Understanding Scientific Notation

Scientific Notation in Measurement and Data

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

Scientific notation stores a coefficient and a power-of-ten scale while retaining the stated unit. A length 0.00034 m becomes 3.4×10^{-4} m; its unit does not change. When comparing measurements, first ensure matching units, then compare complete values. For a design between neighboring powers of ten, choose a coefficient strictly between 1 and 10 and verify both bounds.

Worked example

A model particle is 0.0000047 m wide. Store its width in scientific notation.

1. The power of ten is $10^{-6} = 0.000001$. Multiplying 4.7 by this factor moves the decimal 6 places to the left.

2. The expanded value is $4.7(0.000001) = 0.0000047$. This verifies the equality $4.7 \times 10^{-6} = 0.0000047$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 4.7 < 10$, so 4.7×10^{-6} is normalized scientific notation. The exponent -6 records the scale, not the number of written zeros.

Answer: 4.7×10^{-6} meters.

Practice Problems

Show your thinking.

1. A model distance is 149000000 km. Encode the distance in scientific notation.

2. A fiber diameter is 0.000024 m. Write this measurement in scientific notation.

3. A counter records 3.6×10^{6} events. Write the count in ordinary decimal notation.

4. A scale unit equals 7.5×10^{-4} g. Write the unit mass as a decimal in grams.

5. Design one whole-number data count strictly between 10^{7} and 10^{8}. Give it in normalized scientific and decimal forms.

6. Two sensors have resolutions 8×10^{-5} m and 1.2×10^{-4} m. A smaller value is finer. Choose the finer sensor.

7. A label says a cell is 0.0000062 m long, but its scientific entry is 6.2×10^{-5} m. Repair the entry.

8. A database stores a count as coefficient 4.03 and exponent 8. Recover the count and decide if it exceeds 400000000.

9. Design a length strictly between 0.001 and 0.01 m whose normalized coefficient is 6.5. Find its exponent.

10. A project budget is exactly $\$9040000000$. Write the dollar amount in normalized scientific notation.

Answer Key

1. 1.49×10^{8} kilometers.
2. 2.4×10^{-5} meters.
3. 3600000.0 events.
4. 0.00075 grams.
5. For example, $2 \times 10^{7} = 20000000$.
6. The 8×10^{-5} m sensor.
7. 6.2×10^{-6} m.
8. 403000000; yes.
9. 6.5×10^{-3} m.
10. 9.04×10^{9} dollars.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The power of ten is $10^{8} = 100000000$. Multiplying 1.49 by this factor moves the decimal 8 places to the right.

2. The expanded value is $1.49(100000000) = 149000000.00$. This verifies the equality $1.49 \times 10^{8} = 149000000.00$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 1.49 < 10$, so 1.49×10^{8} is normalized scientific notation. The exponent 8 records the scale, not the number of written zeros.

Problem 2

1. The power of ten is $10^{-5} = 0.00001$. Multiplying 2.4 by this factor moves the decimal 5 places to the left.

2. The expanded value is $2.4(0.00001) = 0.000024$. This verifies the equality $2.4 \times 10^{-5} = 0.000024$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 2.4 < 10$, so 2.4×10^{-5} is normalized scientific notation. The exponent -5 records the scale, not the number of written zeros.

Problem 3

1. The power of ten is $10^{6} = 1000000$. Multiplying 3.6 by this factor moves the decimal 6 places to the right.

2. The expanded value is $3.6(1000000) = 3600000.0$. This verifies the equality $3.6 \times 10^{6} = 3600000.0$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 3.6 < 10$, so 3.6×10^{6} is normalized scientific notation. The exponent 6 records the scale, not the number of written zeros.

Problem 4

1. The power of ten is $10^{-4} = 0.0001$. Multiplying 7.5 by this factor moves the decimal 4 places to the left.

2. The expanded value is $7.5(0.0001) = 0.00075$. This verifies the equality $7.5 \times 10^{-4} = 0.00075$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 7.5 < 10$, so 7.5×10^{-4} is normalized scientific notation. The exponent -4 records the scale, not the number of written zeros.

Problem 5

1. The allowed endpoints are $10^{7} = 10000000$ and $10^{8} = 100000000$. Choose a normalized coefficient 2, strictly greater than 1 and less than 10.

2. The count $2 \times 10^{7} = 20000000$ is a whole number, and $10000000 < 20000000 < 100000000$. It satisfies both strict design limits.

Problem 6

1. Expand the resolutions in the same unit: $8 \times 10^{-5} = 0.00008$ meter and $1.2 \times 10^{-4} = 0.00012$ meter.

2. Since $0.00008 < 0.00012$, the first sensor resolves a smaller length. Under the stated rule, it is the finer sensor despite having the larger coefficient.

Problem 7

1. Expand the entered value: $6.2 \times 10^{-5} = 0.000062$ meter. It is ten times the label length 0.0000062 meter.

2. Decrease the exponent by 1: $6.2 \times 10^{-6} = 0.0000062$. This keeps the normalized coefficient 6.2 and restores the exact stated measurement.

Problem 8

1. Reconstruct the stored value: $4.03 \times 10^{8} = 4.03(100000000) = 403000000$. Interior zero digits must be retained when moving the decimal.

2. Compare $403000000 > 400000000$. The count exceeds the threshold by 3000000, so the answer is yes without rounding either value.

Problem 9

1. The bounds are 10^{-3} and 10^{-2} meters. Multiplying the lower scale by the required coefficient gives $6.5 \times 10^{-3} = 0.0065$.

2. Check $0.001 < 0.0065 < 0.01$. Thus exponent -3 meets the complete length specification; exponent -2 would instead give 0.065, outside the interval.

Problem 10

1. The power of ten is $10^{9} = 1000000000$. Multiplying 9.04 by this factor moves the decimal 9 places to the right.

2. The expanded value is $9.04(1000000000) = 9040000000.00$. This verifies the equality $9.04 \times 10^{9} = 9040000000.00$ without rounding or changing its size.

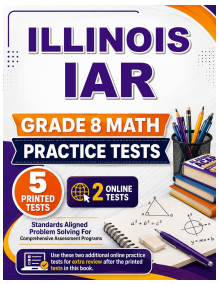
3. The coefficient satisfies $1 \leq 9.04 < 10$, so 9.04×10^{9} is normalized scientific notation. The exponent 9 records the scale, not the number of written zeros.

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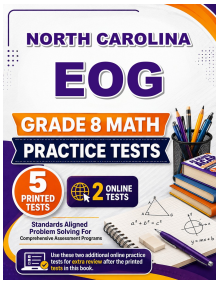
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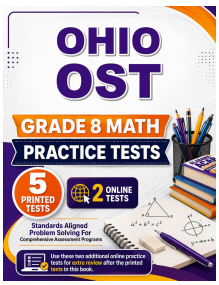
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