

Algebra 2

Unit 1 Lesson 8: Properties of Exponents

- Simplify expressions using properties of exponents
- Apply multiple properties to simplify radical expressions

Property I:

Expand the following exponent expression...

$$2^2 * 2^3$$

$$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$$

$$2^5$$

$$a^m * a^n = a^{m+n}$$

Product of Powers Property:

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$$\begin{aligned}\text{Ex: } & 8^3 * 8^9 \\ & = 8^{12}\end{aligned}$$

$$\begin{aligned}\text{Ex 2: } & 3^{12} * 3^{-5} \\ & = 3^7\end{aligned}$$

Property II:

Expand $\frac{5^4}{5^2}$ and simplify to see property.

$$5^2 \quad \frac{\cancel{5} \cdot \cancel{5} \cdot 5 \cdot 5}{\cancel{5} \cdot \cancel{5}} = 5 \cdot 5 = 5^2$$

- Same base in a fraction: Top exponent - bottom exponent.

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

Power of a Quotient Property:

$$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$$

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$$\text{Ex: } \frac{6^{16}}{6^7}$$

$$6^9$$

$$\text{Ex: } \frac{x^{11}}{x^4}$$

$$x^7$$

Property III:

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

Power to a power -> Multiply

Ex: $\left(y^2\right)^4$
 y^8

Ex: $\left(x^5\right)^9$
 x^{45}

Property IV:

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

"distribute" the power to each base.

Note: This DOES NOT WORK with addition/ subtraction.

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

Property V:

- Anything (Except 0) raised to the 0 power is 1.

$$a^0 = 1, a \neq 0$$

Property VI:

Negative exponents relate to Reciprocals.

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

When you take the reciprocal of the base, the negative "goes away"

Rewrite the expressions with positive exponents.

Ex: y^{-4}

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

Ex: $\left(\frac{1}{z} \right)^{-7}$

$$\left(\frac{z}{1} \right)^7 = z^7$$

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Using multiple Properties:

$$\frac{5^2 x^2}{y^5}$$

$$\frac{5^7 x^3 y^1}{5^5 x^1 y^6}$$

$$\frac{5^2 x^2}{1 y^5}$$

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$$\begin{aligned}
 & \frac{(x^3 y)^2}{x^{-5} y} = \frac{(x^3)^2 y^2}{x^{-5} y} \\
 & = \frac{x^6 y^2}{x^{-5} y} = \frac{x^6 y^2 x^5}{y} \\
 & = x^{11} y
 \end{aligned}$$

(Note: In the original image, there are green annotations: a '4' and a 'y' above the second fraction, a '4' and a 'y' above the third fraction, and a 'y' below the third fraction, all of which appear to be corrections or additional work.)

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$$\frac{4x^{-2}y^5}{20x^8} * \frac{-5x^6y^1}{15y^{-9}}$$

$$\frac{-20x^4y^6}{300x^8y^{-9}} = \frac{-20x^4y^{15}}{300x^8}$$

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