Scientific Notation

Jen Kershaw

AUTHOR
Jen Kershaw

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CONCEPT 1

Scientific Notation

Here you'll learn to recognize the equivalence of standard form, product form and scientific notation of very small and very large decimal numbers.

Have you ever seen an exhibit on the solar system?

While Marc was observing the scientists, Kara spent her time at the solar system exhibit. She was amazed at all of the different distances between earth and the other planets and moons.

Her favorite planet is Saturn.

She discovered that the distance from Earth to Saturn is 887 million miles.

Can you write this is standard form?

Can you write it in scientific notation?

This Concept will show you how to recognize equivalence in decimal numbers. By the end of it, you will be able to answer these questions.

Guidance

To better understand our world, scientists take measurements. Some measurements can often be extremely large or small.

The distance between Earth and Jupiter, for instance, is about 595,000,000 kilometers.

The diameter of an insect's cell is about .000000000017 meters.

Scientific notation **is a way to represent very large and very small numbers. Scientific notation makes it easier to read, write, and calculate extreme numbers.**

How do we work with scientific notation?

To understand scientific notation, we need to first back up a bit and think about some of the things that we have already learned.

Do you remember working with powers? ***Exponential notation*** is a way to write multiplication as a power.

In a power like 2^3, 2 is the base and 3 is the exponent. In expanded form, 2^3 is written 2(2)(2), we multiply 2 by 2, three times.

Scientific notation relies on the exponential notation—powers of 10—to rewrite numbers in a simpler form. Let's look at powers of 10 once again.

Our place-value system is based on these powers of 10.

10(10) = 100

100(10) = 1,000

1000(10) = 10,000 and so on.

Now let's think about that original distance that we introduced between Earth and Jupiter.

The distance is 595,000,000. This is the number written in ***standard form***.

We could also write this number using an exponent. Look at all those zeros. If we count them, there are 8 zeros. The distance could also be written as 5.95×10^8. When we write a number as a factor and a product of 10 and a power, we call this ***scientific notation***.

Write 560,000 in scientific notation.

To begin with, we take the first two numbers and convert this to a decimal.

56 becomes 5.6

Now we can think about how we would multiply 5.6 times a power of 10 to get 560,000. There are 5 decimal places involved.

Our answer is 5.6×10^5

Because we started with a whole number, our exponent is positive.

If we started with a decimal, our exponent would be negative.

Well, it has to do with the way that the decimal point is moving. If it moves to the left, then the power of ten is positive. If it moves to the right, then the power of ten is negative. In the last problem, our decimal moved to the left to 5.6. Now let's look at one where it moves to the right.

The diameter of the insect's gland cell is .000000000017.

.000000000017 is the ***standard form*** of the number. Notice that that is a very tiny decimal. **To write this in scientific notation, we have to move the decimal point 11 places to the right.**

.000000000017 becomes 1.7

We moved the decimal 11 places, so that is our exponent.

Now we write the whole thing as a product of the decimal and a power of ten.

Our answer is 1.7×10^{-11}**.**

We can also work the other way around. We can take a number in scientific notation and rewrite it in standard form. To do this, we have to work backwards. Pay close attention to whether the exponent is negative or positive, and this will tell you which way to move the decimal point.

Write 1.2×10^4 in standard form.

First, we notice that the exponent is positive. This means that we move the decimal four places to the right.

1.2×10^4**becomes 12,000.**

Our answer is 12,000.

Now it's time for you to try a few on your own.

Example A

Write 450,000,000 in scientific notation.

Solution:4.5×10^8

Example B

Write 3.4×10^5 in standard form.

Solution:$340,000$

Example C

Write 6.7×10^{-9} in standard form.

Solution: .0000000067

Here is the original problem once again.

While Marc was observing the scientists, Kara spent her time at the solar system exhibit. She was amazed at all of the different distances between earth and the other planets and moons.

Her favorite planet is Saturn.

She discovered that the distance from Earth to Saturn is 887 million miles.

Can you write this is standard form?

Can you write it in scientific notation?

First, let's start with standard form. We can write 887 million by adding in six zeros and some commas.

$887,000,000$

Then, we can write it in scientific notation by writing it as a product of a base ten power.

8.87×10^8

Now our work is complete.

Vocabulary

Standard Form
the writing of a number with zeros not written using exponents and powers of 10.

Exponential Form
A number written with an exponent

Scientific Notation
Numbers that are written as decimal products with base ten powers

Guided Practice

Here is one for you to try on your own.

Write 4.5×10^{-6} in standard form.

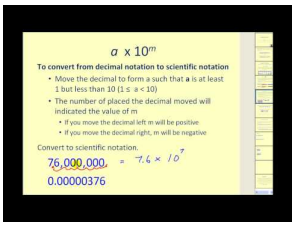
Answer

First, notice that the exponent is negative. This means that we move the decimal six places to the left.

4.5×10^{-6}**becomes .0000045.**

Our answer is .0000045

Video Review



MEDIA

Click image to the left for more content.

- This is a James Sousa video onscientific notation.

Practice

Directions: Write each number in scientific notation.

1. 0.0000000056731
2. 24,010,000,000
3. 960,000,000,000,000,000
4. 0.0000001245
5. 36,000,000
6. .00098
7. .000000034
8. 345,000,000

Directions: Write each number in standard form.

9. 3.808×10^{11}
10. 2.1×10^{-6}
11. 5.912×10^{8}
12. 6.78×10^{-6}
13. 5.7×10^{9}
14. 4.5×10^{-5}
15. 3.21×10^{7}