = \frac{3s^3}{t^2}$

$\frac{3(2^3)}{(-3)^2} = \frac{3(8)}{9} = \frac{8}{3}$

Got It?

What is the value of each expression for $n = -2$ and $w = 5$?

$n^{-4}w^0$

$\frac{1}{n^4}$

$\frac{1}{(-2)^4} = \frac{1}{16}$

$\frac{n^{-1}}{w^2}$

$\frac{1}{n^1} \div w^2$

$\frac{1}{n^1} \cdot \frac{1}{w^2}$

$\frac{1}{n^1w^2}$

$\frac{1}{(-2)(5^2)} = \frac{1}{-2(25)} = \frac{1}{-50}$

$\frac{n^0}{w^6}$

$\frac{1}{w^6}$

$\frac{1}{5^6} = \frac{1}{15{,}625}$

$\frac{1}{nw^{-1}}$

$\frac{w}{n}$

$\frac{5}{-2}$

Using an Exponential Expression

A population of marine bacteria doubles every hour under controlled laboratory conditions. The number of bacteria is modeled by the expression $\mathbf{1000 \cdot 2^h}$, where h is the number of hours after a scientist measures the population size. Evaluate the expression for $h = 0$ and $h = -3$. What does each value of the expression represent in the situation?

$1000 \cdot 2^h$

$h = 0$

$1000 \cdot 2^0$

$1000 \cdot 1$

1000 bacteria

When scientist starts counting

$h = -3$

$1000 \cdot 2^{-3}$

$\frac{1000}{2^3} = \frac{1000}{8} =$

125 bacteria

3 hrs. before scientist starts counting

Assignment

Algebra I
Lesson 7-1b

Pgs. 421-422 #38-44 even, 45, 46