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 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 $(2a^2b^3)(-3a^4b^6)$ $= -6a^6b^9$
2) DIVISION of POWERS keep the base, subtract the exponents.	$a^5 \div a^2 = a^3$	Simplify $\frac{27x^9}{3x^{-6}}$ $= 9x^{9-(-6)} = 9x^{15}$
3) POWER of a POWER keep the base, multiply the exponents.	$(a^2)^5 = a^{10}$	Simplify $(a^{-2})^{-3} \times 3a^6$ $= a^6(3a^6)$ $= 3a^{12}$
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 $(-2a^2b^5)^3$ $= -8a^6b^{15}$
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 $(\frac{12x^5}{4y^3})^3$ $= \left(\frac{3x^5}{y^3}\right)^3 = 27\frac{x^{15}}{y^9}$
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 $(\frac{2x^3}{3y^2})^{-3}$ $= \left(\frac{3y^2}{2x^3}\right)^3 = \frac{27y^6}{8x^9}$
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 $-(14a^3b^{-4})^0$

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

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

$= -20a^4b^6$

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

$= \frac{96b^{-2}}{6b^{-10}} = 16b^8$

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

$= (-\frac{1}{2})^4 c^8 d^{12}$

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

d. $\frac{(t^7)^3(t)}{t^{16}}$

$= \frac{t^{21}t}{t^{16}} = \frac{t^{22}}{t^{16}}$

$= t^6$

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

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

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

$= \frac{m^5n^2}{m^4n^{12}} = mn^{-10} = \frac{m}{n^{10}}$

b. $\frac{x(x^{4a+1})}{x^{a+3}} = \frac{x^{4a+2}}{x^{a+3}}$

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

$= x^{3a-1}$

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

$= \frac{1}{3^{-1}} = 1 \div \frac{1}{3}$

$= 3$

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

$= \frac{\frac{1}{2}+\frac{1}{16}}{\frac{1}{4}+\frac{1}{4}} = \frac{\frac{8}{16}+\frac{1}{16}}{\frac{2}{4}}$

$= \frac{9}{16} \div \frac{2}{4} = \frac{9}{16} \times \frac{4}{2} = \frac{36}{32} = \frac{9}{8}$