8.3 Define and Use Zero and Negative Exponents

Goal • Use zero and negative exponents.

Your Notes

DEFINITION OF ZERO AND NEGATIVE EXPONENTS

Words	Algebra	Example
a to the zero power is 1.	$a^0 =$ 1 , $a \neq 0$	$5^0 =$ 1
a^{-n} is the reciprocal of a^n.	$a^{-n} =$ $\frac{1}{a^n}$, $a \neq 0$	$2^{-1} =$ $\frac{1}{2}$
a^n is the reciprocal of a^{-n}.	$a^n =$ $\frac{1}{a^{-n}}$, $a \neq 0$	$2 =$ $\frac{1}{2^{-1}}$

Example 1 ***Use definition of zero and negative exponents***

Evaluate the expression.

a. $2^{-3} = \frac{1}{2^3}$ — **Definition of** negative exponents

$= \frac{1}{8}$ — **Evaluate exponent.**

b. $(-10)^0 =$ 1 — **Definition of** zero exponent

c. $\left(\frac{1}{4}\right)^{-3} = \frac{1}{\left(\frac{1}{4}\right)^3}$ — **Definition of** negative exponents

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

$= 64$ — **Simplify.**

d. $0^{-7} =$ undefined — a^{-n} **is defined only for a** nonzero **number** a.

Your Notes

PROPERTIES OF EXPONENTS

Let a and b be real numbers, and let m and n be integers.

$a^m \cdot a^n = a^{m+n}$	Product of powers property
$(a^m)^n = a^{mn}$	Power of a power property
$(ab)^m = a^m b^m$	Power of a product property
$\frac{a^m}{a^n} = a^{m-n}$, $a \neq 0$	Quotient of powers property
$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$, $b \neq 0$	Power of a quotient property

Example 2 ***Evaluate exponential expressions***

Evaluate the expression.

a. $(-5)^4 \cdot (-5)^{-4} = (-5)^{4+(-4)}$ — **Product of powers property**

$= 5^0$ — Add **exponents.**

$= 1$ — **Definition of zero exponent**

b. $(5^{-2})^{-2} = 5^{-2 \cdot (-2)}$ — **Power of a power property**

$= 5^4$ — Multiply **exponents.**

$= 625$ — **Evaluate power.**

c. $\frac{1}{4^{-2}} = 4^2$ — **Definition of negative exponents**

$= 16$ — **Evaluate power.**

d. $\frac{3^2}{3^{-1}} = 3^{2-(-1)}$ — Quotient of powers **property**

$= 3^3$ — Subtract **exponents.**

$= 27$ — **Evaluate power.**

Your Notes

✔ ***Checkpoint*** **Evaluate the expression.**

1. $\left(\frac{1}{8}\right)^{-1}$ 8	**2.** $\frac{1}{3^{-2}}$ 9
3. $\frac{6^{-1}}{6}$ $\frac{1}{36}$	**4.** $(5^{-1})^2$ $\frac{1}{25}$

Example 3 ***Use properties of exponents***

Simplify the expression $\frac{2w^{-3}x}{(2wx)^2}$. Write your answer using only positive exponents.

Solution

$\frac{2w^{-3}x}{(2wx)^2} = \frac{2x}{w^3(2wx)^2}$ **Definition of negative exponents**

$= \frac{2x}{w^3(4w^2x^2)}$ Power of a product **property**

$= \frac{2x}{4w^5x^2}$ Product of powers **property**

$= \frac{1}{2w^5x}$ Quotient of powers **property**

✔ ***Checkpoint*** **Simplify the expression.**

5. $\frac{6fg^{-4}}{2f^2g}$ $\frac{3}{fg^5}$	**6.** $(3yz^2)^{-2}$ $\frac{1}{9y^2z^4}$

Homework