Reviewing the Exponent Laws

a^m is a power in exponential form where: ***m*** is the exponent ***a*** is the base ***m*** is a power of base *a*

In expanded form, a^m = a x a x a x a … (multiply ***a*** by itself as many times as given by the value of m, exponent)

To **simplify** an expression means to leave the final answer in exponential form.]

RULE	EXAMPLE	PRACTICE
1) MULTIPLICATION of POWERS keep the base, add the exponents.	$a^2 \times a^5 = a^7$	Simplify $(2a^2b^3)(-3a^4b^6)$ $= (2)(-3)(a^2)(a^4)(b^3)(b^6)$ $= -6a^{2+4}b^{3+6}$ $= -6a^4b^9$
2) DIVISION of POWERS keep the base, subtract the exponents.	$a^5 \div a^2 = a^3$	Simplify $\frac{27x^9}{3x^{-6}} = 9x^{9-(-6)}$ $= 9x^{9+6}$ $= 9x^{15}$
3) POWER of a POWER keep the base, multiply the exponents.	$(a^2)^5 = a^{10}$	Simplify $(a^{-2})^{-3} \times 3a^6$ $= a^{-2\cdot -3} \times 3a^6$ $= 1\cdot a^6 \times 3a^6$ $= 3a^{6+6} \longrightarrow = 3a^{12}$
4) POWER of a PRODUCT distribute the exponent over the brackets to each term inside. Then apply rule #3	$(2a^3b^2)^4 = (2^1)^4(a^3)^4(b^2)^4$ $= (2^{1\times4})(a^{3\times4})(b^{2\times4})$ $= 2^4a^{12}b^8$ $= 16a^{12}b^8$	Simplify $(-2a^2b^5)^3$ $= (-2)^3\cdot(a^2)^3\cdot(b^5)^3$ $= -8\cdot a^{2\times3}\cdot b^{5\times3}$ $= -8a^6b^{15}$
5) POWER of a QUOTIENT same as rule #4	$\left(\frac{a^3}{b^2}\right)^3 = \frac{(a^3)^3}{(b^2)^3}$ $= \frac{a^{3\times3}}{b^{2\times3}}$ $= \frac{a^9}{b^6}$	Simplify $(\frac{12x^5}{4y^3})^3$ $= \left(\frac{3x^5}{y^3}\right)^3$ $= \frac{(3)^3(x^5)^3}{(y^3)^3}$ $= \frac{27x^{5\cdot3}}{y^{3\cdot3}}$ $= \frac{27x^{15}}{y^9}$
6) NEGATIVE EXPONENT reciprocate the base, switch the sign of the exponent	$a^{-2} = \frac{1}{a^2}$ $\left(\frac{2}{3}\right)^{-2} = \left(\frac{3}{2}\right)^2$ = 9/4	Simplify $(\frac{2x^3}{3y^2})^{-3}$ $= \left(\frac{3y^2}{2x^3}\right)^3$ $= \frac{(3)^3(y^2)^3}{(2)^3(x^3)^3}$ $= \frac{27y^{2\cdot3}}{8x^{3\cdot3}}$ $= \frac{27y^6}{8x^9}$
7) ZERO EXPONENT depending on the sign of the base, it is either equal to 1 or -1	$x^0 = 1$ $-x^0 = -1$	Simplify $-(\underbrace{14a^3b^{-4}}_{1})^0$ $= -1$

Ex1. Use the exponent laws to simplify the following. (Remember more than one law can be used to simplify an expression completely.)

a. $(4ab^4)(-5a^3b^2)$

$= (4)(-5)(a)(a^3)(b^4)(b^2)$

$= -20a^{1+3}\cdot b^{4+2}$

$= -20a^4b^6$

b. $(12b^2)(8b^{-4}) \div (6b^{-10})$

$= (12)(8)b^{2+-4} \div 6b^{-10}$ do multiplic. first

$= 96b^{-2} \div 6b^{-10}$

$= 16b^{-2-(-10)}$

$= 16b^8$

c. $(-\frac{1}{2}c^2d^3)^4$

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

$= \frac{1}{16} c^{2\cdot 4} d^{3\cdot 4}$

$= \frac{1}{16} c^8 d^{12}$

d. $\frac{(t^7)^3\,(t)}{t^{16}} = \frac{t^{\overset{21}{7\cdot 3}}\cdot t}{t^{16}}$

$= \frac{t^{21+1}}{t^{16}}$

$= t^{22-16}$

$= t^6$

Ex2. Use the laws of exponents to simplify the following:

a. $\frac{(-m^2n^3)^2(mn^{-4})}{(mn^3)^4} = \frac{(-1)^2(m^2)^2(n^3)^2(mn^{-4})}{(m)^4(n^3)^4}$

$= \frac{m^4n^6mn^{-4}}{m^4n^{12}}$

$= \frac{m^{4+1}n^{6+(-4)}}{m^4n^{12}}$

$= \frac{m^5n^2}{m^4n^{12}}$

$= m^{5-4}n^{2-12}$

$= mn^{-10}$

OR

$= \frac{m}{n^{10}}$

b. $\frac{x(x^{4a+1})}{x^{a+3}} = \frac{x^{1+4a+1}}{x^{a+3}}$

$= x^{2+4a-(a+3)}$

$= x^{2+4a-a-3}$

$= x^{3a-1}$

c. $\frac{(3^4+2^6)^0}{3^{-1}}$

$= \frac{1}{\frac{1}{3}}$ reciprocate $1/3$

$= 3$

d. $\frac{(2^{-1}+4^{-2})}{(2^{-2}+4^{-1})} = \frac{\frac{8\cdot 1}{8\cdot 2}+\frac{1}{16}}{\frac{1}{4}+\frac{1}{4}}$

$= \frac{\frac{8+1}{16}}{\frac{1+1}{4}}$

$= \frac{\frac{9}{16}}{\frac{1}{2}}$ b/c $2/4$

$= \frac{9}{16} \div \frac{1}{2}$

$= \frac{9}{\cancel{16}\,8} \times \frac{\cancel{2}\,1}{1}$

$= 9/8$

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