

ALG 1 – Unit 7 – Division Properties of Exponents

Target: I can simplify expressions using exponent rules

Division Properties of Exponents

Review – Write the rule to help you remember what is being done to the exponents.

When you multiply powers that have the **SAME BASE**, you add exponents

Example: $x^5 \cdot x^3 = x^{5+3} = x^8$

When you raise a **power to a power**, you multiply exponents

Example: $(x^5)^3 = x^{5 \cdot 3} = x^{15}$

Predict – What do you think will be done with the exponents?

When you divide powers that have the **SAME BASE**, you subtract exponents

Example: $\frac{x^5}{x^3} = x^{5-3} = x^2$

TRY THIS: Expand the numerator and denominator using repeated multiplication. Then cancel like terms

1) $\frac{5^6}{5^2} = \frac{\cancel{5} \cdot \cancel{5} \cdot 5 \cdot 5 \cdot 5 \cdot 5}{\cancel{5} \cdot \cancel{5}} = 5^4$

2) $\frac{x^8}{x^7} = \frac{\cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot x}{\cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x}} = x$

3) $\frac{b^3}{b^7} = \frac{\cancel{b} \cdot \cancel{b} \cdot \cancel{b}}{\cancel{b} \cdot \cancel{b} \cdot \cancel{b} \cdot \cancel{b} \cdot \cancel{b} \cdot \cancel{b} \cdot b} = \frac{1}{b^4}$

1) Is there a faster way to reduce these exponents? With a partner, create a rule to help simplify these expressions.

Subtract exponents

2) Use your rule to simplify the following: $\frac{x^{1600}}{x^{600}} = x^{1000}$

Property

Dividing Powers With the Same Base

For every nonzero number a and integers m and n , $\frac{a^m}{a^n} = a^{m-n}$

Example $\frac{3^7}{3^3} = 3^{7-3} = 3^4 = 81$

Examples: Simplify the following expressions

You do:

$$\frac{a^6}{a^{14}}$$

$$= a^{-8} = \frac{1}{a^8}$$

We do:

$$\frac{cd^3}{c^5d^2}$$

$$= c^{1-5} d^{3-2} = c^{-4} d^1 = \frac{d}{c^4}$$

We do:

$$\frac{m^{-1}n^2}{m^3n}$$

$$= m^{-1-3} n^{2-1} = m^{-4} n^1 = \frac{n}{m^4}$$

You do:

$$\frac{x^2y^{-1}z^4}{xy^4z^{-3}}$$

$$= x^{2-1} y^{-1-4} z^{4-(-3)} = x^1 y^{-5} z^7 = \frac{xz^7}{y^5}$$

Quick Check:

Error Analysis: Find the error in the following problem. Give the correct answer.

$$5^4 \div 5 = \frac{5^4}{5} \rightarrow 5^{4-1} = 5^3 = 125$$

$$= 14$$

$$= 1$$

order of operations,
+ they didn't use
properties of
exponents

Expand the expression below and then simplify

1) $\left(\frac{a}{b}\right)^5 = \frac{a a a a a}{b b b b b} = \frac{a^5}{b^5}$

2) $\left(\frac{xy}{z^2}\right)^4 = \frac{xy \cdot xy \cdot xy \cdot xy}{z^2 \cdot z^2 \cdot z^2 \cdot z^2} = \frac{x^4 y^4}{z^8}$

3) $\left(\frac{2y^3}{z^2}\right)^3 = \frac{2y^3 \cdot 2y^3 \cdot 2y^3}{z^2 \cdot z^2 \cdot z^2} = \frac{8y^9}{z^6}$

1) Is there a faster way to reduce these expressions? With a partner, create a rule to help simplify these expressions.

2) Use your rule to simplify the following: $\left(\frac{x}{y^2}\right)^{100} = \frac{x^{100}}{y^{200}}$

Raising a Quotient to a Power

For every nonzero number a and b and integer n, $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

Examples: Simplify the following expressions.

I do: We do: We do: You do:

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

$\left(\frac{4}{x^2}\right)^2 = \frac{4^2}{x^4} = \frac{16}{x^4}$

$\left(\frac{4b}{c}\right)^{-2} = \frac{4^{-2} b^{-2}}{c^{-2}} = \frac{c^2}{16b^2}$

$\left(\frac{2m^{-5}}{m^2}\right)^{-4} = (2m^{-7})^{-4} = 2^{-4} m^{28} = \frac{m^{28}}{16}$

or $2^{-4} m^{20} / m^{-8} = 2^{-4} m^{20-(-8)} = 2^{-4} m^{28} = \frac{m^{28}}{16}$

Quick Check:

Error Analysis: Find the error in the following problem. Give the correct answer.

$\left(\frac{6^4}{3^2}\right)^3 = \frac{6^{12}}{3^6} = \frac{2^4 \cdot 3^4}{3^2} = 2^4 \cdot 3^2 = 144$

the bases weren't the same, so you can't subtract the exponents

$\frac{6^{12}}{3^6} = 2985984$

ALG 1 - Division Properties of Exponents HW

Name _____

Simplify.

1. $\frac{a^{10}}{a^3} = \boxed{a^7}$

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

3. $\frac{8j^4}{2j^3} = \boxed{4j}$

4. $\frac{h^4}{h^4} = \boxed{1}$

5. $\frac{6x^5 y^4}{12x^3 y^4} = \boxed{\frac{x^2}{2}}$

6. $\frac{-15p^{-4}}{-3p^2 q^{-2}} = \boxed{\frac{5q^2}{p^6}}$

7. $\left(\frac{4}{x^2}\right)^3 = \boxed{\frac{64}{x^6}}$

8. $\left(\frac{5}{a^3}\right)^{-2} = \boxed{\frac{a^6}{25}}$

Copy and complete each equation.

1. $\frac{5^9}{5^2} = 5^7$

2. $\frac{2^4}{2^3} = 2^1$

3. $\frac{3^2}{3^5} = 3^{-3}$

4. $\frac{5^2 5^3}{5^3 5^2} = 5^0$

Simplify each expression.

5. $\frac{2^5}{2^7} = 2^{-2} = \boxed{\frac{1}{4}}$

6. $\frac{2^7}{2^5} = 2^2 = \boxed{4}$

7. $\frac{c^{12}}{c^{15}} = c^{-3} = \boxed{\frac{1}{c^3}}$

8. $\frac{m^{-2}}{m^{-5}} = \boxed{m^3}$

9. $\frac{3s^{-9}}{6s^{-11}} = \boxed{\frac{s^2}{2}}$

10. $\frac{x^{13} y^2}{x^{13} y} = \boxed{y}$

11. $\frac{c^2 d^{-3}}{c^3 d^{-1}} = \boxed{\frac{1}{cd^2}}$

12. $\frac{3^2 m^3 t^6}{3^5 m^7 t^{-5}} = \boxed{\frac{t^{11}}{27m^4}}$