

The Exponent Laws

A. Quick Review: Powers

Powers are a convenient way of writing repeated multiplication. A power consists of two parts: a **base** and an **exponent**. The base tells us which number to repeatedly multiply, and the exponent tells us how many times to perform the multiplication.

Example 1: 2^6 This power is written in *exponential form*.

The base is _____. The exponent is _____. Write this power in *expanded form*: _____

B. Multiplying Powers

The first exponent law deals with multiplying powers. We use this exponent law when we are multiplying powers that have the **same base**. Let's look at a few examples to find the pattern.

a) $5^2 \times 5^4$

b) 2×2^3

c) $a \times a$

Rule for Multiplying Powers

When multiplying powers with the **same base**, you **keep the base** and add the exponents. If you do not see an exponent, it is assumed to be "1". **Example:** $x(x^3) = x^4$

$$b^x \times b^y = b^{x+y}$$

C. Dividing Powers

The second exponent law deals with dividing powers. Let's look at a few examples to find the pattern.

a) $\frac{5^6}{5^4}$

b) $2^5 \div 2^2$

c) $a^4 \div a$

Rule for Dividing Powers

When dividing powers with the **same base**, you **keep the base** and subtract the exponents.

Example: $x^7 \div x^3 = x^4$

$$b^x \div b^y = b^{x-y}$$

D. Powers of Powers

The third exponent law deals with powers being raised to other powers. Let's look at some examples to find the pattern.

a) $(3^2)^3$

b) $(4a)^3$

c) $(2^2b^4)^2$

Rule for Powers of Powers

When using powers of powers with the **same base**, you **keep the base** and multiply the exponents. **Example:** $(x^2)^3 = x^6$

$$(b^x)^y = b^{xy}$$

E. Powers with Zero Exponents

One extension of the exponent laws is considering a power when its exponent is zero. For the expression below, let's complete the following:

i) use the exponent law to subtract the exponents

ii) expand the powers and reduce the expressions

iii) use a calculator to evaluate the result

$$\frac{4^3}{4^3}$$

i)

ii)

iii)

Powers with Zero Exponents

When applying the exponent law for dividing powers, you get an exponent equal to zero. When dividing two powers with the same base and the same exponent, you get a result of 1. Thus, any base (with the exception of 0) raised to an exponent of zero equals 1.

Since: $b^x \div b^x = b^0$

And: $b^x \div b^x = 1$

Then: $b^0 = 1$

Practice: a) $(b^3)^0$

b) $2b^0$

c) $\frac{12x^3}{3x^3}$