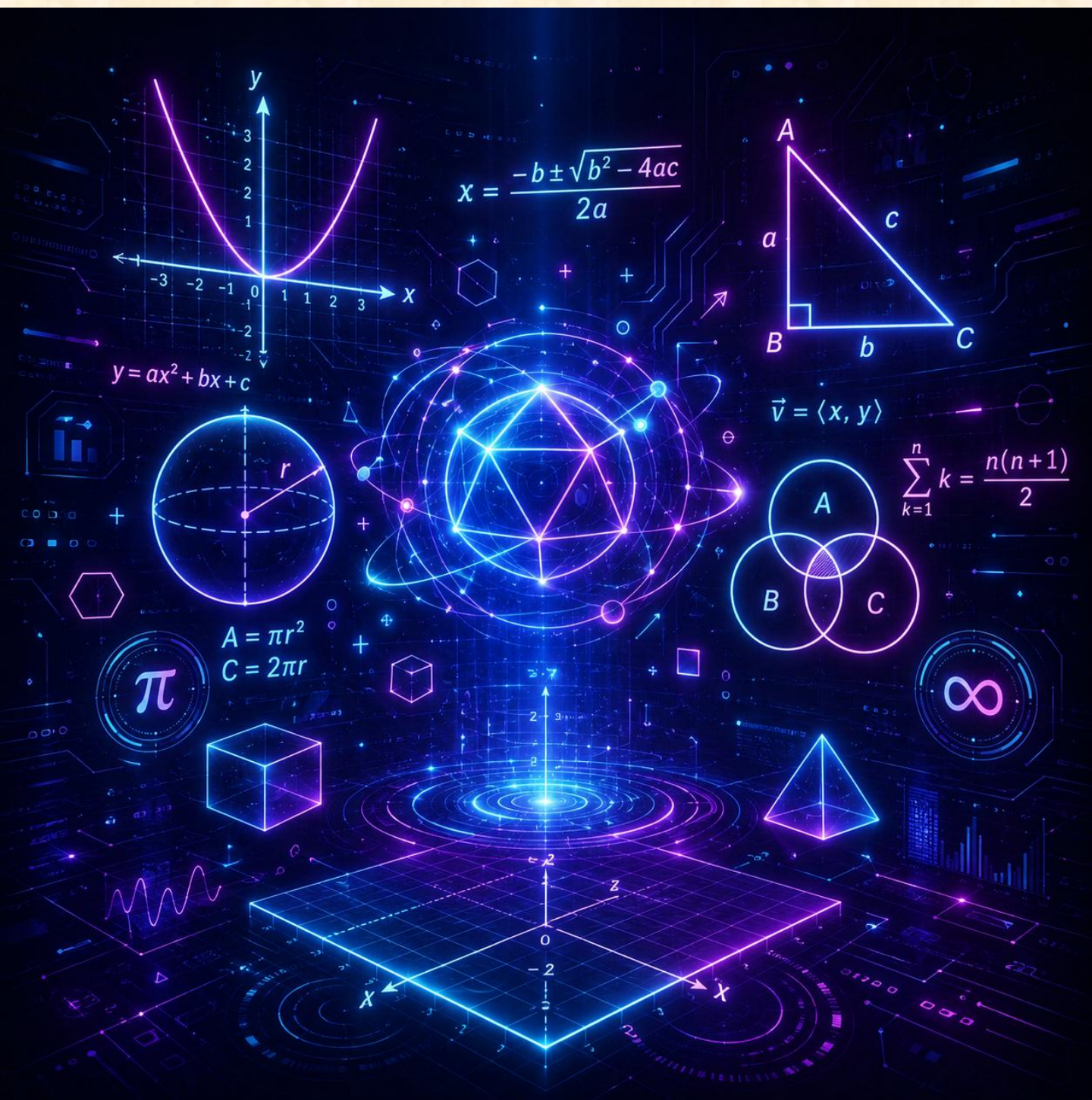




雙語數學誌

Bilingual Mathematics Magazine



From Cells to Galaxies: A Guide to Scientific Notation

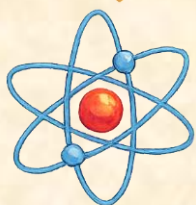
科學記號探索指南

Can You Imagine These Numbers?



Distance from Earth to the Sun

150,000,000 km



Size of an Atom

0.0000000001 m



Stars in the Milky Way Galaxy

100,000,000,000 to 400,000,000,000 stars



There are a LOT of zeros!

These numbers are so large or so small that they are hard to read, compare, and calculate.

So, how do scientists and mathematicians make these numbers easier to use?



Exponent Make Numbers Shorter

Before we learn scientific notation, we need to understand exponents. An exponent expression has two important parts:

10^3

Diagram showing the parts of the exponent expression 10^3 :
The **base** is 10 (indicated by an orange bracket).
The **exponent** is 3 (indicated by a green bracket).

The **base** tells us what number is being multiplied.

The **exponent** tells us how many times the base is used as a factor.

This means 10 is multiplied by itself 3 times. So:

$$10^3 = 10 \times 10 \times 10 = 1000$$

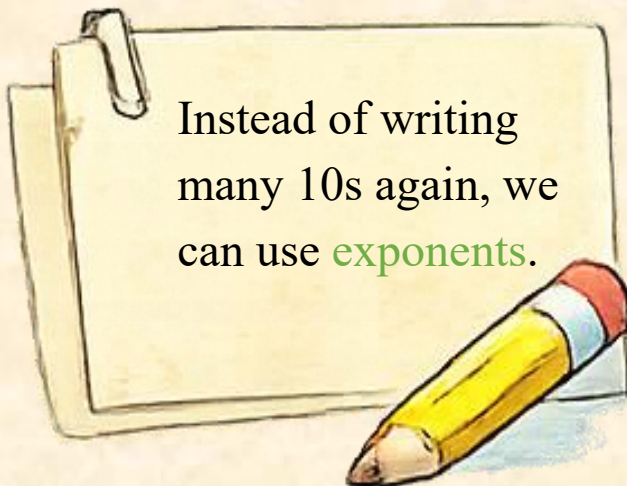


More Examples

$$10^2 = 10 \times 10 = 100$$

$$10^3 = 10 \times 10 \times 10 = 1000$$

$$10^6 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 1,000,000$$



Instead of writing many 10s again, we can use **exponents**.

Exponents help us write repeated multiplication in a shorter and cleaner way.

In science, powers of 10 are often used to represent very large or very small numbers.
For example:

Power of 10	Number Name
10^3	thousand
10^6	million
10^9	billion
10^{12}	trillion
10^{15}	quadrillion

Scientists realized that powers of 10 are especially useful for describing very large and very small numbers.



Scientific notation is a way to write very large or very small numbers using exponents.



How to Convert

150,000,000

to scientific notation?

Method 1: Repeatedly Divide by 10

Start with:

 $150,000,000$ 

Divide by 10 each time until the first factor is between 1 and 10, including 1.

$$\begin{aligned}150,000,000 &= 15,000,000 \times 10 \\150,000,000 &= 1,500,000 \times 10^2 \\150,000,000 &= 150,000 \times 10^3 \\150,000,000 &= 15,000 \times 10^4 \\150,000,000 &= 1,500 \times 10^5 \\150,000,000 &= 150 \times 10^6 \\150,000,000 &= 15 \times 10^7 \\150,000,000 &= 1.5 \times 10^8\end{aligned}$$



$$150,000,000 = 1.5 \times 10^8$$

Method 2: Move the Decimal Point



Step 1: Find the decimal point

The decimal point is at the end of this very large number :
150,000,000.

Step 2: Move the decimal point

Move the decimal point to the left until you get a number between 1 and 10, including 1.

From 150000000. to 1.50000000, the decimal point moved 8 places.

Step 3: Write the original number using power of 10

Because the decimal moved 8 places to the left, the exponent is positive 8.

$$10^8$$



$$150,000,000 = 1.5 \times 10^8$$

History Corner

For thousands of years, mathematicians have searched for ways to describe extremely large numbers.

Here are a few examples:

- More than 2,200 years ago, the Greek mathematician Archimedes wrote a book called *The Sand Reckoner*. In this book, he asked an unusual question: "How many grains of sand could fit inside the universe?"
- Archimedes invented a system for naming huge numbers and became one of the first people to study very large quantities.
- In the 17th century, John Napier introduced logarithms, which made calculations involving large numbers much easier.

Today, scientific notation is used in astronomy, chemistry, biology, engineering, and computer science.



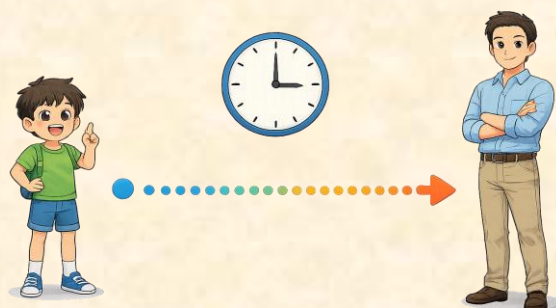
Fun Story

Do you know how long it would take to count from 1 to 1,000,000,000.

Imagine counting one number at the time every second without stopping, counting from 1(*one*), 2(*two*), 3(*three*), ... 1000000(*one million*) would take about eleven days.

However, counting from 1 to 10000000000(*one billion*) would take nearly thirty-two years!

Even when we are just saying one number at a time out loud, when the number is very large or very small, using scientific notation would be much easier to say the same number.



Numbers In Life

Real-life is filled with numbers that are almost impossible to imagine.

The average distance from Earth to the Sun is 1.496×10^{11} m

Light travels at the speed about 3×10^8 m/s

Astronomers estimate that the observable universe contains approximately 1×10^{22} stars.

Without scientific notation, these numbers would be difficult to understand and work with.



The Tiny World

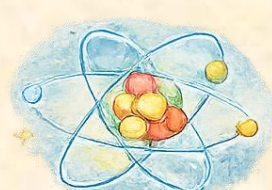
Not everything in science is enormous. Some objects are incredibly small.

The length of a virus is about 10^{-7} m

A DNA molecule has a diameter of approximately 2×10^{-9} m

Atoms are even smaller in size, measuring around 10^{-10} m

Because these values are so tiny, the scientific notation is needed to describe them.



Scientific Notation And Computers

Modern computers perform millions or even billions of calculations every second.

Artificial intelligence, weather forecasting, video games, and medical imaging all rely on scientific notation to describe extremely large or small numbers..

Computers often use “E” notation instead of powers of ten.

For example,



1.2E14 Means 1.2×10^{14}

This allows computers to store and process extremely large and small numbers efficiently.

Amazing Number Records

Did you know that the human body contains approximately 3.7×10^{13} cells.

The Earth is about 4.54×10^9 years old.

Google processes around 8.5×10^9 searches every day.

Scientists estimate that there are approximately 2×10^{16} ants living on Earth.



Meet The Googol

A googol is the number 10^{100} which means one followed by one hundred zeros.

The term was invented by mathematician Edward Kasner in 1938.

Interestingly, the company Google got its name from the word "googol."



Scan the QR code to read Scientific Notation in English like a pro!



Challenge Zone

Easy

- ① Write 6,400,000 in scientific notation.
- ② Write 5.3×10^{-5} in standard form.

Medium

Compare: 4.8×10^9 and 7.1×10^8

Hard

The Milky Way galaxy has approximately 2×10^{11} stars.

If each star had 5 planets, how many planets would there be?



Challenge Zone Answer key

Easy

① Write 6,400,000 in scientific notation.

$$6.4 \times 10^6$$

② Write 5.3×10^{-5} in standard form.

$$0.000053$$

Medium

Compare: 4.8×10^9 and 7.1×10^8

$$4.8 \times 10^9 > 7.1 \times 10^8$$

$$4,800,000,000 > 710,000,000$$

Hard

The Milky Way galaxy has approximately 2×10^{11} stars.

If each star had 5 planets, how many planets would there be?

1×10^{12} planets (or 1 trillion planets)

$$\text{Total planets} = (2 \times 10^{11}) \times 5 = 10 \times 10^{11} = 1 \times 10^{12}$$



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