ZERO + NEGATIVE EXPONENT

Additional Examples — Lesson 8-1

1 EXAMPLE **Simplify:** THINK FRACTIONS! $\frac{1}{3 \cdot 3}$

a. $3^{-2} = \frac{1}{3^2}$ Use the definition of negative exponent.

$= \frac{1}{9}$ Simplify.

b. $(-22.4)^0 = 1$ Use the definition of zero as an exponent.

2 EXAMPLE **Simplify each expression.**

a. $3ab^{-2} = 3a\left(\frac{1}{b^2}\right)$ Use the definition of negative exponent.

$= \frac{3a}{b^2}$ Simplify.

b. $\frac{1}{x^{-3}} = 1 \div x^{-3}$ Rewrite using a division symbol.

$= 1 \div \frac{1}{x^3}$ Use the definition of negative exponent.

$= 1 \cdot x^3$ Multiply by the reciprocal of $\frac{1}{x^3}$, which is x^3.

$= x^3$ Identity Property of Multiplication

ZERO AS AN EXPONENT:

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

NEGATIVE EXPONENT

For every nonzero number a and integer n, $a^{-n} = \frac{1}{a^n}$ (move it, lose it)

3 EXAMPLE Evaluate $4x^2y^{-3}$ for $x = 3$ and $y = -2$.

Method 1: Write with positive exponents first.

$$4x^2y^{-3} = \frac{4x^2}{y^3}$$ Use the definition of negative exponent.

$$= \frac{4(3)^2}{(-2)^3}$$ Substitute 3 for x and -2 for y.

$$= \frac{36}{-8} = -4\frac{1}{2}$$ Simplify.

Method 2: Substitute first.

$$4x^2y^{-3} = 4(3)^2(-2)^{-3}$$ Substitute 3 for x and -2 for y.

$$= \frac{4(3)^2}{(-2)^3}$$ Use the definition of negative exponent.

$$= \frac{36}{-8} = -4\frac{1}{2}$$ Simplify.

4 EXAMPLE In the lab, the population of a certain bacteria doubles every month. The expression $3000 \cdot 2^m$ models a population of 3000 bacteria after m months of growth. Evaluate the expression for $m = 0$ and $m = -2$. Describe what the value of the expression represents in each situation.

a. Evaluate the expression for $m = 0$.

$3000 \cdot 2^m = 3000 \cdot 2^0$ Substitute 0 for m.

$= 3000 \cdot 1$ Simplify.

$= 3000$

When $m = 0$, the value of the expression is 3000. This represents the initial population of the bacteria. This makes sense because when $m = 0$, no time has passed.

b. Evaluate the expression for $m = -2$.

$3000 \cdot 2^m = 3000 \cdot 2^{-2}$ Substitute -2 for m.

$= 3000 \cdot \frac{1}{4}$ Simplify.

$= 750$

When $m = -2$, the value of the expression is 750. This represents the 750 bacteria in the population 2 months before the present population of 3000 bacteria.