Exponent Properties

1. Define exponent $x^1 = x$ any number to the first power is just itself
2. Define exponent x^n = $x^1x^1x^1x^1$… n times… not x times n
   a. $x^3 = x^1 * x^1 * x^1$
3. Product of like bases; $x^n * x^m = x^{n+m}$
   a. To multiply powers with the same base, add the exponents and keep the common base.
   b. Example $x^3 * x^2 = (x^1 * x^1 * x^1) * (x^1 * x^1) = x^{3+2} = x^5$
4. Quotient of like bases; $\frac{x^m}{x^n} = x^{m-n}$
   a. To divide powers with the same base, subtract the denominator exponent from the numerator exponent and keep the common base
   b. Example 1 $\frac{x^5}{x^3} = \frac{x*x*x*x*x}{x*x*x} = \frac{x*x}{1} = x^{5-3} = x^2$
   c. Example 2 $\frac{x^3}{x^5} = \frac{x*x*x}{x*x*x*x*x} = \frac{1}{x*x} = x^{3-5} = x^{-2}$ see 9 below
   d. Example 3 $\frac{x^5}{x^5} = \frac{x*x*x*x*x}{x*x*x*x*x} = \frac{1}{1} = x^{5-5} = x^0 = 1$ see 8 below
   e. …Yes! Any number to the zero power is 1…except zero
5. Power to a Power; $(x^m)^n = x^{m*n}$
   a. To raise a power to a power, keep the base and multiply the exponents
   b. $(x^n)^m = x^{m*n}$
   c. Example $(x^5)^3 = x^5 * x^5 * x^5 = x^{5*3} = x^{15}$
6. Product to a Power; $(x * y)^n = x^n * y^n$
   a. To raise a product to a power, raise each factor to the power
   b. Example $(x * y)^3 = (x * y) * (x * y) * (x * y) = (x * x * x) * (y * y * y) = x^3 * y^3$
   c. Example $(3x^3)^3 = (3x^3)(3x^3)(3x^3) = 3^3 * (x^3)^3 = 27x^9$
7. Quotient to a Power; $(\frac{x}{y})^n = \frac{x^n}{y^n}$
   a. To raise a quotient to a power, raise the numerator and the denominator to the power
   b. Example $(\frac{x}{y})^3 = \frac{x^3}{y^3}$
   c. Example $(\frac{x^3}{y^4})^3 = \frac{x^9}{y^{12}}$
8. Zero Exponent $x^0 = 1$
   a. Any number raised to the zero power is 1…(except 0, 0^0 is undefined)
   b. See 4.d above
9. Negative Exponent $x^{-n} = \frac{1}{x^n}$ or $\frac{1}{x^{-n}} = x^n$
   a. Negative exponents indicate reciprocation with the exponent of the reciprocal becoming positive. You may want to to think of this way; unhappy (negative) exponents will become happy (positive) by having the base/exponent pair "switch floors"!
   b. Example $8^{-2} = \frac{1}{8^2} = \frac{1}{64}$ $\frac{4}{x^{-3}} = 4x^3$
10. Fractional Exponents (1) $x^{\frac{m}{n}} = (x^{\frac{1}{n}})^m \; or \; (x^m)^{\frac{1}{n}}$
11. Fractional Exponents (2) $(x)^{\frac{1}{n}} = \sqrt[n]{x}$