5.1 – Zero and Negative Properties of Exponents

Power { 3^4 (4 ← Exponent; ← base) → $3\cdot3\cdot3\cdot3 = 81$ (The exponent tells how many times the base is used as a factor)

3^4 DOES NOT mean $3\cdot4$

$2x^0$? what is the exponent? $2x \to 2x^1$

Power Key [^] allows you to raise a base to any power: 4^3 enter → 64

When bases are negative, you must put the base in ( ) when using the calculator.
$-3^4 \to (-3)^4 = 81$

Zero Exponent Property → $a^0 = 1$ (any based raised to the power of zero is 1)

Ex: $5^0 = 1$ | $(-\frac{1}{3})^0 = 1$ | $ab^0 = a(1) \to a$ | $-(2.57)^0 = -1$; $-(1)$

$\frac{1}{2^0} \to \frac{1}{1} \to 1$ | $\frac{5}{2x^0} \to \frac{5}{2(1)} \to \frac{5}{2}$ | $3a^0b \to 3(1)b \to 3b$ | $(2x^5y^3)^0 \to 1$

Negative Exponent Property → $1a^{-n} \to \frac{1}{a^n}$ or $\frac{1}{a^{-n}} = 1a^n$

a is the same as 1a

Ex: $2^{-4} = \frac{1}{2^4} \to \frac{1}{16}$ | $\frac{1}{(-5)^{-2}} = 1(-5)^2 \to 25$ | $\frac{x^2y^{-3}}{z^{-1}} = \frac{x^2}{y^3z^{-1}} \to \frac{x^2z}{y^3}$

$2^{-14} \to \frac{1}{2^{14}} \to \frac{1}{16{,}384}$ | $5^{-3}xy^{-2} \to \frac{x}{5^3y^2} \to \frac{x}{125y^2}$ | $\frac{a^3b^{-2}}{cd^{-3}} \to \frac{a^3}{b^2cd^{-3}} \to \frac{a^3d^3}{b^2c}$

- An algebraic expression is in SIMPLEST form when its written with only POSITIVE exponents.

Final answer has only POSITIVE exponents.

- A "fractional" algebraic expression is in SIMPLEST form when there are no common factors, the GCF = 1.

$\frac{24}{60} \to \frac{12}{30} \to \frac{6}{15} \to \frac{2}{5}$ } The GCF is 1

↖ simplest Form

Example 1: Simplify.

a.) $3^2 x^0 y^4$

$3^2(1)y^4$

$9(1)y^4$

$9y^4$

b.) $4m^{-3}n^5$

$\frac{4n^5}{m^3}$

c.) $\frac{8}{4c^{-3}}$

$\frac{8c^3}{4}$

$2c^3$

*Only move what has the negative exponent!

d.) $\frac{6^{-2} r s^{-4}}{(-4)^{-3}}$

$\frac{(-4)^3 r}{6^2 s^4}$

Simplify fraction!

$\frac{-64r}{36s^4} \rightarrow \frac{-16r}{9s^4}$

e.) $\frac{5^{-2} a^8 b^{-1}}{c^0 d^{-2}}$

$\frac{a^8 d^2}{5^2(1)b}$

$\frac{a^8 d^2}{25b}$

f.) $\frac{7s^0 t^{-5}}{2^{-1} v^2}$

$\frac{7(1)(2)}{t^5 v^2}$

$\frac{14}{t^5 v^2}$

Example 2: a.) Write each expression with only positive exponents.
b.) Evaluate each expression where m = 2 and t = – 3.

a.) $2m^{-3}t^4$

$\frac{2t^4}{m^3}$

$\frac{2(-3)^4}{(2)^3} \rightarrow \frac{2(81)}{8} \rightarrow \frac{162}{8} \rightarrow \frac{81}{4}$

b.) $\frac{4^{-1}}{m^t}$

$\frac{1}{4m^t}$

$\frac{1}{4(2)^{-3}} \rightarrow \frac{2^3}{4} \rightarrow \frac{8}{4} = 2$

c.) $5t^{-m}$

$\frac{5}{t^m}$

$\frac{5}{(-3)^2} \rightarrow \frac{5}{9}$

Example 3 (Application Problem):

A sample of bacteria is growing very rapidly each month and its population is represented by the expression $5400 \cdot 3^m$ where m = the months of growth. Find the following:

a.) The initial amount of the bacteria (what would "m" equal?): m = 0 $5400 \cdot 3^0 \rightarrow 5400 \cdot 1 \rightarrow$ 5400 bacteria is the initial amount.

b.) The amount of the bacteria two months from its initial amount (what would "m" equal?): m = 2 $5400 \cdot 3^2 \rightarrow 5400 \cdot 9 \rightarrow$ 48,600 bacteria after 2 months.