

# Properties of Exponents

An exponent (also called power or degree) tells us how many times the base will be multiplied by itself. For example  $x^5$ , the exponent is 5 and the base is  $x$ . This means that the variable  $x$  will be multiplied by itself 5 times. You can also think of this as  $x$  to the fifth power.

Below is a list of properties of exponents:

| Properties  | General Form       | Application     | Example                                |
|---|--------------------|-----------------|--|
| <b>Product Rule</b><br><i>Same base add exponents</i>                       | $a^m a^n$          | $a^{m+n}$       | $x^5 x^3 = x^{5+3} = x^8$              |
| <b>Quotient Rule</b><br><i>Same base subtract exponents</i>                 | $\frac{a^m}{a^n}$  | $a^{m-n}$       | $\frac{x^9}{x^5} = x^{9-5} = x^4$      |
| <b>Power Rule I</b><br><i>Power raised to a power multiply exponents.</i>   | $(a^m)^n$          | $a^{mn}$        | $(x^3)^4 = x^{3 \cdot 4} = x^{12}$     |
| <b>Power Rule II</b><br><i>Product to power distribute to each base</i>     | $(ab)^m$           | $a^m a^n$       | $(4x^3)^2 = 4^2 x^{3 \cdot 2} = 16x^6$ |
| <b>Negative Exponent I</b><br><i>Flip and change sign to positive</i>       | $a^{-m}$           | $\frac{1}{a^m}$ | $x^{-3} = \frac{1}{x^3}$               |
| <b>Negative Exponent II</b><br><i>Flip and change sign to positive</i>      | $\frac{1}{a^{-m}}$ | $a^m$           | $\frac{1}{x^{-5}} = x^5$               |
| <b>Zero Exponent</b><br><i>Anything to the zero power (except 0) is one</i> | $a^0$              | $a^0 = 1$       | $(-4x)^0 = 1$                          |

- It is important to note that none of these applications can occur if the bases are not the same.

For example,  $\frac{x^5}{y^3}$  cannot be simplified.