



Math Skills Review

Scientific Notation

Scientific notation is the way that scientists easily handle very large numbers or very small numbers. For example, instead of writing 0.0000000056, we write 5.6×10^{-9} . So, how does this work?

We can think of 5.6×10^{-9} as the product of two numbers: 5.6 (the digit term) and 10^{-9} (the exponential term).

Here are some examples of scientific notation.

$10000 = 1 \times 10^4$	$24327 = 2.4327 \times 10^4$
$1000 = 1 \times 10^3$	$7354 = 7.354 \times 10^3$
$100 = 1 \times 10^2$	$482 = 4.82 \times 10^2$
$10 = 1 \times 10^1$	$89 = 8.9 \times 10^1$ (not usually done)
$1 = 10^0$	
$1/10 = 0.1 = 1 \times 10^{-1}$	$0.32 = 3.2 \times 10^{-1}$ (not usually done)
$1/100 = 0.01 = 1 \times 10^{-2}$	$0.053 = 5.3 \times 10^{-2}$
$1/1000 = 0.001 = 1 \times 10^{-3}$	$0.0078 = 7.8 \times 10^{-3}$
$1/10000 = 0.0001 = 1 \times 10^{-4}$	$0.00044 = 4.4 \times 10^{-4}$

As you can see, the exponent of 10 is the number of places the decimal point must be shifted to give the number in long form. A **positive** exponent shows that the decimal point is shifted that number of places to the right. A **negative** exponent shows that the decimal point is shifted that number of places to the left.

In scientific notation, the digit term indicates the number of significant figures in the number. The exponential term only places the decimal point. As an example,

$$46600000 = 4.66 \times 10^7$$

This number only has 3 significant figures. The zeros are not significant; they are only holding a place. As another example,

$$0.00053 = 5.3 \times 10^{-4}$$

This number has 2 significant figures. The zeros are only place holders.

How to do calculations:

On your scientific calculator:

Make sure that the number in scientific notation is put into your calculator correctly.

Read the directions for your particular calculator. For inexpensive scientific calculators:

1. Punch the number (the digit number) into your calculator.
2. Push the EE or EXP button. Do **NOT** use the x (times) button!!
3. Enter the exponent number. Use the +/- button to change its sign.
4. Voila! Treat this number normally in all subsequent calculations.

To check yourself, multiply 6.0×10^5 times 4.0×10^3 on your calculator. Your answer should be 2.4×10^9 .

On your cheap non-scientific calculator:

You will need to be familiar with exponents since your calculator cannot take care of them for you. For an introduction to rules concerning exponents, see the section on Manipulation of Exponents.

Addition and Subtraction:

- All numbers are converted to the same power of 10, and the digit terms are added or subtracted.
- Example: $(4.215 \times 10^{-2}) + (3.2 \times 10^{-4}) = (4.215 \times 10^{-2}) + (0.032 \times 10^{-2}) = 4.247 \times 10^{-2}$
- Example: $(8.97 \times 10^4) - (2.62 \times 10^3) = (8.97 \times 10^4) - (0.262 \times 10^4) = 8.71 \times 10^4$

Multiplication:

- The digit terms are multiplied in the normal way and the exponents are added. The end result is changed so that there is only one nonzero digit to the left of the decimal.
- Example: $(3.4 \times 10^6)(4.2 \times 10^3) = (3.4)(4.2) \times 10^{(6+3)} = 14.28 \times 10^9 = 1.4 \times 10^{10}$
(to 2 significant figures)
- Example: $(6.73 \times 10^{-5})(2.91 \times 10^2) = (6.73)(2.91) \times 10^{(-5+2)} = 19.58 \times 10^{-3} = 1.96 \times 10^{-2}$
(to 3 significant figures)

Division:

- The digit terms are divided in the normal way and the exponents are subtracted. The quotient is changed (if necessary) so that there is only one nonzero digit to the left of the decimal.
- Example: $(6.4 \times 10^6)/(8.9 \times 10^2) = (6.4)/(8.9) \times 10^{(6-2)} = 0.719 \times 10^4 = 7.2 \times 10^3$
(to 2 significant figures)
- Example: $(3.2 \times 10^3)/(5.7 \times 10^{-2}) = (3.2)/(5.7) \times 10^{3-(-2)} = 0.561 \times 10^5 = 5.6 \times 10^4$
(to 2 significant figures)

Powers of Exponentials:

- The digit term is raised to the indicated power and the exponent is multiplied by the number that indicates the power.
- Example: $(2.4 \times 10^4)^3 = (2.4)^3 \times 10^{(4 \times 3)} = 13.824 \times 10^{12} = 1.4 \times 10^{13}$
(to 2 significant figures)
- Example: $(6.53 \times 10^{-3})^2 = (6.53)^2 \times 10^{(-3) \times 2} = 42.64 \times 10^{-6} = 4.26 \times 10^{-5}$
(to 3 significant figures)

Roots of Exponentials:

- Change the exponent if necessary so that the number is divisible by the root. Remember that taking the square root is the same as raising the number to the one-half power.
- Example:

$$\sqrt{3.6 \times 10^5} = \sqrt{36 \times 10^4} = \sqrt{36} \times \sqrt{10^4} = 6.0 \times 10^2$$

- Example:

$$\sqrt[3]{7.3 \times 10^{-9}} = \sqrt[3]{73 \times 10^{-9}} = \sqrt[3]{73} \times \sqrt[3]{10^{-9}} = 1.9 \times 10^{-3}$$

QUIZ:

- Question 1** Write in scientific notation: 0.000467 and 32000000
- Question 2** Express 5.43×10^{-3} as a number.
- Question 3** $(4.5 \times 10^{-14}) \times (5.2 \times 10^3) = ?$
- Question 4** $(6.1 \times 10^5)/(1.2 \times 10^{-3}) = ?$
- Question 5** $(3.74 \times 10^{-3})^4 = ?$
- Question 6** The fifth root of $7.20 \times 10^{22} = ?$

Answers: (1) 4.67×10^{-4} ; 3.2×10^7 (2) 0.00543 (3) 2.3×10^{-10} (2 significant figures) (4) 5.1×10^8 (2 significant figures) (5) 1.96×10^{-10} (3 significant figures) (6) 3.73×10^4 (3 significant figures)

Pick your next topic:

- [Algebraic Manipulation](#)
- [Significant Figures](#)
- [Manipulation of Exponents](#)
- [Dimensional Analysis](#)
- [Logarithms](#)
- [The Quadratic Equation](#)

SCIENTIFIC NOTATION

Name _____

Scientists very often deal with very small and very large numbers, which can lead to a lot of confusion when counting zeros! We have learned to express these numbers as powers of ten. Scientific notation takes the form of $M \times 10^n$ where $1 \leq M < 10$ and "n" represents the number of decimal places to be moved. Positive n indicates the standard form is a large number. Negative n indicates a number between zero and one.

Example 1: Convert 1,500,000 to scientific notation.

We move the decimal point so that there is only one digit to its left, a total of 6 places.

$$1,500,000 = 1.5 \times 10^6$$

Example 2: Convert 0.000025 to scientific notation.

For this, we move the decimal point 5 places to the right.

$$0.000025 = 2.5 \times 10^{-5}$$

(Note that when a number starts out less than one, the exponent is always negative.)

Convert the following to scientific notation.

1. $0.005 =$ _____

6. $0.25 =$ _____

2. $5,050 =$ _____

7. $0.025 =$ _____

3. $0.0008 =$ _____

8. $0.0025 =$ _____

4. $1,000 =$ _____

9. $500 =$ _____

5. $1,000,000 =$ _____

10. $5,000 =$ _____

Convert the following to standard notation.

1. $1.5 \times 10^3 =$ _____

6. $3.35 \times 10^{-1} =$ _____

2. $1.5 \times 10^{-3} =$ _____

7. $1.2 \times 10^{-4} =$ _____

3. $3.75 \times 10^{-2} =$ _____

8. $1 \times 10^4 =$ _____

4. $3.75 \times 10^2 =$ _____

9. $1 \times 10^{-1} =$ _____

5. $2.2 \times 10^5 =$ _____

10. $4 \times 10^0 =$ _____

CHAPTER 3 REVIEW ACTIVITY

Text Reference: Section 3-3

Scientific Notation

Scientific notation is a useful way of writing very large and very small numbers. It is easier to carry out calculations with such numbers when they are written in scientific notation. When measured quantities are expressed in scientific notation, the number of significant figures is clearly shown. (In this activity, assume that all figures are significant.)

A number written in scientific notation consists of two factors: (a) a number between 1 and 10, and (b) a power of 10. The power of 10 shows the number of 10's that are to be multiplied together. For example,

$$10^1 = 10; 10^2 = 10 \times 10 = 100; 10^3 = 10 \times 10 \times 10 = 1000; \text{ and so on.}$$

Negative exponents indicate reciprocals:

$$10^{-1} = \frac{1}{10^1} = 0.1; 10^{-2} = \frac{1}{10^2} = 0.01; 10^{-3} = \frac{1}{10^3} = 0.001$$

In scientific notation, $1201 = 1.201 \times 1000 = 1.201 \times 10^3$. Similarly, $0.001201 = \frac{1.201}{1000} = 1.201 \times 10^{-3}$.

Example 1

Express the mass of a hydrogen atom in scientific notation.

Mass = 0.000 000 000 000 000 000 000 001 67 g.

Answer: 1.67×10^{-24} g

Example 2

Express the diameter of a hydrogen atom in standard notation.

Diameter = 1×10^{-10} m.

Answer: 0.000 000 000 1 m

Write the following numbers in scientific notation.

- | | |
|----------------|----------|
| 1. 512 | 1. _____ |
| 2. 35 615 | 2. _____ |
| 3. 885 326 251 | 3. _____ |
| 4. 0.000 40 | 4. _____ |
| 5. 0.010 01 | 5. _____ |

Write the following numbers in standard notation.

- | | |
|----------------------------|-----------|
| 6. 3.0×10^6 | 6. _____ |
| 7. 1.49×10^{-5} | 7. _____ |
| 8. $5.000 102 \times 10^3$ | 8. _____ |
| 9. 4.4×10^{-7} | 9. _____ |
| 10. 9.993×10^{-2} | 10. _____ |