

5.1 Use Properties of Exponents

TEKS a.1, 2A.2.A

Before

You evaluated powers.

Now

You will simplify expressions involving powers.

Why?

So you can compare the volumes of two stars, as in Example 5.



Key Vocabulary

- scientific notation

Consider what happens when you multiply two powers that have the same base:

$$2^3 \cdot 2^5 = (2 \cdot 2 \cdot 2) \cdot (2 \cdot 2 \cdot 2 \cdot 2 \cdot 2) = 2^8$$

Note that the exponent **8** in the product is the sum of the exponents **3** and **5** in the factors. This property is one of several properties of exponents shown below.

KEY CONCEPT

For Your Notebook

Properties of Exponents

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

Property Name	Definition	Example
Product of Powers	$a^m \cdot a^n = a^{m+n}$	$5^3 \cdot 5^{-1} = 5^{3+(-1)} = 5^2 = 25$
Power of a Power	$(a^m)^n = a^{mn}$	$(3^3)^2 = 3^{3 \cdot 2} = 3^6 = 729$
Power of a Product	$(ab)^m = a^m b^m$	$(2 \cdot 3)^4 = 2^4 \cdot 3^4 = 1296$
Negative Exponent	$a^{-m} = \frac{1}{a^m}, a \neq 0$	$7^{-2} = \frac{1}{7^2} = \frac{1}{49}$
Zero Exponent	$a^0 = 1, a \neq 0$	$(-89)^0 = 1$
Quotient of Powers	$\frac{a^m}{a^n} = a^{m-n}, a \neq 0$	$\frac{6^{-3}}{6^{-6}} = 6^{-3-(-6)} = 6^3 = 216$
Power of a Quotient	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, b \neq 0$	$\left(\frac{4}{7}\right)^2 = \frac{4^2}{7^2} = \frac{16}{49}$

AVOID ERRORS

When you multiply powers, do not multiply the bases. For example, $3^2 \cdot 3^5 \neq 9^7$.

EXAMPLE 1 Evaluate numerical expressions

- a. $(-4 \cdot 2^5)^2 = (-4)^2 \cdot (2^5)^2$ **Power of a product property**
 $= 16 \cdot 2^{5 \cdot 2}$ **Power of a power property**
 $= 16 \cdot 2^{10} = 16,384$ **Simplify and evaluate power.**
- b. $\left(\frac{11^5}{11^8}\right)^{-1} = \frac{11^8}{11^5}$ **Negative exponent property**
 $= 11^{8-5}$ **Quotient of powers property**
 $= 11^3 = 1331$ **Simplify and evaluate power.**