

# Chapter 32

## SCIENTIFIC NOTATION

We usually write numbers in **STANDARD NOTATION**.

**EXAMPLE:** 2,300,000

NOT VERY SCIENTIFIC.



**SCIENTIFIC NOTATION** is a shorthand way of writing numbers that are often very small or large by using powers of 10.

**EXAMPLE:**  $2.3 \times 10^6$

(which is the same as 2,300,000)

I APPROVE!



In scientific notation, the first number is greater than or equal to 1, but less than 10. The second number is a power of 10.

**EXAMPLE** of a very **LARGE** number:

$$7.4 \times 10^9 = 7,400,000,000$$

**EXAMPLE** of a very small number:

$$7.4 \times 10^{-9} = 0.0000000074$$

## To CONVERT A NUMBER FROM SCIENTIFIC NOTATION TO STANDARD NOTATION:

If the exponent on the **10** is positive, move the decimal that many spaces to the **RIGHT**.

If the exponent on the **10** is negative, move the decimal that many spaces to the **LEFT**.

**EXAMPLE:** Convert  $8.91 \times 10^7$  to standard notation.

$$8.91 \times 10^7 \leftarrow$$

The exponent **7** is positive, so move the decimal seven spaces to the right (and fill with zeros).

$$89,100,000$$

**EXAMPLE:** Convert  $4.667 \times 10^{-6}$  to standard notation.

$$4.667 \times 10^{-6} \leftarrow$$

The exponent **6** is negative, so move the decimal six spaces to the left (and fill with zeros).

$$0.000004667$$

To **CONVERT A POSITIVE NUMBER FROM STANDARD NOTATION TO SCIENTIFIC NOTATION**, count how many places you have to move the decimal point so that there is only a number between **1** and **10** that remains. The number of spaces that you move the decimal point is related to the exponent of **10**.

If the standard notation number is greater than 1, the exponent of 10 will be **POSITIVE**.

**EXAMPLE:** Convert 3,320,000 to scientific notation.

3,320,000 Move the decimal point six spaces to get a number between 1 and 10: 3.32.

$3.32 \times 10^6$  ← The standard notation number (3,320,000) is greater than 1, so the exponent of 10 is positive 6.

If the standard notation number is less than 1, the exponent of 10 will be **NEGATIVE**.

**EXAMPLE:** Convert 0.0007274 to scientific notation.

0.0007274 Move the decimal point four spaces to get a number between 1 and 10: 7.274.

$7.274 \times 10^{-4}$  ← The standard notation number (0.0007274) is less than 1, so the exponent of 10 is negative 4.

You can use scientific notation with negative numbers, too. For example, changing -360 to scientific notation would be:  $-3.6 \times 10^2$ . You simply count how many places you have to move the decimal point so that there is only a number between 0 and -10 that remains.



## Calculating Numbers in Scientific Notation

To **MULTIPLY NUMBERS IN SCIENTIFIC NOTATION**, remember our shortcut for multiplying powers with the same base. Just write the base once and add the exponents.

**EXAMPLE:**  $(2 \times 10^4)(3 \times 10^5)$

$$= 2 \cdot 10^4 \cdot 3 \cdot 10^5 \text{ Keep the base } 10 \text{ and add the exponents: } 10^{4+5} = 10^9.$$

$$= 2 \times 3 \times 10^9$$

$$= 6 \times 10^9$$

To **DIVIDE NUMBERS IN SCIENTIFIC NOTATION**, remember our shortcut for dividing powers with the same base. Just write the base once and subtract the exponents.

**EXAMPLE:**  $\frac{8 \times 10^9}{4 \times 10^6}$

$$= \frac{8}{4} \times \frac{10^9}{10^6}$$

Keep the base 10 and subtract the exponents:  
 $10^{9-6} = 10^3$ .

$$= 2 \times 10^3$$

EXCELLENT! MY WORK  
HERE IS DONE!





# CHECK YOUR KNOWLEDGE

1. Convert  $2.29 \times 10^5$  to standard notation.
2. Convert  $8.44 \times 10^{-3}$  to standard notation.
3. Convert  $1.2021 \times 10^{-9}$  to standard notation.
4. Convert 4,502,000 to scientific notation.
5. Convert 67,000,000,000 to scientific notation.
6. Convert 0.00005461 to scientific notation.

For 7 through 11, evaluate:

7.  $(4.6 \times 10^3)(2.1 \times 10^2)$

8.  $(2 \times 10^{-5})(3.3 \times 10^{-2})$

9.  $(4 \times 10^4)(3 \times 10^3)$

10.  $\frac{9 \times 10^7}{1.8 \times 10^3}$

11.  $\frac{3.64 \times 10^5}{2.6 \times 10^{-2}}$

ANSWERS

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# CHECK YOUR ANSWERS



1. 229,000

2. 0.00844

3. 0.00000000012021

4.  $4.502 \times 10^6$

5.  $6.7 \times 10^{10}$

6.  $5.461 \times 10^{-5}$

7.  $9.66 \times 10^5$

8.  $6.6 \times 10^{-7}$

9.  $12 \times 10^7 = 1.2 \times 10^8$

10.  $5 \times 10^4$

11.  $1.4 \times 10^7$