



Exponent Rules

Parts

- When a number, variable, or expression is raised to a power, the number, variable, or expression is called the **base** and the power is called the **exponent**.



The diagram shows the mathematical expression b^n in a large, white, serif font. Two arrows originate from the text above: a blue arrow points from the word "base" to the letter b , and a red arrow points from the word "exponent" to the letter n .

$$b^n$$

What is an Exponent?

- An exponent means that you multiply the base by itself that many times.
- For example

$$x^4 = x \cdot x \cdot x \cdot x$$

$$2^6 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 64$$

The Invisible Exponent

- When an expression does not have a visible exponent its exponent is understood to be 1.

$$x = x^1$$

Exponent Rule #1

- When **multiplying** two expressions with the same base you **add** their exponents.

$$b^n \cdot b^m = b^{n+m}$$

- For example

$$x^2 \cdot x^4 = x^{2+4} = x^6$$

$$2 \cdot 2^2 = 2^1 \cdot 2^2 = 2^{1+2} = 2^3 = 8$$

Exponent Rule #1

$$b^n \cdot b^m = b^{n+m}$$

- Try it on your own:

$$1. h^3 \cdot h^7 = h^{3+7} = h^{10}$$

$$2. 3^2 \cdot 3 = 3^{2+1} = 3^3 \\ = 3 \cdot 3 \cdot 3 = 27$$

Exponent Rule #3

- When raising a **power to a power** you **multiply** the exponents

$$(b^n)^m = b^{n \cdot m}$$

- For example

$$(x^2)^4 = x^{2 \cdot 4} = x^8$$

$$(2^2)^2 = 2^{2 \cdot 2} = 2^4 = 16$$

Exponent Rule #3

$$(b^n)^m = b^{n \cdot m}$$

- Try it on your own

$$5. (h^3)^2 = h^{3 \cdot 2} = h^6$$

$$6. (3^2)^2 = 3^{2 \cdot 2} = 3^4 = 81$$

Note

- When using this rule the exponent can not be brought in the parenthesis **if there is addition or subtraction**

$$(x^2 + 2^2)^2 \neq x^4 + 2^4$$

You would have to use FOIL in these cases

Exponent Rule #4

- When a product is raised to a power, each piece is raised to the power

$$(ab)^m = a^m b^m$$

- For example

$$(xy)^2 = x^2 y^2$$

$$(2 \cdot 5)^2 = 2^2 \cdot 5^2 = 4 \cdot 25 = 100$$

Exponent Rule #4

$$(ab)^m = a^m b^m$$

- Try it on your own

$$7. (hk)^3 = h^3 k^3$$

$$8. (2 \cdot 3)^2 = 2^2 \cdot 3^2 = 4 \cdot 9 = 36$$

Note

- This rule is for products only. When using this rule the exponent can not be brought in the parenthesis **if there is addition or subtraction**

$$(x + 2)^2 \neq x^2 + 2^2$$

You would have to use FOIL in these cases

Exponent Rule #6: Zero Exponent

- When anything, except 0, is raised to the zero power it is 1.

$$a^0 = 1 \quad (\text{if } a \neq 0)$$

- For example

$$x^0 = 1 \quad (\text{if } x \neq 0)$$

$$25^0 = 1$$

Zero Exponent

$$a^0 = \mathbf{1} \quad (\text{if } a \neq 0)$$

- Try it on your own

$$11. \quad h^0 = \mathbf{1} \quad (\text{if } h \neq 0)$$

$$12. \quad 1000^0 = \mathbf{1}$$

$$13. \quad 0^0 = \textit{undefined}$$