Algebra 1: 6.1 Properties of Exponents

Today we'll be covering shortcuts to simplify problems with exponents. I'll start by expanding everything to show why the shortcut works, then we'll just use the shortcut.

Simplify: $8^3 \cdot 8^4$

$8 \cdot 8 \cdot 8 \quad 8 \cdot 8 \cdot 8 \cdot 8$

if we recombined them... 8^7

Exponent: # here (AKA a power)

Base: the # raised to the exponent.

How to do powers: take the base times itself the Exponent # of times.

Property: $a^m \cdot a^n = a^{m+n}$

if you multiply the bases (and they are the same)

you add the powers to simplify.

6.1 Properties of Exponents

You Try:

multiplication Symbol.

Ex: $8^3 * 8^9 = 8^{3+9} = 8^{12}$ this is "simplified"

Ex 2: $3^{12} * 3^{-5} = 3^{12+-5} = 3^{12-5} = 3^7$

6.1 Properties of Exponents

Simplify: $\frac{6^8}{6^3} = \frac{6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 \cdot 6}{6 \cdot 6 \cdot 6}$

$= 6^5$

$6^{8-3} = 6^5$

Side Note:

$\frac{4x}{4} = \frac{8}{4}$

$x = 2$

this cancelling is what we are doing here...

Property: $\frac{a^m}{a^n} = a^{m-n}$

When you divide the bases you subtract the powers.

6.1 Properties of Exponents

You Try:

Ex: $\dfrac{6^{16}}{6^{7}}$

$= 6^{16-7}$

$= 6^{9}$

Ex: $\dfrac{x^{11}}{x^{4}}$

$= x^{11-4}$

$= x^{7}$

6.1 Properties of Exponents

Simplify: $\left(y^2\right)^4$

Base: y^2

Exponent: 4

The base times itself 4 times.

Expanded:

$y^2 \cdot y^2 \cdot y^2 \cdot y^2$

use 1st Property to Add powers.

$y^{2+2+2+2} = y^8$

Property: $\left(a^m\right)^n = a^{mn}$

when you have a power raised to a power, you multiply the powers.

6.1 Properties of Exponents

You Try:

Ex: $\left(y^{7}\right)^{-4}$

$= y^{7 \cdot -4}$

$= y^{-28}$

Ex: $\left(x^{5}\right)^{9}$

$= x^{5 \cdot 9}$

$= x^{45}$

6.1 Properties of Exponents

Simplify: $\left(x^5 y^3\right)^2$

Base : $x^5 y^3$

Power : 2

Expanded: $x^5 y^3 \cdot x^5 y^3$ ← you could rewrite this as $x^5 x^5 y^3 y^3$

Use 1st property

$x^{5+5} y^{3+3} = x^{10} y^6$

Property: $\left(a^m b^n\right)^p = \left(a^m\right)^p * \left(b^n\right)^p$

$\left(x^5 \cdot y^3\right)^2 = \left(x^5\right)^2 \left(y^3\right)^2 = x^{10} y^6$

Power to power multiply.

Property: Any (non-zero) number raised to the zero power is 1.

Ex: Simplify $(-27)^0 = 1$

Ex: $\frac{4^3}{4^3} = 4^{3-3} = 4^0 = 1$

Expand $\frac{4 \cdot 4 \cdot 4}{4 \cdot 4 \cdot 4} = 1 \cdot 1 \cdot 1 = 1$

Property:

Negative exponents relate to Reciprocals.

$$x^{-3} = \left(\frac{1}{x^3}\right)$$

If you see a Negative Exponent, You can move that base to the Other side of the fraction to make it positive!

Rewrite the expressions with positive exponents.

Ex: y^{-4}

$\frac{1}{y^4}$

Ex: $\frac{2x^{-3}y^4}{z^{-2}}$

$= \frac{2y^4z^2}{x^3}$

you have to convert the negative powers to positive powers.

$\frac{y^7}{y^3} = y^{7-3} = y^4$

Proving using old properties

$\frac{y^7}{y^3} = y^7 \cdot y^{-3} = y^{7+-3} = y^4$

Using multiple Properties:

$$\frac{5^{7}x^{3}y}{5^{5}xy^{6}}$$

method #1 top minus bottom power.

$= 5^{7-5} x^{3-1} y^{1-6}$

$= 5^{2} x^{2} y^{-5} = \frac{25x^{2}}{y^{5}}$

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method 2.

$$\frac{5^{7}x^{3}y}{5^{5}xy^{6}} = \frac{5^{2}x^{2}}{y^{5}}$$

$\frac{5\,5\,5\,5\,5\,5\,5}{5\,5\,5\,5\,5}$

$\frac{x\,x\,x}{x}$

$\frac{y}{x\,y\,y\,y\,y\,y}$

6.1 Properties of Exponents

$$\frac{\left(x^3 y^1\right)^2}{x^{-5} y}$$

multiply

$$= \frac{x^6 y^2}{x^{-5} y} = \frac{x^6 y^2 x^5}{y}$$

$$= x^{11} y$$

6.1 Properties of Exponents

$$\frac{4x^{-2}y^{5}}{20x^{8}} * \frac{-5x^{6}y}{15y^{-9}}$$

Step 1: multiply across and simplify the top & bottom

$$= \frac{-20x^{4}y^{6}}{300x^{8}y^{-9}}$$

(-2+6 = 4; 5+1 = 6)

Step 2: make all powers positive.

$$= \frac{-20x^{4}y^{6}}{300x^{8}y^{-9}} = \frac{-20x^{4}y^{6}y^{9}}{300x^{8}}$$

Step 3: combine / simplify

$$= \frac{-1y^{15}}{15x^{4}}$$

Homework:

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