7.3 Zero and Negative Exponents

GOAL Use zero and negative exponents.

Common Student Errors

- Always subtracting the smallest exponent from the largest one

  Tip Remind students that they should subtract the exponent in the denominator from the exponent in the numerator.

Student equation: $\frac{x^3}{x^5} = x^{5-3} = x^2$

ALL ZERO EXPONENTS MAKE ANSWER 1

TO REMOVE NEGATIVE EXPONENT TAKE IT TO THE OTHER SIDE OF THE FRACTION. IF IT IS THE NUMERATOR TAKE IT TO THE DENOMINATOR. IF IT IS IN THE DENOMINATOR MOVE IT TO THE NUMERATOR.

EXAMPLE 1 Use definition of zero and negative exponents

Evaluate the expression.

a. $4^{-3} = \frac{1}{4^3}$ Definition of negative exponents

$= \frac{1}{64}$ Evaluate exponent.

b. $15^0 = 1$ Definition of zero exponent

c. $\left(\frac{3}{2}\right)^{-3} = \frac{1}{\left(\frac{3}{2}\right)^3}$ Definition of negative exponents

$= \frac{1}{\left(\frac{27}{8}\right)}$ Evaluate exponents.

$= \frac{8}{27}$ Simplify.

Exercises for Example 1

Evaluate the expression.

1. $\left(-\frac{1}{2}\right)^0$

2. $(-5)^{-4}$

3. $\frac{1}{6^{-2}}$

4. $\left(\frac{5}{2}\right)^{-3}$

EXAMPLE 2 Evaluate exponential expressions

Evalute the expression.

a. $13^{16} \cdot 13^{-14} = 13^{16\,-\,14}$ Product of powers property

$= 13^2$ Subtract exponents.

$= 169$ Evaluate power.

b. $[(-2)^{-4}]^2 = (-2)^{-4\,\cdot\,2}$ Power of a power property

$= (-2)^{-8}$ Multiply exponents.

$= \frac{1}{(-2)^8}$ Definition of negative exponents

$= \frac{1}{256}$ Evaluate power.

Exercises for Example 2

Evaluate the expression.

5. $\dfrac{8^{-5}}{8^{-5}}$

6. $\dfrac{1}{9^{-2}}$

7. $(-4)^7 \cdot (-4)^{-9}$

8. $\dfrac{10^2}{10^{-3}}$

EXAMPLE 3 ## Use properties of exponents

Simplify the expression. Write your answer using only positive exponents.

a. $(3m^{-2}n^3)^3 = 3^3 \cdot (m^{-2})^3 \cdot (n^3)^3$ Power of a product property

$= 27 \cdot m^{-6} \cdot n^9$ Power of a power property

$= \dfrac{27n^9}{m^6}$ Definition of negative exponents

b. $\dfrac{(-5st)^2t^{-4}}{-10s^3t^{-8}} = \dfrac{(-5st)^2t^8}{-10s^3t^4}$ Definition of negative exponents

$= \dfrac{(25s^2t^2)t^8}{-10s^3t^4}$ Power of a product property

$= \dfrac{25s^2t^{10}}{-10s^3t^4}$ Product of powers property

$= \dfrac{5t^6}{-2s}$ Quotient of powers property

Exercises for Example 3

Simplify the expression. Write your answer using only positive exponents.

9. $(5x^2y^{-3}z)^4$

10. $\dfrac{4m^{-2}np^3}{12m^2n^{-5}p}$

11. $\dfrac{(2r^2t)^{-3}rst^4}{6r^6s^{-3}}$