

SCIENTIFIC NOTATION

In the field of science and computers, large numbers with lots of zeros are cumbersome to compute. Thus, a short notation, called scientific notation, is used to write these numbers.

First we'll look at the meaning of scientific notation and writing standard numbers for numbers expressed in scientific notation. Then we'll express large numbers in scientific notation. We'll extend our knowledge of scientific notation by looking at more numbers expressed in scientific notation.

Write answers for scientific notation similar to this example:

3.4 times 10 to the 4th power

PROBLEM SOLVING: FRACTION AND DECIMAL APPLICATIONS

We will practice problem solving and apply our knowledge of decimals and fractions. Remember to use addition when finding sums, subtraction to find differences and compare amounts, multiplication when finding products, and division to find quotients. Use division when sharing amounts equally and finding averages.

Standard Form for Numbers in Scientific Notation

When a number is expressed in scientific notation, it is written as a product of two parts:

- a number that is less than 10, but greater than or equal to 1
- a power of ten

$$5.6 \times 10^4 = 56,000$$

In this section, we will take numbers given in scientific notation and write them in standard form.

Example 1: What is the standard form for 7×10^4 ?

$$\begin{aligned} 7 \times 10^4 &= \\ &= 7 \times (10 \times 10 \times 10 \times 10) & 10^4 &= 10 \times 10 \times 10 \times 10 \\ &= 7 \times 10,000 & 10 \times 10 \times 10 \times 10 &= 10,000 \\ &= 70,000 \end{aligned}$$

The standard form for 7×10^4 is 70,000.

Example 2: What is the standard form for 8.2×10^5 ?

$$\begin{aligned} 8.2 \times 10^5 &= \\ &= 8.2 \times (10 \times 10 \times 10 \times 10 \times 10) \\ &= 8.2 \times 100,000 \\ &= 820,000 \end{aligned} \quad \left(\begin{array}{l} 8.2 \\ \times 100000 \\ \hline 820000.\cancel{0} = 820,000 \end{array} \right)$$

The standard form for 8.2×10^5 is 820,000.

A shortcut to multiply by a power of ten is to start at the decimal point's location and move it **right** as many places as the given power.

$$8.2 \times 10^5 = 8\underbrace{20000}_{\text{move 5 places right}} = 820,000$$

*Use zeros as place holders. In this case, the 2 takes up one place, so four zeros are needed to complete the move of 5 places to the right for the power of 5.

Express Large Numbers in Scientific Notation

When a number is expressed in scientific notation, it is written as a product of two parts:

- a number that is less than 10, but greater than or equal to 1
- a power of ten

$$56,000 = 5.6 \times 10^4$$

To express a number in scientific notation, determine the first part that is a number between 1 and 10, and then determine the power of 10 that will make the expression equal to the given number.

Example 1: What is the scientific notation for 9,000,000?

Look at the first nonzero digits of the number and write as a **number between 1 and 10**.

$$9 \times 10^6$$

Multiply the number by a **power of ten** that will give the standard number.

$$\begin{aligned} 9,000,000 &= \\ &= 9 \times 1,000,000 \\ &= 9 \times 10^6 \end{aligned}$$

A shortcut to calculate the power is to place a decimal point after the first digit of the number, and then count the number of places **right** to the end of the whole number.

$$9,000,000 = 9.\underbrace{000000}_6 = 9 \times 10^6$$

Count six places to the end of the number, so the power is 6. Counting right gives a positive power.

The scientific notation for 9,000,000 is 9×10^6 .

Example 2: What is the scientific notation for 673,000?

Look at the nonzero digits at the beginning of the number and write as a **number between 1 and 10** by placing a decimal point after the first digit.

$$6.73 \times 10^5$$

Multiply the number by a **power of ten** that will give the standard number.

$$\begin{aligned} 673,000 &= \\ &= 6.73 \times 100,000 \\ &= 6.73 \times 10^5 \end{aligned}$$

A shortcut to calculate the power is to place a decimal point after the first digit of the number, and then count the number of places **right** to the end of the whole number.

$$673,000 = 6.\underline{73000} = 6.73 \times 10^5$$

Count five places to the end of the number, so the power is 5. Counting right gives a positive power.

The scientific notation for 673,000 is 6.73×10^5 .