

# Scientific Notation


Scientific notation is a compact way of expressing very large or very small numbers. A number expressed in scientific notation has the following format:

$$\pm a \times 10^b$$

where  $a$  is a number between 1 and 10 (equal to or greater than 1 but less than 10)<sup>1</sup> and  $b$  is the exponent for the appropriate power of 10. The  $\pm$  symbol in front of the  $a$  indicates that the number could be either positive or negative. Examples of numbers expressed in scientific notation are

$$\begin{aligned} &1.6 \times 10^3 \\ &-5.1 \times 10^5 \\ &7.112 \times 10^{-6} \end{aligned}$$

The number 365,000 expressed in scientific notation is  $3.65 \times 10^5$ . To convert a number to scientific notation, do the following:

1. Write down the number: 365000
2. If the number does not have a decimal point, put one at the end: 365000.
3. Move the decimal point to the right or left until there is exactly one non-zero digit to the left of the decimal point: 3.65000  

4. Count how many places you had to move the decimal point and in which direction: five to the left.
5. Drop any leading or trailing zeros. The result is  $a$ :  $a = 3.65$
6.  $b$  is the number the places you had to move the decimal point.  $b$  is positive if you moved the decimal point to the left and negative if you moved the decimal point to the right:  $b = 5$ .

As an example, convert 0.00045 to scientific notation

1. 0.00045
2. The number already has a decimal point.

<sup>1</sup> Formally, we would write that  $0 \leq a < 10$ .

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3. 00004.5

4. four to the right

5.  $a = 4.5$

6.  $b = -4$  ( $b$  is negative since you had to move the decimal to the right.)

The result is  $4.5 \times 10^{-4}$ .

## Test Your Understanding

1. Express the following numbers in scientific notation:

145

3.1415

-9200

0.0068

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2. Convert these numbers, expressed in scientific notation, to regular numbers: (Hint: If the exponent is positive move the decimal point to the right. If it's negative, move the decimal point to the left. Add leading or trailing zeros as necessary.)

$7.24 \times 10^3$

$1.889 \times 10^5$

$-4.8 \times 10^{-5}$

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