Understanding Scientific Notation

Scientific Notation and Place Value

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

QUICK REVIEW

Normalized scientific notation is $a \times 10^n$ with integer n and $1 \le a < 10$ for positive values. A positive exponent represents a large scale; a negative exponent represents a fraction of one. For instance, $2.3 \times 10^4 = 23000$ and $2.3 \times 10^{-4} = 0.00023$. Moving the decimal changes the exponent in the compensating direction so the represented value stays unchanged.

Worked example

Write 0.0000216 in scientific notation.

1. The power of ten is $10^{-5} = 0.00001$. Multiplying 2.16 by this factor moves the decimal 5 places to the left.
2. The expanded value is $2.16(0.00001) = 0.0000216$. This verifies the equality $2.16 \times 10^{-5} = 0.0000216$ without rounding or changing its size.
3. The coefficient satisfies $1 \le 2.16 < 10$, so 2.16×10^{-5} is normalized scientific notation. The exponent -5 records the scale, not the number of written zeros.
Answer: 2.16×10^{-5}

Practice Problems

Show your thinking.

1. Write 640000.0 in scientific notation.

2. Write 0.000308 in scientific notation.

3. Write 9.2×10^7 in standard decimal form.

4. Write 7.05×10^{-3} in standard decimal form.

5. Write 1002000.000 in scientific notation.

6. Write 0.0000045 in scientific notation.

7. Express 8 in normalized scientific notation, including a power of ten.

8. Choose the normalized representation of 5060: 50.6×10^2 or 5.06×10^3. Explain.

9. Order 4.8×10^{-3}, 6.1×10^{-4}, and 2.5×10^{-2} from least to greatest.

10. Write 72×10^4 in normalized scientific notation.

Answer Key

1. 6.4×10^{5}
2. 3.08×10^{-4}
3. 92000000.0
4. 0.00705
5. 1.002×10^{6}
6. 4.5×10^{-6}
7. 8×10^{0}
8. 5.06×10^{3}
9. $6.1 \times 10^{-4} < 4.8 \times 10^{-3} < 2.5 \times 10^{-2}$.
10. 7.2×10^{5}.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The power of ten is $10^{5} = 100000$. Multiplying 6.4 by this factor moves the decimal 5 places to the right.

2. The expanded value is $6.4(100000) = 640000.0$. This verifies the equality $6.4 \times 10^{5} = 640000.0$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 6.4 < 10$, so 6.4×10^{5} is normalized scientific notation. The exponent 5 records the scale, not the number of written zeros.

Problem 2

1. The power of ten is $10^{-4} = 0.0001$. Multiplying 3.08 by this factor moves the decimal 4 places to the left.

2. The expanded value is $3.08(0.0001) = 0.000308$. This verifies the equality $3.08 \times 10^{-4} = 0.000308$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 3.08 < 10$, so 3.08×10^{-4} is normalized scientific notation. The exponent -4 records the scale, not the number of written zeros.

Problem 3

1. The power of ten is $10^{7} = 10000000$. Multiplying 9.2 by this factor moves the decimal 7 places to the right.

2. The expanded value is $9.2(10000000) = 92000000.0$. This verifies the equality $9.2 \times 10^{7} = 92000000.0$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 9.2 < 10$, so 9.2×10^{7} is normalized scientific notation. The exponent 7 records the scale, not the number of written zeros.

Problem 4

1. The power of ten is $10^{-3} = 0.001$. Multiplying 7.05 by this factor moves the decimal 3 places to the left.

2. The expanded value is $7.05(0.001) = 0.00705$. This verifies the equality $7.05 \times 10^{-3} = 0.00705$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 7.05 < 10$, so 7.05×10^{-3} is normalized scientific notation. The exponent -3 records the scale, not the number of written zeros.

Problem 5

1. The power of ten is $10^{6} = 1000000$. Multiplying 1.002 by this factor moves the decimal 6 places to the right.

2. The expanded value is $1.002(1000000) = 1002000.000$. This verifies the equality $1.002 \times 10^{6} = 1002000.000$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 1.002 < 10$, so 1.002×10^{6} is normalized scientific notation. The exponent 6 records the scale, not the number of written zeros.

Problem 6

1. The power of ten is $10^{-6} = 0.000001$. Multiplying 4.5 by this factor moves the decimal 6 places to the left.

2. The expanded value is $4.5(0.000001) = 0.0000045$. This verifies the equality $4.5 \times 10^{-6} = 0.0000045$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 4.5 < 10$, so 4.5×10^{-6} is normalized scientific notation. The exponent -6 records the scale, not the number of written zeros.

Problem 7

1. The power of ten is $10^{0} = 1$. Multiplying 8 by this factor moves the decimal 0 places to the right.

2. The expanded value is $8(1) = 8$. This verifies the equality $8 \times 10^{0} = 8$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 8 < 10$, so 8×10^{0} is normalized scientific notation. The exponent 0 records the scale, not the number of written zeros.

Problem 8

1. The power of ten is $10^{3} = 1000$. Multiplying 5.06 by this factor moves the decimal 3 places to the right.

2. The expanded value is $5.06(1000) = 5060.00$. This verifies the equality $5.06 \times 10^{3} = 5060.00$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 5.06 < 10$, so 5.06×10^{3} is normalized scientific notation. The exponent 3 records the scale, not the number of written zeros.

Problem 9

1. Expand the values to compare their actual sizes: $4.8 \times 10^{-3} = 0.0048$, $6.1 \times 10^{-4} = 0.00061$, and $2.5 \times 10^{-2} = 0.025$.

2. The decimal order is $0.00061 < 0.0048 < 0.025$. Return to the original labels in that order; larger negative-exponent magnitude means a smaller scale here.

Problem 10

1. The coefficient 72 is too large for normalized notation. Rewrite it as $72 = 7.2 \times 10^{1}$, keeping the same exact value.

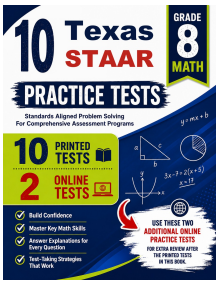
2. Then $(7.2 \times 10^{1}) \times 10^{4} = 7.2 \times 10^{1+4} = 7.2 \times 10^{5}$. The coefficient is now between 1 and 10, and the value remains 720000.

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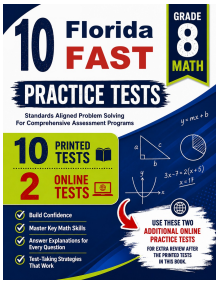
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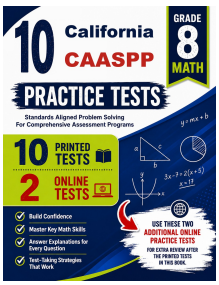
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