Review of Exponents

Exponents are the mathematician's shorthand.

In general, the format for using exponents is:

$$(\text{base})^{\text{exponent}}$$

where the exponent tells you how many of the base are being multiplied together.

Consider: $2 \cdot 2 \cdot 2$ is the same as 2^3, since there are **three** **2's** being multiplied together.

Likewise, $5 \cdot 5 \cdot 5 \cdot 5 = 5^4$, because there are **four** **5's** being multiplied together.

Exponents are also referred to as "powers".
For example, 2^3 can be read as **"two cubed"** or as **"two raised to the third power"**.

Exponents of Negative Values

When we multiply **negative** numbers together, we must utilize parentheses to switch to exponent notation.

$$(-3)(-3)(-3)(-3)(-3)(-3) = (-3)^6$$

BEWARE!! -3^6 is **NOT** the same as $(-3)^6$

The missing parentheses mean that -3^6 will multiply **six 3's** together first (by order of operations), and then **take the negative of that answer.**

$(-3)^6 = 729$ but $-3^6 = -729$

so be careful with negative values and exponents !

Note: **Even powers of negative numbers** allow for the negative values to be arranged in pairs. This pairing guarantees that the answer will always be **positive**.

$(-5)^6 = (-5)\bullet(-5) \bullet (-5)\bullet(-5) \bullet (-5)\bullet(-5)$ ← All pairs.

$= 25 \bullet 25 \bullet 25$

$= 15625$ **(a positive answer)**

Odd powers of negative numbers, however, always leave one factor of the negative number not paired. This one lone negative term guarantees that the answer will always be **negative**.

$(-5)^5 = (-5)\bullet(-5) \bullet (-5)\bullet(-5) \bullet (-5)$ ←One lone, un-paired, negative.

$= 25 \bullet 25 \bullet (-5)$

$= -3125$ **(a negative answer)**

Zero Exponents

The number **zero** may be used as an exponent.

The value of any expression raised to the zero power is 1.

(Except zero raised to the zero power is undefined.)

Base^0	Value
$2^0 =$	**1**
$(-6)^0 =$	**1**
$4^0 =$	**1**
$-8^0 =$	**-1** Raise to the zero power first: $8^0=1$ then take the negative.
$0^0 =$	undefined

Negative Exponents

Negative numbers as exponents have a special meaning.
The rule is as follows:

$$\text{base}^{\text{negative exponent}} = \frac{1}{\text{base}^{\text{positive exponent}}}$$

For example:

Negative Exponent	Positive Exponent
$4^{-1} =$	$\frac{1}{4^1}$
$7^{-3} =$	$\frac{1}{7^3}$
$(-5)^{-2} =$	$\frac{1}{(-5)^2}$

Exponents and Units

When working with units and exponents (or powers), remember to adjust the units appropriately.

$$\begin{aligned}(36\text{ ft})^3 &= (36\text{ ft}) \bullet (36\text{ ft}) \bullet (36\text{ ft}) \\ &= (36 \bullet 36 \bullet 36)\,(\text{ft} \bullet \text{ft} \bullet \text{ft}) \\ &= 46656\text{ ft}^3\end{aligned}$$

Exponents can be very useful for evaluating expressions. It is also useful to learn how to use your calculator when working with exponents.