Concepts
Scientific Notation

Based on power point presentations by Pearson Education, Inc.
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Learning Objectives

1. Write numbers as powers of 10.
2. Define scientific notation.
3. Change from standard notation to scientific notation.
4. Change from scientific notation to standard notation.

NOTE: This lesson contains some examples. You can find more examples in the "Examples" document also located in the appropriate MOM Learning Materials folder.

1. Powers of Ten

The **powers of 10** refer to the numbers in which the base is 10 and the exponent is an integer. For example, 10^{-2}, 10^{-3}, 10^{-6}, 10^{2}, 10^{3}, or 10^{6} show the different powers of 10.

Example 1:

a. Expand $\mathbf{10^{9}}$. We write a 1 followed by 9 zeros:

$\mathbf{10^{9} = 1{,}000{,}000{,}000}$

b. Expand $\mathbf{10^{-4}}$. We write a decimal point followed by 3 zeros and then a 1.

$\mathbf{10^{-4} = .0001}$ which is better expressed as **0.0001** showing a 0 in the whole number place.

2. Scientific Notation

In scientific applications and certain technical fields, computations with very large and very small numbers are required. These numbers in their regular form are inconvenient to read, write, and use in computations.

For example, a coulomb (unit of electrical charge) equals 6,241,960,000,000,000,000 electrical charges. Copper expands 0.00000900 per unit of length per degree Fahrenheit. Scientific notation simplifies these numbers.

A number is written in *Scientific Notation* when it is expressed in the form

$$\boldsymbol{a \times 10^{n}}\text{ , where } 1 \le a < 10 \text{ and } n \text{ is an integer}$$

The symbol × indicates multiplication!

For example, the coulomb is then written as $\mathbf{6.24196 \times 10^{18}}$.

3. Change from Standard Notation to Scientific Notation (1 of 5)

To change from standard notation to scientific notation we will use the following three steps.

Step 1:

Begin by writing the number as a value between 1 and 10 using all non-zero digits.

Step 2:

Count the number of places the decimal point has shifted after writing the number as a value between 1 and 10.

- If the decimal point has shifted to the **left**, the exponent of the base 10 is **positive**.
- If the decimal point has shifted to the **right**, the exponent of the base 10 is **negative**.

Step 3:

Multiply the number found in Step 1 with the exponential expression found in Step 2 using the multiplication symbol $\times$.

Change from Standard Notation to Scientific Notation (2 of 5)

Example 2:

Change **123000** to scientific notation using all of its non-zero digits.

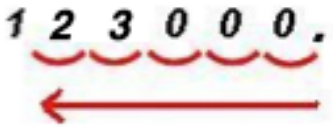
Step 1:

We need to write the number as a value between 1 and 10.

We get 1.23 using all non-zero digits.

Step 2:

Now we count the number of places the decimal point has shifted after writing 123000 as a value between 1 and 10.



We moved the decimal point 5 places to the **left**.

Change from Standard Notation to Scientific Notation (3 of 5)

Step 2 continued:

Since the decimal point has shifted 5 places to the **left**, the exponent of the base 10 is **positive 5**.

We use 10^{5} .

Step 3:

We multiply the number found in Step 1 with the exponential expression found in Step 2 using the multiplication symbol $\times$.

The number **123000** is written as $\mathbf{1.23 \times 10^{5}}$ in scientific notation.

Change from Standard Notation to Scientific Notation (4 of 5)

Example 3:

Change **0.0168** to scientific notation using all its non-zero digits.

Step 1:

We need to write the number as a value between 1 and 10.

We get 1.68 using all non-zero digits.

Step 2:

Now we count the number of places the decimal point has shifted after writing 0.0168 as a value between 1 and 10.

We moved the decimal point 2 places to the **right**.

Change from Standard Notation to Scientific Notation (5 of 5)

Step 2 continued:

Since the decimal point has shifted 2 places to the **right**, the exponent of the base 10 is **negative 2**.

We use 10^{-2}.

Step 3:

We multiply the number found in Step 1 with the exponential expression found in Step 2 using the multiplication symbol $\times$.

The number **0.0168** is written as $\mathbf{1.68 \times 10^{-2}}$ in scientific notation.

4. Change from Scientific Notation to Standard Notation

To change from scientific notation to standard notation, simply use the calculator and multiply!

Example 4:

a. Change 4.5×10^{2} to standard notation. The calculator tells us 450.

b. Change 4.5×10^{-2} to standard notation. The calculator tells us 0.045.