Exponents

An **exponent** is a number written above and to the right of an expression that indicates how many times to multiply that expression together. For example:

$$2^5 = 2 \times 2 \times 2 \times 2 \times 2$$
$$= 32$$

The parts of an exponential expression have names.

$$\text{BASE} \Rightarrow 32 = 2^5 \Leftarrow \text{EXPONENT}$$

There are **exponent laws** that describe how operations involving exponents should be carried out. They are listed below, along with examples of how they work:

$x^m \cdot x^n = x^{m+n}$	$x^5 \cdot x^6 = x^{11}$; $x^5 \cdot x = x^5 \cdot x^1 = x^6$; $10^2 \cdot 10^3 = 10^{2+3}$
$\frac{x^m}{x^n} = x^{m-n}$	$\frac{b^6}{b^3} = b^{6-3} = b^3$; $\frac{b^4}{b^7} = b^{4-7} = b^{-3} = \frac{1}{b^3}$
$(x^m)^n = x^{mn}$	$(x^5)^2 = x^{10}$
$(xy)^m = x^m y^m$	$(7a)^2 = 7^2a^2 = 49a^2$; $(mnap)^2 = m^2n^2a^2p^2$
$\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}$	$(\frac{2}{3})^2 = \frac{2^2}{3^2}$; $(\frac{5}{2})^2 = \frac{5^2}{2^2} = \frac{25}{4}$
$x^0 = 1$	$5^0 = 1$; $(a^2b^3c^{12})^0 = 1$
$x^{-m} = 1/x^m$	$x^{-5} = \frac{1}{x^5}$; $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$
$1/x^{-m} = x^m$	$\frac{1}{x^{-4}} = x^4$; $\frac{1}{4^{-2}} = 4^2 = 16$
$(x/y)^m = (y/x)^n$	$(\frac{2}{3})^{-2} = (\frac{3}{2})^2 = \frac{3^2}{2^2} = \frac{9}{4}$
$\frac{x^{-m}}{y^{-n}} = \frac{y^n}{x^m}$	$\frac{x^{-2}}{y^{-3}} = \frac{y^3}{x^2}$; $\frac{3^{-2}}{2^{-3}} = \frac{2^3}{3^2} = \frac{8}{9}$

NOTES:

1. To evaluate $-x^2$, square x first, then multiply the result by -1. So, $-4^2 = -16$. If a negative number is being squared, it needs to be put in brackets: $(-4)^2 = 16$.
2. While it is possible to simplify $x^4 \cdot x^3$ by adding the exponents, the expression $x^4 + x^3$ or $x^4 - x^3$ cannot be simplified without evaluating x^4 and x^3 first.

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