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 ⇒ compare a values. Different exponents ⇒ 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. $6{,}370{,}000 \to 6.37$; the decimal moved 6 places to the left, so the exponent is 6.

Answer: 6.37×10^6

② Which is larger: 3.8×10^5 or 9.1×10^4?

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: 3.8×10^5

Practice Problems

Convert between standard form and scientific notation.

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

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

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

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:** 5.2×10^3

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: $\frac{5.88\times10^{12}}{9.3\times10^7} = \frac{5.88}{9.3} \times 10^{12-7} \approx 0.632 \times 10^5 = 6.32 \times 10^4 \approx 63{,}200$ times.

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

$0.000007 = 7 \times 10^{-6}\ m$. $\frac{5\times10^{-4}}{7\times10^{-6}} = \frac{5}{7} \times 10^{-4-(-6)} = \frac{5}{7} \times 10^2 \approx 0.714 \times 100 \approx 71$ cells.

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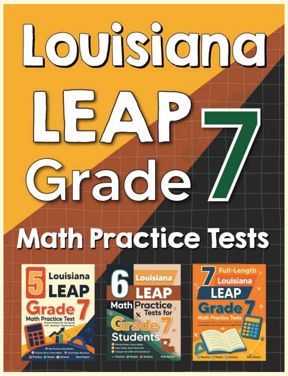

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