

Exponents

Exponent - The number that tells how many times a number is multiplied by itself.

Base - The number that gets raised to the exponent

In 4^3 , 3 would be the exponent, and 4 is the base.

So this means the same thing as $4 \times 4 \times 4$.

Multiplication Properties of Exponents

Consider: $b^3 \cdot b^4 = b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b = b^7$

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$$(-3)^4$$

Product of Powers - To multiply powers that have the same base, KEEP the base the same and ADD the exponents

$$x^a \cdot x^b = x^{a+b}$$

Examples: Write the expression as a single power of the base, then simplify if possible.

$$4^2 \cdot 4^3$$

$$4^5$$

$$1024$$

$$(-3)^2 \cdot (-3)^1$$

$$(-3)^3$$

$$-27$$

$$a \cdot a^7$$

$$a^8$$

$$n^5 \cdot n^2 \cdot n^3$$

$$n^{10}$$

Consider: $(b^2)^3 = b^2 \cdot b^2 \cdot b^2 = b^6$

Power of a Power - To find the power of a power, KEEP the base and MULTIPLY the exponents

$$(x^a)^b = x^{ab}$$

Examples: Write the expression as a single power of the base, then simplify if possible.

$$(4^4)^3$$

$$4^{12}$$

$$16,777,216$$

$$[(-3)^5]^2$$

$$(-3)^{10}$$

$$59,049$$

$$(n^4)^5$$

$$n^{20}$$

$$(x^3)^3$$

$$x^9$$

Consider: $(ab)^3 = ab \cdot ab \cdot ab = a \cdot a \cdot a \cdot b \cdot b \cdot b$
 $= a^3 b^3$

Power of a Product - To find the power of a product, find the power of each factor and multiply.

$$(a \cdot b)^m = a^m \cdot b^m$$

Examples: Simplify

$$(2 \cdot 4)^3$$
$$2^3 \cdot 4^3$$
$$8 \cdot 64 = 512$$

$$(-3 \cdot 5)^2$$
$$(-3)^2 \cdot 5^2$$
$$9 \cdot 25 = 225$$

$$(2x)^6$$
$$2^6 x^6$$
$$64x^6$$

$$(7a)^2$$
$$7^2 a^2$$
$$49a^2$$

Examples: Simplify

$$(4x^3)^4$$
$$4^4 (x^3)^4$$
$$256x^{12}$$

$$(-3a^4)^2$$
$$(-3)^2 (a^4)^2$$
$$9a^8$$

$$(9z^5)^2$$
$$9^2 (z^5)^2$$
$$81z^{10}$$

$$(n^2)^3 \cdot n^7$$
$$n^6 \cdot n^7 = n^{13}$$

$$\left(\left(\begin{matrix} X & Y & Z \\ X & Y & Z \end{matrix} \right) \right)^2$$

$$\begin{matrix} X^2 & (Y & Z)^2 \\ X^2 & Y & 6 \end{matrix}$$