

## Exponents

Dealing with positive and negative exponents and simplifying expressions dealing with them is simply a matter of remembering what the definition of an exponent is.

- ∞ A positive exponent means repeated multiplication.
- ∞ A negative exponent means the *opposite* of repeated multiplication, which is repeated division.

Let's evaluate the following:

$$2^3 =$$
$$2^2 =$$
$$2^1 =$$
$$2^0 =$$
$$2^{-1} =$$
$$2^{-2} =$$
$$2^{-3} =$$

Notice that a negative exponent makes the "2" flip from  $\frac{2}{1}$  raised to some power over to  $\frac{1}{2}$  raised to some power. In other words, instead of multiplying by 2 repeatedly, we're dividing by two repeatedly. In effect, a negative exponent makes us do the opposite of what it initially looks like. If a number with a negative exponent is in the bottom (division), it means to move it to the top (multiply); If a number with a negative exponent is in the top (multiplication), it means to move it to the bottom (divide).

Simplify:

- 1)  $x^{-5}$                       2)  $\frac{1}{x^{-6}}$                       3)  $x^3 \cdot x^{-4}$                       4)  $(3x)^{-2}$

## Laws of Exponents

Next, we're going to examine some rules typically called the "laws of exponents". There are two things that need to be kept in mind:

- 1) Exponents are a shortcut for repeated multiplication.
- 2) Anything divided by itself is "1", except for the number "0". (We can't divide by "0", remember.)

Example 1: Simplify:  $x^2 \cdot x^4$

Example 2: Simplify  $\frac{x^2}{x^6}$

Example 3: Simplify  $(x^3)^4$

Example 4: Simplify  $\left(\frac{x^4}{y^3}\right)^2$

When simplifying an expression involving positive and negative exponents, it's sometimes easier to move the base with the negative exponents first. That way, when we use the "laws of exponents" that we all know, we don't have to worry about double negatives and the like.

Simplify:

Example 5:  $\frac{x^{-4}}{x^5}$

Example 6:  $(x^{-3}y^2)^4$

Example 7:  $\left(\frac{x^{-3}}{y^2}\right)^{-6}$