

5.3 Division Properties of Exponents

Review of Exponent Properties:

A) Zero as an Exponent $a^0 = 1$

$$(-2)^0 = 1$$

$$-2^0 = -1$$

$$-5xy^0z^3 = -5xz^3$$

$$(2xy^3)^0 = 1$$

Everything inside () raised to power of 0!

B) Negative Exponents $a^{-n} = \frac{1}{a^n}$ OR $\frac{1}{a^{-n}} = a^n$

$$2x^{-3} = \frac{2}{x^3}$$

$$\frac{b^5}{3c^{-2}} = \frac{b^5c^2}{3}$$

(Answers should only contain POSITIVE EXPONENTS)

C) Product Property $a^m \cdot a^n = a^{m+n}$

$$(2x^3y^5z^7)(-5x^5y^{-8}z^{-7})$$

$$(2 \cdot -5)x^{3+5}y^{5+(-8)}z^{7+(-7)}$$

$$-10x^2y^{-3}z^0$$

$$\frac{-10x^2}{y^3}$$

D) Power Raised to a Power $(a^m)^n = a^{m \cdot n}$

$$(2^3)^{-6} = 2^{3 \cdot -6} = 2^{-18} = \frac{1}{2^{18}} = \frac{1}{262,144}$$

E) Product of a Power Raised to a Power $(ab)^n = a^n b^n$

$$\frac{2^7}{2^4} \text{ Rewrite w/out Exponents: } \frac{\cancel{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}}{\cancel{2 \cdot 2 \cdot 2 \cdot 2}} = 2^3 = 8$$

$$\frac{x^3}{x^5} \rightarrow \frac{\cancel{x \cdot x \cdot x}}{\cancel{x \cdot x \cdot x \cdot x \cdot x}} = \frac{1}{x^2}$$

Quotient Property $\frac{a^m}{a^n} = a^{m-n}$ } When dividing powers with the SAME BASE, SUBTRACT the EXPONENTS.

* Top - Bottom *

Examples: $\frac{c^{11}}{c^5} \rightarrow c^{11-5} \rightarrow c^6$

$\frac{x^8}{x^{13}} \rightarrow x^{8-13} \rightarrow x^{-5} \rightarrow \frac{1}{x^5}$

Quotient Raised to a Power

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

Examples: $\left(\frac{3}{5}\right)^4 = \frac{3^{1 \cdot 4}}{5^{1 \cdot 4}} = \frac{3^4}{5^4} \rightarrow \frac{81}{625}$

$$\left(\frac{a^2}{b^5}\right)^{-2} \rightarrow \frac{a^{2 \cdot -2}}{b^{5 \cdot -2}} \rightarrow \frac{a^{-4}}{b^{-10}} \rightarrow \frac{b^{10}}{a^4}$$

Example 1: Simplify each expression; only positive exponents should be in your answers.

a) $\frac{x^3 y^4}{x^2 y}$
 $x^{3-2} y^{4-1}$
 $\boxed{x^1 y^3}$

b) $\frac{k^7 m^{10} p^3}{k^5 m^{12} p^3}$
 $k^{7-5} m^{10-12} p^{3-3}$
 $k^2 m^{-2} p^0 \rightarrow \boxed{\frac{k^2}{m^2}}$

c) $\frac{5x^{-5} y^4}{-20x^2 y^7 z^{-5}}$
 $\frac{5}{-20} x^{-3-2} y^{4-7} z^5$
 $-\frac{1}{4} x^{-5} y^{-3} z^5$
 $\frac{-1z^5}{4x^5 y^3}$

$$d) \frac{2a^2b^3c^5}{10a^3b^1c^4}$$

$$\left(\frac{2}{10}\right) a^{2-3} b^{3-1} c^{5-4} \rightarrow \frac{1a^5b^4c^1}{5}$$

$$\frac{1a^5b^4}{5c}$$

$$e) \left(\frac{3x^4}{4}\right)^3$$

$$\frac{3^{1 \cdot 3} x^{4 \cdot 3}}{4^{1 \cdot 3}} \rightarrow \frac{3^3 x^{12}}{4^3}$$

$$\frac{27x^{12}}{64}$$

$$f) \left(\frac{2a^{-2}b^4c^2}{-4a^{-2}b^{-5}c^{-7}}\right)^2$$

* WORK INSIDE TO THE OUTSIDE *

$$g) \left(\frac{4c^2d^3f}{2c^{-4}d^{-5}}\right)^{-3}$$

$$\left(\frac{2a^{-2-(-2)}b^{4-(-5)}c^{2-(-7)}}{-4}\right)^2$$

$$\left(\frac{1c^{2-(-4)}d^{3-(-5)}f}{2}\right)^{-3}$$

$$\left(\frac{-1a^0b^9c^9}{2}\right)^2$$

$$\left(\frac{1c^6d^8f}{2}\right)^{-3}$$

$$\left(\frac{-1b^9c^9}{2}\right)^2$$

$$\frac{(1)^{-3}c^{6 \cdot (-3)}d^{8 \cdot (-3)}f^{1 \cdot (-3)}}{(2)^{-3}}$$

$$\frac{(-1)^2b^{9 \cdot 2}c^{9 \cdot 2}}{(2)^2}$$

$$\frac{(2)^3c^{-18}d^{-24}f^{-3}}{(1)^3}$$

$$\frac{1b^{18}c^{18}}{4}$$

$$\frac{8}{c^{18}d^{24}f^3}$$