

# Introduction to Scientific Notation

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Score: \_\_\_\_\_ / 17

Have you ever wondered how scientists write numbers like the distance to the Sun (150,000,000  $km$ ) or the width of a human hair (0.00007  $m$ ) without running out of room? The answer is **scientific notation**: a compact form  $a \times 10^n$  where  $1 \leq a < 10$  and  $n$  is an integer. To convert a big number, slide the decimal left until one non-zero digit remains; the number of places you slid becomes the positive exponent. For a tiny number, slide right instead, and the exponent is negative. Once you feel comfortable with powers of ten, you will be able to switch between standard form and scientific notation quickly—and you will see why scientists, engineers, and astronomers rely on it every single day.

## Key Concepts & Quick Review

**Form:**  $a \times 10^n$ , where  $1 \leq a < 10$  and  $n$  is an integer.

**Powers of ten:**

$10^1$	$10^2$	$10^3$	$10^4$	$10^5$	$10^6$
10	100	1,000	10,000	100,000	1,000,000

**Large numbers** use a **positive** exponent:  $45,000 = 4.5 \times 10^4$ .

**Small numbers** use a **negative** exponent:  $0.0032 = 3.2 \times 10^{-3}$ .

**Comparing:** Same exponent  $\Rightarrow$  compare  $a$  values. Different exponents  $\Rightarrow$  the larger exponent is the larger number (for positives).

## Examples

① Write 6,370,000 in scientific notation.

**Think It Through:** Move the decimal point left until you have a number between 1 and 10.  $6,370,000 \rightarrow 6.37$ ; the decimal moved 6 places to the left, so the exponent is 6.

**Answer:**  $6.37 \times 10^6$

② Which is larger:  $3.8 \times 10^5$  or  $9.1 \times 10^4$ ?

**Think It Through:** Compare the exponents first.  $10^5$  is ten times as large as  $10^4$ , so  $3.8 \times 10^5 = 380,000$  and  $9.1 \times 10^4 = 91,000$ . Since  $380,000 > 91,000$ , the first number is larger.

**Answer:**  $3.8 \times 10^5$

## Practice Problems

Convert between standard form and scientific notation.



- |                               |                                  |
|-------------------------------|----------------------------------|
| 1. 5,200 = _____              | 9. $8.1 \times 10^{-2} =$ _____  |
| 2. 89,000 = _____             | 10. $3.56 \times 10^4 =$ _____   |
| 3. 340,000 = _____            | 11. $6.003 \times 10^6 =$ _____  |
| 4. 7,000,000 = _____          | 12. $1.9 \times 10^{-4} =$ _____ |
| 5. 0.006 = _____              | 13. 42,500 = _____               |
| 6. 0.00045 = _____            | 14. 0.078 = _____                |
| 7. $2.7 \times 10^3 =$ _____  | 15. $9.99 \times 10^2 =$ _____   |
| 8. $5.04 \times 10^5 =$ _____ |                                  |

### Study Tips

-  The coefficient  $a$  must satisfy  $1 \leq a < 10$ . If your coefficient is 10 or more, move the decimal one more place and add 1 to the exponent.
-  Moving the decimal to the **left** makes the exponent **positive**; moving it to the **right** makes the exponent **negative**.
-  To compare two numbers in scientific notation, first compare exponents, then compare coefficients only if the exponents are equal.

### Word Problems

16. The distance from the Earth to the Sun is approximately 93,000,000 *mi*. Write this distance in scientific notation. A light-year is about  $5.88 \times 10^{12}$  *mi*. How many times larger is a light-year than the Earth-to-Sun distance? \_\_\_\_\_
17. A red blood cell measures about 0.000007 *m* across. Write this measurement in scientific notation. A grain of sand measures about  $5 \times 10^{-4}$  *m*. Approximately how many red blood cells placed side by side would equal the width of one grain of sand? \_\_\_\_\_



## Answer Keys

- |   |   |
|---|---|
| <p>1) <math>5.2 \times 10^3</math></p> <p>2) <math>8.9 \times 10^4</math></p> <p>3) <math>3.4 \times 10^5</math></p> <p>4) <math>7 \times 10^6</math></p> <p>5) <math>6 \times 10^{-3}</math></p> <p>6) <math>4.5 \times 10^{-4}</math></p> <p>7) 2,700</p> <p>8) 504,000</p> <p>9) 0.081</p> | <p>10) 35,600</p> <p>11) 6,003,000</p> <p>12) 0.00019</p> <p>13) <math>4.25 \times 10^4</math></p> <p>14) <math>7.8 \times 10^{-2}</math></p> <p>15) 999</p> <p>16) <math>9.3 \times 10^7</math> mi; about 63,226 times larger</p> <p>17) <math>7 \times 10^{-6}</math> m; about 71 red blood cells</p> |
|---|---|

### Step-by-Step Explanations

**Strategy:** For Introduction to Scientific Notation, use scientific notation to show size clearly: keep one nonzero digit before the decimal and count how many places the decimal moves. Keep the scientific-notation setup visible so the arithmetic has something solid to follow.

**Practice 1:** 5,200 = **Answer:**  $5.2 \times 10^3$

In the first example, move the decimal and count places; positive powers make the number larger, while negative powers make it smaller.

**Practice 15:**  $9.99 \times 10^2 =$  **Answer:** 999

Toward the end, move the decimal and count places; positive powers make the number larger, while negative powers make it smaller.

**Word-problem notes:**

**16. Answer:**  $9.3 \times 10^7$  mi; a light-year is about 63,226 times larger.

Move the decimal 7 places:  $93,000,000 = 9.3 \times 10^7$ . Divide:  $\frac{5.88 \times 10^{12}}{9.3 \times 10^7} = \frac{5.88}{9.3} \times 10^{12-7} \approx 0.632 \times 10^5 = 6.32 \times 10^4 \approx 63,200$  times.

**17. Answer:**  $7 \times 10^{-6}$  m; about 71 red blood cells.

$0.000007 = 7 \times 10^{-6}$  m.  $\frac{5 \times 10^{-4}}{7 \times 10^{-6}} = \frac{5}{7} \times 10^{-4-(-6)} = \frac{5}{7} \times 10^2 \approx 0.714 \times 100 \approx 71$  cells.



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