Exponent Rules 1 to 4

Definitions:	A **coefficient** is a regular number (usually a whole number) which multiplies some variable. A **base** is a regular number (usually a whole number) which can be raised to another power. An **exponent** is the super-scripted value which notes how many times a base is multiplied by itself. **Expanded notation** uses the none-exponent version of numbers to show or check the simplified value of bases and exponents.

Formulas:	Rule #1 $(x^a)(x^b) = x^{a+b}$	Rule #2 $(x^a)^b = x^{ab}$	Rule #3 $(xyz)^a = x^a y^a z^a$	Rule #4 $(n)^0 = {}^1/_1 = 1$

Example #1 *...using rule #1*	$(x^4)\bullet(x^3) = x^{4+3} = x^7$ xxxx • xxx	$(3x^4)\bullet(5x^3) = 3\cdot5\,x^{4+3} = 15x^7$ 3xxxx • 5xxx	$2(3x^4)\bullet(5x^3) = 2\cdot15x^7 = 30x^7$
Example #2 *...using rule #1*	$(x^6)\bullet(x^8) = x^{6+8} = x^{14}$ xxxxxx • xxxxxxxx	$(-x^6)\bullet(4x^8) = -1\cdot4x^{6+8} = -4x^{14}$ -1xxxxxx • 4xxxxxxxx	$7(-x^6)\bullet(4x^8) = -4x^{14}\cdot7 = -28x^{14}$

$(x^a)(x^b) = x^{a+b}$ we use either the exponent rule #1 or the expanded notation to solve each. The expanded notation shows why the rule works.

Example #3 *...using rule #2*	$(x^4)^3 = x^{4\cdot3} = x^{12}$ xxxx • xxxx • xxxx	$(5x^4)^3 = 5^3x^{4\cdot3} = 125x^{12}$ 5xxxx • 5xxxx • 5xxxx	$2(5x^4)^3 = 2\cdot125x^{12} = 250x^{12}$ 2 • 5xxxx • 5xxxx • 5xxxx
Example #4 *...using rule #2*	$(x^5)^2 = x^{5\cdot2} = x^{10}$ xxxxx • xxxxx	$(4x^5)^2 = 4^2x^{5\cdot2} = 16x^{10}$ 4xxxxx • 4xxxxx	$7(4x^5)^2 = 7\cdot4^2x^{5\cdot2} = 112x^{10}$ 7 • 4xxxxx • 4xxxxx

$(x^a)^b = x^{a\cdot b}$ Exponent Rule 2 tells us to raise an exponent to an exponent by multiplying. The expanded notation shows us why it works.

Example #5 *...using rule #3*	$(xyz)^4 = x^4y^4z^4$ $x^4y^4z^4$ $xyz \cdot xyz \cdot xyz \cdot xyz$	$(3xyz)^4 = 3^4x^4y^4z^4$ $81x^4y^4z^4$ $3xyz \cdot 3xyz \cdot 3xyz \cdot 3xyz$	$5(3xyz)^4 = 5 \cdot 3^4x^4y^4z^4$ $405x^4y^4z^4$ $5 \cdot 3xyz \cdot 3xyz \cdot 3xyz \cdot 3xyz$

Example #6 *...using rule #3*	$(wxyz)^2 = w^2x^2y^2z^2$ $w^2x^2y^2z^2$ $wxyz \cdot wxyz$	$(8wxyz)^2 = 8^2w^2x^2y^2z^2$ $64w^2x^2y^2z^2$ $8 \cdot wxyz \cdot 8wxyz$	$-3(8wxyz)^2 = -3 \cdot 8^2w^2x^2y^2z^2$ $-192w^2x^2y^2z^2$ $-3 \cdot 8wxyz \cdot 8wxyz$

$(xyz)^a = x^a y^a z^a$

In each case, using rule #3, we see the exponent effect every part of the expression... in the parenthese. expanding notation helps us see why.

Example #7 *...using rule #4*	$(x)^0 = \frac{x}{x} = 1$ 1 $\frac{\cancel{x}}{\cancel{x}} = 1$	$(5x)^0 = \frac{5x}{5x} = 1$ 1 $\frac{\cancel{5x}}{\cancel{5x}} = 1$	$3(5x)^0 = 3 \cdot \frac{5x}{5x} = 3$ 3 $3 \cdot \frac{\cancel{5x}}{\cancel{5x}} = 3$

Example #8 *...using rule #4*	$(x^3y^0)^2 = (x^3 \cdot 1)^2 =$ x^6 $xxx \cdot xxx$	$(2x^3y^0)^2 = (2x^3 \cdot 1)^2 =$ $4x^6$ $2xxx \cdot 2xxx$	$4(2x^3y^0)^2 = 4 \cdot (2x^3 \cdot 1)^2 =$ $16x^6$ $4 \cdot 2xxx \cdot 2xxx$

$n^0 = \frac{n}{n} = 1$

We know all numbers to the zero-power equal "1." Example 7's expanded notation shows us why. Example #8 shows us why a zero-exponent does not make all answers a one if something else is multiplying.