Operations with Scientific Notation

Scientific Notation for Quantities and Capacity

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

QUICK REVIEW

Scientific-notation operations model rates, totals, and ratios. Multiply a rate by time for a count; divide a total by equal groups for a group size. Add compatible quantities only when units match. A design must meet its capacity or length target, not merely resemble its exponent. Normalize final results, keep stated units, and use exact given values unless rounding is requested.

Worked example

A system processes 4.8×10^7 bytes in 1.2×10^3 seconds. Find its rate in bytes per second.

1. Coefficients: $4.8 \div 1.2 = 4$. Powers: $10^7 \div 10^3 = 10^{7-(3)} = 10^4$.
2. Combine the coefficient and power: 4×10^4. Next normalize the coefficient.
3. Normalize: 4×10^4, with $1 \leq 4 < 10$. Expanded-value check: 40000.
Answer: 4×10^4 bytes per second.

Practice Problems

Show your thinking.

1. A sensor takes 2.5×10^4 readings per second for 3.2×10^3 seconds. Find the total readings in scientific notation.

2. A file of 6.4×10^8 bytes is split into 8×10^2 equal packets. Find bytes per packet in scientific notation.

3. Two data sets contain 4.6×10^7 and 8×10^6 entries, with no overlap. Find the combined entry count.

4. A wire is 7.2×10^{-2} m long. A piece of 9×10^{-3} m is removed. Find the remaining length.

5. A stack has 2×10^5 sheets, each 1.5×10^{-4} m thick. Ignoring gaps, find total height.

6. A storage target is 9×10^9 bytes. Each unit holds 3×10^7 bytes. How many units meet the target exactly? Give scientific notation and the ordinary count.

7. A sample has mass 5.6×10^{-3} g. Each equal grain has mass 7×10^{-7} g. Find the number of grains.

8. A project needs $(3 \times 10^4)(2 \times 10^2)$ bytes. A drive holds 5×10^6 bytes. Is it sufficient? Find any shortfall.

9. Design equal boxes for 3.6×10^6 beads, using 9×10^2 boxes. How many beads should each box contain?

10. A ribbon segment is 8.1×10^{-5} m long; another is 2.7×10^{-5} m. How many times as long is the first?

Answer Key

1. 8×10^{7} readings.
2. 8×10^{5} bytes per packet.
3. 5.4×10^{7} entries.
4. 6.3×10^{-2} meters.
5. 3×10^{1} meters.
6. 3×10^{2} units. Ordinary count: 300.
7. 8×10^{3} grains.
8. No; shortfall 1×10^{6} bytes.
9. 4×10^{3} beads per box.
10. 3×10^{0} times as long.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Coefficients: $2.5 \cdot 3.2 = 8.00$. Powers: $10^{4} \cdot 10^{3} = 10^{4+(3)} = 10^{7}$.
2. Combine the coefficient and power: 8.00×10^{7}. Next normalize the coefficient.
3. Normalize: 8×10^{7}, with $1 \leq 8 < 10$. Expanded-value check: 80000000.00.

Problem 2

1. Coefficients: $6.4 \div 8 = 0.8$. Powers: $10^{8} \div 10^{2} = 10^{8-(2)} = 10^{6}$.
2. Combine the coefficient and power: 0.8×10^{6}. Next normalize the coefficient.
3. Normalize: 8×10^{5}, with $1 \leq 8 < 10$. Expanded-value check: 800000.0.

Problem 3

1. Align the powers: $4.6 \times 10^{7} = 46.0 \times 10^{6}$; $8 \times 10^{6} = 8 \times 10^{6}$.
2. Combine aligned coefficients: $(46.0 + 8) \times 10^{6} = 54.0 \times 10^{6}$. Keep exponent 6.
3. Normalize: 5.4×10^{7}, with $1 \leq 5.4 < 10$. Expanded-value check: 54000000.0.

Problem 4

1. Align the powers: $7.2 \times 10^{-2} = 72.0 \times 10^{-3}$; $9 \times 10^{-3} = 9 \times 10^{-3}$.
2. Combine aligned coefficients: $(72.0 - 9) \times 10^{-3} = 63.0 \times 10^{-3}$. Keep exponent -3.
3. Normalize: 6.3×10^{-2}, with $1 \leq 6.3 < 10$. Expanded-value check: 0.0630.

Problem 5

1. Coefficients: $1.5 \cdot 2 = 3.0$. Powers: $10^{-4} \cdot 10^{5} = 10^{-4+(5)} = 10^{1}$.
2. Combine the coefficient and power: 3.0×10^{1}. Next normalize the coefficient.
3. Normalize: 3×10^{1}, with $1 \leq 3 < 10$. Expanded-value check: 30.0.

Problem 6

1. Coefficients: $9 \div 3 = 3$. Powers: $10^{9} \div 10^{7} = 10^{9-(7)} = 10^{2}$.
2. Combine the coefficient and power: 3×10^{2}. Next normalize the coefficient.
3. Normalize: 3×10^{2}, with $1 \leq 3 < 10$. Expanded-value check: 300.

Problem 7

1. Coefficients: $5.6 \div 7 = 0.8$. Powers: $10^{-3} \div 10^{-7} = 10^{-3-(-7)} = 10^{4}$.
2. Combine the coefficient and power: 0.8×10^{4}. Next normalize the coefficient.
3. Normalize: 8×10^{3}, with $1 \leq 8 < 10$. Expanded-value check: 8000.0.

Problem 8

1. The required storage is $(3 \cdot 2) \times 10^{4+2} = 6 \times 10^{6}$ bytes. This is the total demand, not the capacity of the drive.
2. Compare $6 \times 10^{6} > 5 \times 10^{6}$. Subtract on the common scale: $(6 - 5) \times 10^{6} = 1 \times 10^{6}$ bytes are missing, so the drive is insufficient.

Problem 9

1. Coefficients: $3.6 \div 9 = 0.4$. Powers: $10^{6} \div 10^{2} = 10^{6-(2)} = 10^{4}$.
2. Combine the coefficient and power: 0.4×10^{4}. Next normalize the coefficient.
3. Normalize: 4×10^{3}, with $1 \leq 4 < 10$. Expanded-value check: 4000.0.

Problem 10

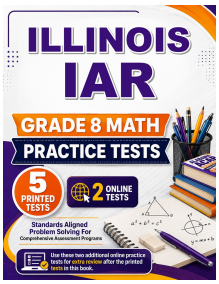
1. Coefficients: $8.1 \div 2.7 = 3$. Powers: $10^{-5} \div 10^{-5} = 10^{-5-(-5)} = 10^{0}$.
2. Combine the coefficient and power: 3×10^{0}. Next normalize the coefficient.
3. Normalize: 3×10^{0}, with $1 \leq 3 < 10$. Expanded-value check: 3.

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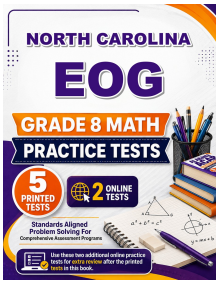
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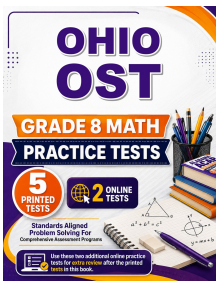
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