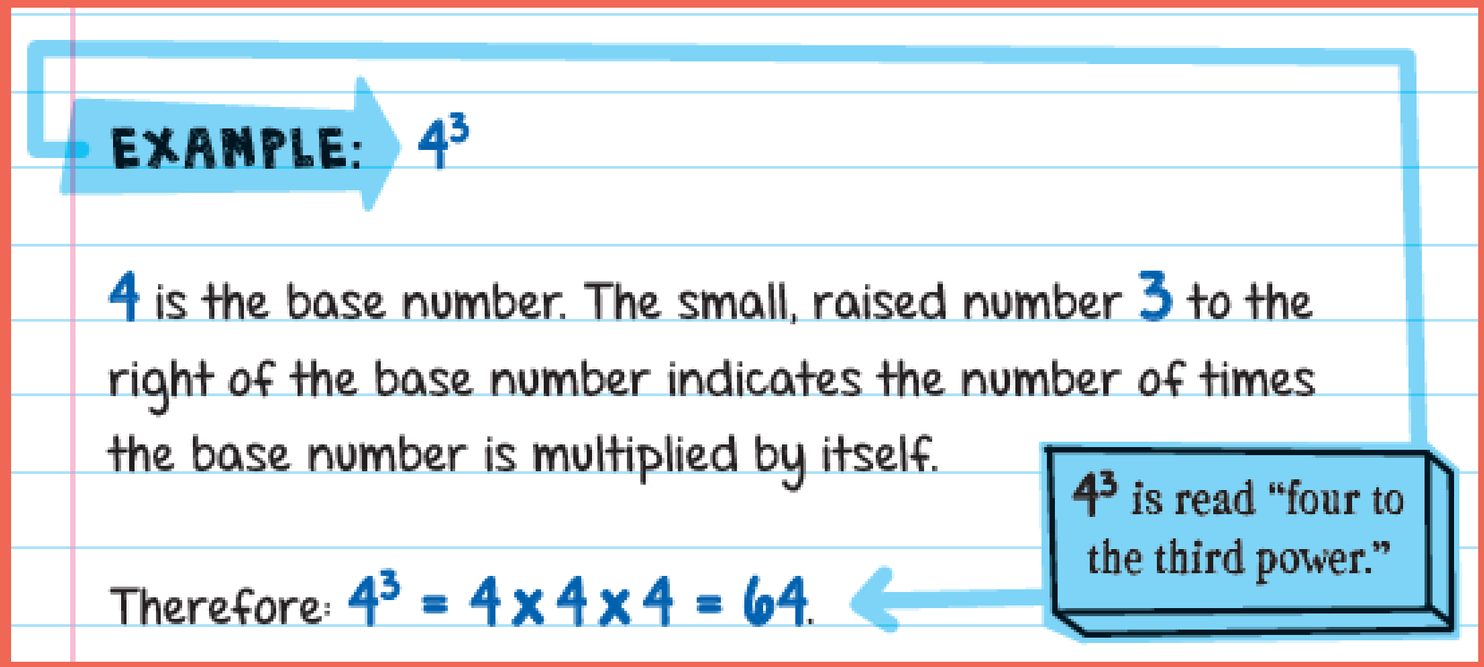
Exponents

Exponents

An EXPONENT is the number of times the base number is multiplied by itself.



Common mistakes

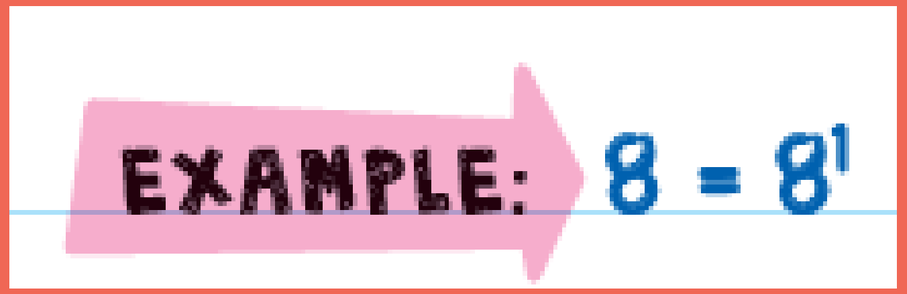
COMMON MISTAKE:

The expression 4^3 does NOT mean 4×3.

Exponents

Things to remember about exponents

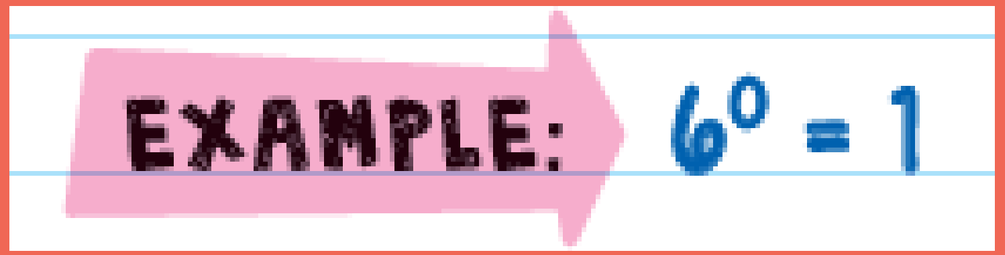
1. Any base without an exponent has a "invisible" exponent of 1



Exponents

Things to remember about exponents

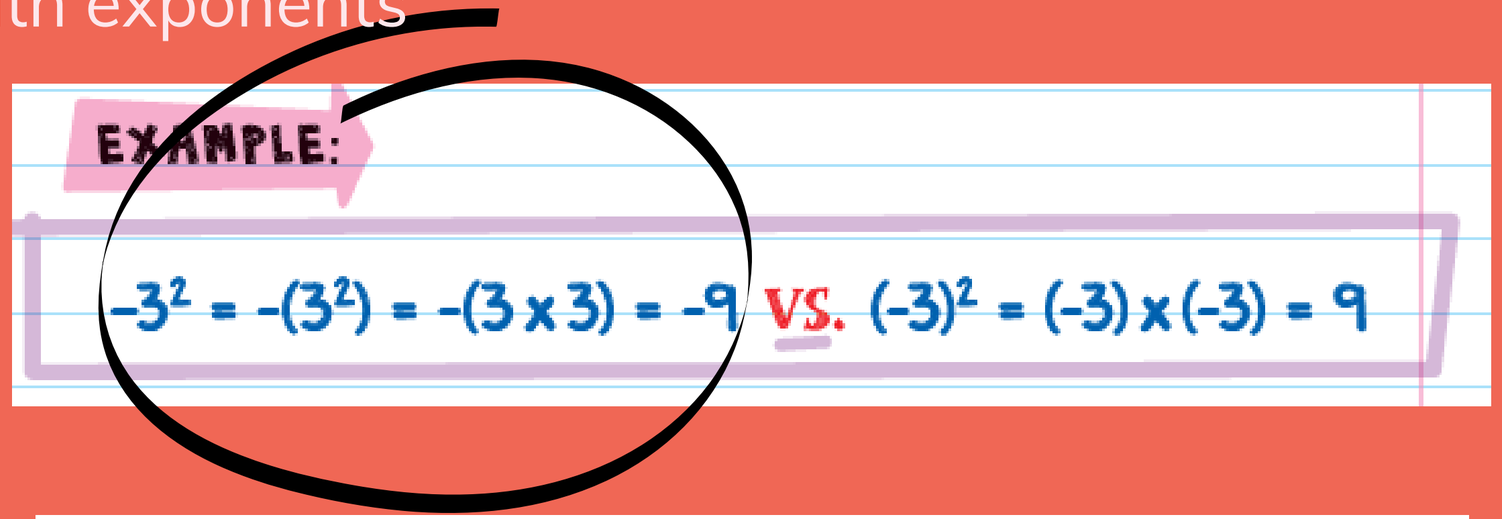
2. Any base with an exponent 0, equals 1



Exponents

Things to remember about exponents

3. Be careful when calculating negative numbers with exponents



Always **LOOK AT WHAT IS NEXT TO THE EXPONENT:**
In the first example, the number **3** is next to the exponent.
So, only the **3** is being raised to the second power.

Exponents

Things to remember about exponents

3. Be careful when calculating negative numbers with exponents

EXAMPLE:

$-3^2 = -(3^2) = -(3 \times 3) = -9$ **vs.** $(-3)^2 = (-3) \times (-3) = 9$

In the second example, the parentheses is next to the exponent, so we raise *everything* inside the parentheses to the second power. The **-3** is inside the parentheses and, therefore, **-3** is raised to the second power.

Simplifying

Simplifying expressions with exponents

You can simplify expressions with more than one exponent by combining the exponents-the only requirement is that **the base must be the same**. It looks like this:

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

$$x^a \div x^b = x^{a-b}$$

Simplifying

Examples

When multiplying powers with the same base, write the base once, and then add the exponents!

EXAMPLE: $5^2 \cdot 5^6 = 5^{2+6} = 5^8$

If you want to check that this works, try the long way:

$5^2 \cdot 5^6 = 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 = 5^8$

Simplifying

Examples

When dividing powers with the same base, write the base once and subtract the exponents!

EXAMPLE: $7^6 \div 7^2 = 7^{6-2} = 7^4$

If you want to check that this works, try the long way:

$$\frac{7^6}{7^2} = \frac{7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7}{7 \cdot 7} = 7^4$$

(We can cancel out two of the 7s on top and both on the bottom because anything divided by itself equals 1.)

$$\frac{7^6}{7^2} = \frac{7 \cdot 7 \cdot 7 \cdot 7 \cdot \cancel{7} \cdot \cancel{7}}{\cancel{7} \cdot \cancel{7}} = 7^4$$

Simplifying

Let's try with variables

EXAMPLE: $x^2 \cdot 2y \cdot x^4$

To simplify, we keep the base (x) and add the exponents $2 + 4$.

$= x^6 \cdot 2y$

CAN ALSO BE WRITTEN AS $2x^6y$

Simplifying

Let's try with variables

EXAMPLE: $3a^9 \div 7a^5$ To simplify $a^9 \div a^5$, we keep the base (a) and subtract the exponents $9-5$.

$= 3a^4 \div 7$

DON'T FORGET THAT YOU CAN ALSO FORMAT THIS QUESTION LIKE A FRACTION IF IT MAKES THE SOLUTION EASIER TO SEE.

$$\frac{3a^9}{7a^5}$$

Power of a power

When there is an exponent inside parentheses and another outside the parentheses, this is called a POWER OF A POWER. A power of a power can be simplified by multiplying the exponents. It looks like this:

$$(v^a)^b = v^{a \cdot b}$$

Power of a power

Examples

EXAMPLE: $(4^2)^3 = 4^{2 \cdot 3} = 4^6$

If you want to check that this works, try the long way:

$(4^2)^3 = 4^2 \times 4^2 \times 4^2 = 4 \times 4 \times 4 \times 4 \times 4 \times 4 = 4^6$

$$[(-7)^2]^3 = (-7)^2 \cdot (-7)^2 \cdot (-7)^2 = (-7)^{2+2+2} = (-7)^6$$

Power of a power

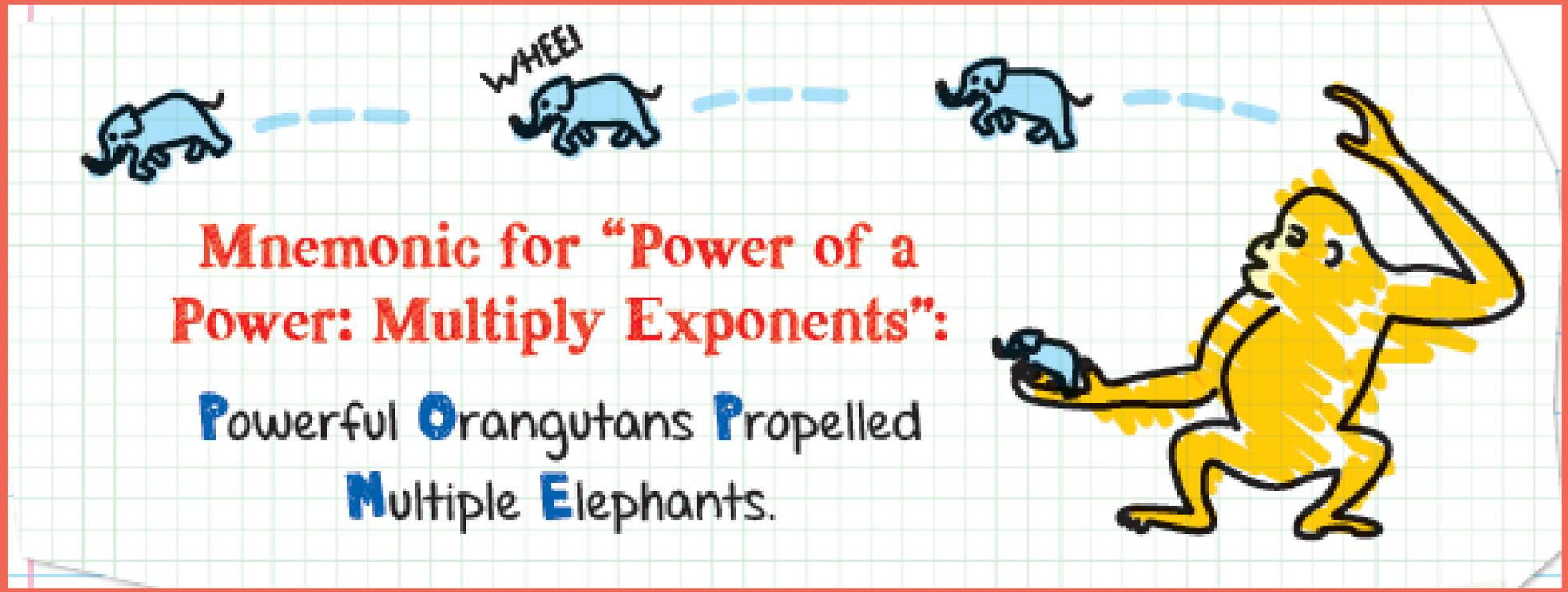
Examples

EXAMPLE:

$(3x^7y^4)^2 = 3^{1\cdot2} \cdot x^{7\cdot2} \cdot y^{4\cdot2} = 3^2 \cdot x^{14} \cdot y^8 = 9x^{14}y^8$

(Don't forget: Any base without an exponent has an "invisible" exponent of 1.)

Power of a power



Don't forget

Negative Exponents

You can easily calculate a negative exponent by using reciprocals

A negative exponent in the numerator becomes a positive exponent when moved to the denominator. It looks like this:

$$x^{-m} = \frac{1}{x^m}$$

See a negative exponent?
MOVE IT! If it's in the numerator, move it to the denominator and vice versa.
Then you can lose the negative sign!

Negative Exponents

Examples

EXAMPLE: $3^{-3} = \frac{1}{3^3} = \frac{1}{27}$

And the opposite is true: A negative exponent in the denominator becomes a positive exponent when moved to the numerator. It looks like this:

$$\frac{1}{x^{-m}} = x^m$$

EXAMPLE: $\frac{1}{5^{-2}} = 5^2 = 25$

Negative Exponents

Examples

EXAMPLE: $\dfrac{x^5 y^{-3}}{x^{-4} y^4}$

Turn y^{-3} into y^3 by moving it to the denominator.

Turn x^{-4} into x^4 by moving it to the numerator.

The new expression is $\dfrac{x^5 \cdot x^4}{y^3 \cdot y^4}$.

It simplifies to $\dfrac{x^9}{y^7}$.

Exersises

1. 5^3
2. $14m^0$
3. -2^4
4. $x^9 \cdot x^5$
5. $4x^2 \cdot 2y \cdot -3x^5$
6. $\frac{t^9}{t}$
7. $\frac{-15x^4y^2}{5x^3y^2}$
8. $(10^3)^2$
9. $(8m^3n)^3$
10. $\frac{y^5z^{-2}}{y^2z^6}$