Understanding Scientific Notation

Decode and Repair Scientific Notation

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

QUICK REVIEW

Check both value and format. The expressions 32×10^3 and 3.2×10^4 are equal, but only the second is normalized. The coefficient must be at least 1 and strictly below 10. A negative exponent does not mean a negative number. Expand an expression to detect place-value mistakes, preserving interior zeros and comparing complete values rather than coefficients alone.

Worked example

Correct $5030000 = 50.3 \times 10^5$ into normalized scientific notation.

1. The power of ten is $10^6 = 1000000$. Multiplying 5.03 by this factor moves the decimal 6 places to the right.

2. The expanded value is $5.03(1000000) = 5030000.00$. This verifies the equality $5.03 \times 10^6 = 5030000.00$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 5.03 < 10$, so 5.03×10^6 is normalized scientific notation. The exponent 6 records the scale, not the number of written zeros.

Answer: 5.03×10^6

Practice Problems

Show your thinking.

1. Correct the claim $0.000042 = 4.2 \times 10^5$. Give the correct exponent and verify the value.

2. Find n if $20700000 = 2.07 \times 10^n$. Check by expanding.

3. Find a if $0.00000063 = a \times 10^{-7}$ and $1 \leq a < 10$.

4. Correct the normalization $0.56 \times 10^{-3} = 5.6 \times 10^{-2}$.

5. Which is larger: 9.9×10^5 or 1.01×10^6? Explain without rounding.

6. Is 10.0×10^3 normalized scientific notation? Rewrite it correctly.

7. A student expands 3.004×10^{-2} as 0.3004. Correct the decimal, keeping the interior zeros.

8. Find integer n such that $10^n \leq 73000 < 10^{n+1}$. Then write 73000 in scientific notation.

9. Do 45×10^{-6} and 4.5×10^{-5} name the same number? Which is normalized?

10. A student claims scientific notation always needs a positive exponent. Represent 0.81 to give a counterexample.

Answer Key

1. 4.2×10^{-5}
2. $n = 7$
3. $a = 6.3$
4. 5.6×10^{-4}.
5. 1.01×10^{6}.
6. No; 1×10^{4}.
7. 0.03004
8. $n = 4$; 7.3×10^{4}.
9. Yes; only 4.5×10^{-5} is normalized.
10. 8.1×10^{-1}

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The power of ten is $10^{-5} = 0.00001$. Multiplying 4.2 by this factor moves the decimal 5 places to the left.

2. The expanded value is $4.2(0.00001) = 0.000042$. This verifies the equality $4.2 \times 10^{-5} = 0.000042$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 4.2 < 10$, so 4.2×10^{-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 $10^{7} = 10000000$. Multiplying 2.07 by this factor moves the decimal 7 places to the right.

2. The expanded value is $2.07(10000000) = 20700000.00$. This verifies the equality $2.07 \times 10^{7} = 20700000.00$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 2.07 < 10$, so 2.07×10^{7} is normalized scientific notation. The exponent 7 records the scale, not the number of written zeros.

Problem 3

1. The power of ten is $10^{-7} = 0.0000001$. Multiplying 6.3 by this factor moves the decimal 7 places to the left.

2. The expanded value is $6.3(0.0000001) = 0.00000063$. This verifies the equality $6.3 \times 10^{-7} = 0.00000063$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 6.3 < 10$, so 6.3×10^{-7} is normalized scientific notation. The exponent -7 records the scale, not the number of written zeros.

Problem 4

1. Expand the original expression: $0.56 \times 0.001 = 0.00056$. The coefficient must increase by a factor of 10 to become 5.6.

2. To preserve value, decrease the power of ten by one: $5.6 \times 10^{-4} = 0.00056$. The proposed $5.6 \times 10^{-2} = 0.056$ is 100 times too large.

Problem 5

1. Expand the two values: $9.9 \times 10^{5} = 990000$ and $1.01 \times 10^{6} = 1010000$. Both expressions are already normalized.

2. Compare $990000 < 1010000$. The second value is larger even though its coefficient is smaller, because its power-of-ten scale is ten times as large.

Problem 6

1. The coefficient condition is $1 \leq a < 10$, so 10.0 fails the strict upper limit even though the expression has a power of ten.

2. Rewrite $10.0 = 1 \times 10^{1}$. Then $(1 \times 10^{1}) \times 10^{3} = 1 \times 10^{4}$, which is normalized and still equals 10000.

Problem 7

1. The power of ten is $10^{-2} = 0.01$. Multiplying 3.004 by this factor moves the decimal 2 places to the left.

2. The expanded value is $3.004(0.01) = 0.03004$. This verifies the equality $3.004 \times 10^{-2} = 0.03004$ without rounding or changing its size.

3. The coefficient satisfies $1 \leq 3.004 < 10$, so 3.004×10^{-2} is normalized scientific notation. The exponent -2 records the scale, not the number of written zeros.

Problem 8

1. The consecutive powers are $10^{4} = 10000$ and $10^{5} = 100000$. Since $10000 \leq 73000 < 100000$, the required exponent is $n = 4$.

2. Divide 73000 by 10000 to obtain coefficient 7.3. Thus $73000 = 7.3 \times 10^{4}$, with coefficient inside the normalized range.

Problem 9

1. Expand both: $45 \times 0.000001 = 0.000045$ and $4.5 \times 0.00001 = 0.000045$. The expressions therefore have identical values.

2. The coefficient 45 is not below 10, while 4.5 satisfies $1 \leq 4.5 < 10$. Only the second expression is normalized scientific notation.

Problem 10

1. The power of ten is $10^{-1} = 0.1$. Multiplying 8.1 by this factor moves the decimal 1 places to the left.

2. The expanded value is $8.1(0.1) = 0.81$. This verifies the equality $8.1 \times 10^{-1} = 0.81$ without rounding or changing its size.

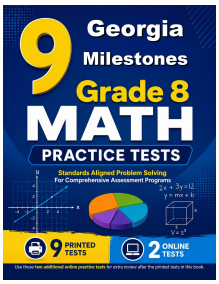
3. The coefficient satisfies $1 \leq 8.1 < 10$, so 8.1×10^{-1} is normalized scientific notation. The exponent -1 records the scale, not the number of written zeros.

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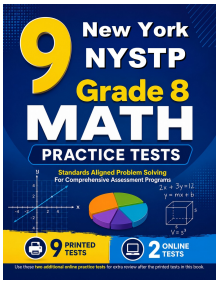
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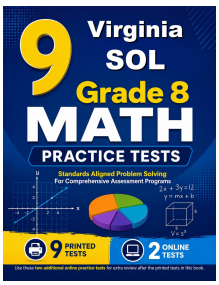
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