

Operations and Scientific Notation

Name: _____

Write Numbers Using Scientific Notation

Study the example problem showing how to write numbers using scientific notation. Then solve problems 1–7.

Example

Five nanobytes is equivalent to 5 one-billionths of a byte, or 0.000000005 byte. Five gigabytes is equivalent to 5 billion bytes, or 5,000,000,000 bytes. Write 0.000000005 and 5,000,000,000 in scientific notation.

0.000000005

5,000,000,000

You can think of 0.000000005 as 5×0.000000001 . Because 0.000000001 is a product of nine tenths, you can write it with an exponent as 10^{-9} . This means that 0.000000005 written in scientific notation is:

$$\begin{aligned} 0.000000005 &= 5 \times 0.000000001 \\ &= 5 \times 10^{-9} \end{aligned}$$

You can think of 5,000,000,000 as $5 \times 1,000,000,000$. Because 1,000,000,000 is a product of nine tens, you can write it with an exponent as 10^9 . This means that 5,000,000,000 written in scientific notation is:

$$\begin{aligned} 5,000,000,000 &= 5 \times 1,000,000,000 \\ &= 5 \times 10^9 \end{aligned}$$

- 1** In the example problem, $0.000000005 = 5 \times 10^{-9}$. What is the standard form of 10^{-9} ?

- 2** Write a number that is greater than 1 in scientific notation. Explain how you know it is greater than 1.

- 3** Explain why you might want to write very large and very small numbers like the ones in the example problem in scientific notation.

Vocabulary

scientific notation a way to express a number as the product of a number greater than or equal to 1 but less than 10 and a power of ten.

$$6.25 \times 10^8$$

$$4.03 \times 10^{-7}$$

Solve.

4 Write the numbers in scientific notation.

a. 0.000000608 _____

b. 0.000000092 _____

5 Write 2.06×10^{10} in standard form.

6 Use the information in the table to solve the problem.

Country	Estimated Population
China	1,390,000,000
Germany	82,700,000
Martinique	405,000

Write each population in scientific notation.

China _____

Germany _____

Martinique _____

The population of Germany is about how many times the population of Martinique? Explain your reasoning.

7 A scientist uses 2.8×10^{12} cells in one experiment, which is 2,000 times the number of cells she uses in a second experiment. Write the number of cells the scientist used in her second experiment in scientific notation. Explain your answer.

Add and Subtract Numbers in Scientific Notation

Study the example problem showing how to add numbers expressed in scientific notation. Then solve problems 1–7.

Example

Evaluate: $(3.8 \times 10^5) + (2.4 \times 10^6)$.

$$(3.8 \times 10^5) + (2.4 \times 10^6)$$

Rewrite so that the powers of 10 are equal.

$$= (3.8 \times 10^5) + (24 \times 10^5)$$

$$= (3.8 + 24) \times 10^5$$

Use the distributive property.

$$= 27.8 \times 10^5$$

Simplify.

$$= 2.78 \times 10^6$$

Write in scientific notation.

$$(3.8 \times 10^5) + (2.4 \times 10^6) = 2.78 \times 10^6$$

- 1** In the example problem, 2.4×10^6 was rewritten as 24×10^5 . Explain why those expressions are equivalent.

- 2** James rewrote the problem as $(0.38 \times 10^6) + (2.4 \times 10^6)$ and then added. Does his method work? Explain.

- 3** You can use the same method to subtract numbers in scientific notation. Complete the steps to evaluate the subtraction expression $(2.1 \times 10^9) - (9.7 \times 10^7)$.

$$(2.1 \times 10^9) - (9.7 \times 10^7) = (\underline{\hspace{2cm}} \times 10^7) - (9.7 \times 10^7)$$

$$= (\underline{\hspace{2cm}} - \underline{\hspace{2cm}}) \times 10^7$$

$$= \underline{\hspace{2cm}} \times 10^7$$

$$= \underline{\hspace{2cm}} \times 10^9$$



Solve.

4 Evaluate the expressions.

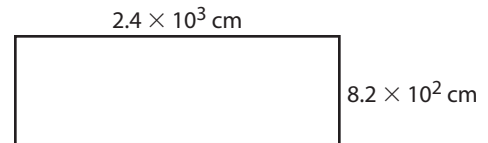
a. $(4.6 \times 10^9) + (1.7 \times 10^7)$ _____

b. $(5.4 \times 10^5) - (1.4 \times 10^4)$ _____

5 Explain one way that you could check your answer to problem 4b.

6 Find the perimeter of the rectangle in scientific notation.

Show your work.



Solution: _____

7 The area of the Southern Ocean is about 7.85×10^6 square miles. The difference between the areas of the Indian Ocean and the Southern Ocean is about 1.865×10^7 square miles. Explain how to find the area of the Indian Ocean. Then find the area.

Multiply Numbers in Scientific Notation

Study the example problem showing how to multiply numbers expressed in scientific notation. Then solve problems 1–8.

Example

Evaluate: $(5.3 \times 10^{-4}) \times (4.8 \times 10^7)$.

$$(5.3 \times 10^{-4}) \times (4.8 \times 10^7)$$

$$= 5.3 \times 4.8 \times 10^{-4} \times 10^7$$

Use the commutative property.

$$= (5.3 \times 4.8) \times (10^{-4} \times 10^7)$$

Use the associative property to group the decimals and group the powers.

$$= 25.44 \times 10^3$$

Multiply.

$$= 2.544 \times 10^4$$

Write in scientific notation.

$$(5.3 \times 10^{-4}) \times (4.8 \times 10^7) = 2.544 \times 10^4$$

- 1** Explain why the product $(10^{-4} \times 10^7)$ in the example problem equals 10^3 and not 10^{-28} .

- 2** Look at the example problem. Estimate the product $(5.3 \times 10^{-4}) \times (4.8 \times 10^7)$ and show your work. Is your solution close to the estimate?

- 3** Estimate the product $0.047 \times (9.2 \times 10^4)$. Then find the product. Is your solution close to your estimate?



Solve.

- 4 Is the value of $(1.7 \times 10^4) \times (2.1 \times 10^{-8})$ greater than 1 or between 0 and 1? Explain your reasoning.

- 5 The thickness of a U.S. penny is 5.98×10^{-2} inch. What is the height of a stack of 2.5×10^4 pennies?

Show your work.

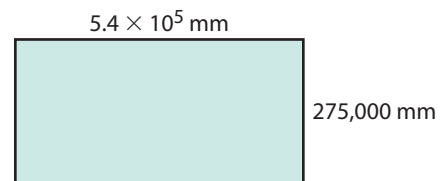
Solution: _____

- 6 The speed of light is about 1.86×10^5 miles per second. How many miles will light travel in 4,200,000 seconds?

- 7 Find the area of the rectangle in scientific notation.

- 8 A container at a paper clip factory holds 2.1×10^3 pounds of paper clips. There are 9.6×10^5 paper clips in the container. Find the approximate weight of each paper clip in ounces. (1 pound = 16 ounces)

Show your work.



Solution: _____

Operations and Scientific Notation

Solve the problems.

- 1 A glass marble factory produces 4.5×10^4 marbles in 1,800 minutes. What is the factory's unit rate of production in marbles per minute? Write the answer in scientific notation.

Show your work.

Which operation do you need to use to solve this problem?



Solution: _____

- 2 Jason incorrectly simplified the expression $(4.7 \times 10^2) \times (6.2 \times 10^4)$. Circle each step that shows an error. Then correct each of those steps so that the expression is correctly simplified.

- A **Step 1.** $4.7 \times 6.2 \times 10^2 \times 10^4$ _____
- B **Step 2.** $(4.7 \times 6.2) \times (10^2 \times 10^4)$ _____
- C **Step 3.** 29.14×10^8 _____
- D **Step 4.** 2.914×10^6 _____

How do you multiply powers of 10?



- 3 Which is the **best** estimate for the product of 3.1×10^4 and 4.85×10^{-2} ?

- A 1.5×10^{-8}
- B 1.2×10^{-8}
- C 1.2×10^3
- D 1.5×10^3



Solve.

4 The area of Asia is about 44,600,000 square kilometers. The area of Europe is about 9.94×10^6 square kilometers. What is the combined area of Asia and Europe?

- A** 1.44×10^6 square kilometers
- B** 5.454×10^6 square kilometers
- C** 1.44×10^7 square kilometers
- D** 5.454×10^7 square kilometers

Marta chose **B** as the correct answer. How did she get that answer?

How would you express the area of Asia in scientific notation?



5 Evaluate: $\frac{5.6 \times 10^6 - 340,000}{2 \times 10^3}$

Show your work.

When you divide two powers with the same base, what do you do with the exponents?



Solution: _____