Introduction to Scientific Notation

Apply the skill to decisions and designs

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

QUICK REVIEW

Scientific notation has the form $a \times 10^n$ with $1 \le a < 10$ for positive values. $720 = 7.2 \times 10^2$ and $0.072 = 7.2 \times 10^{-2}$. A negative exponent means a small positive number, not a negative measurement.

Worked example

Write 0.0635 in scientific notation.

1. Shift the decimal two places right to get 6.35, a coefficient between 1 and 10.
2. Compensate with two factors of $1/10$: $10^{-2} = 0.01$.
3. Check $6.35(0.01) = 0.0635$.
Answer: 6.35×10^{-2}.

Practice Problems

Show your thinking.

1. A measurement is $\frac{21}{5} \times 10^4$ m. A second is $\frac{26}{5} \times 10^4$ m. Compare them and find their difference in ordinary decimal meters. Show the first value as a sum of place values.

2. A sensor scale unit is 10^{-3} m and the reading is $\frac{13}{2}$ scale units. Write the length in scientific notation and ordinary meters. Convert the reading to millimeters.

3. A measurement is 8×10^5 m. A second is 9×10^5 m. Compare them and find their difference in ordinary decimal meters. Find the ratio of the first value to 10^5 in the same units.

4. A sensor scale unit is 10^{-4} m and the reading is $\frac{5}{4}$ scale units. Write the length in scientific notation and ordinary meters. Recover the exponent from the ordinary value when the coefficient is fixed at 1.25.

5. A measurement is $\frac{31}{10} \times 10^3$ m. A second is $\frac{41}{10} \times 10^3$ m. Compare them and find their difference in ordinary decimal meters. Give the ordinary values when the first value is divided and multiplied by 10.

6. A sensor scale unit is 10^{-2} m and the reading is 9 scale units. Write the length in scientific notation and ordinary meters. Compare the ordinary numerical value with 0.1 and find the difference.

7. Signal record: a length is 2.7×10^6 m. Convert it to millimeters in scientific notation; 1000 mm $= 1$ m.

8. Distance marker: compare lengths 4.8×10^{-5} m and 5.8×10^{-5} m. Find the exact difference.

9. Balance check: a length is 6.25×10^2 m. Convert it to millimeters in scientific notation; 1000 mm $= 1$ m.

10. Reference scale: compare lengths 1.2×10^{-2} m and 2.2×10^{-2} m. Find the exact difference.

Answer Key

1. The second is larger by 10000 m. $4.2(10000) = 4(10000) + 2(1000) = 42000$.
2. 6.5×10^{-3} m, or 0.0065 m. $0.0065(1000) = 6.5$ mm.
3. The second is larger by 100000 m. Ratio $(8 \times 10^5)/10^5 = 8$.
4. 1.25×10^{-4} m, or 0.000125 m. $0.000125/1.25 = 0.0001 = 10^{-4}$, so exponent -4.
5. The second is larger by 1000 m. $3100/10 = 310$ and $3100(10) = 31000$.
6. 9×10^{-2} m, or 0.09 m. $0.1 - 0.09 = 0.01$; the value is smaller by 0.01.
7. 2.7×10^9 mm.
8. Second is larger by 0.00001 m.
9. 6.25×10^5 mm.
10. Second is larger by 0.01 m.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The coefficient 4.2 satisfies $1 \le 4.2 < 10$.
2. $10^4 = 10000$; multiply by 4.2 to obtain 42000.
3. Check: $42000 \div (10000) = 4.2$.
4. Coefficient difference $= \frac{26}{5} - (\frac{21}{5}) = 1$; length difference $= 1(10^4) = 10000$ m.
5. $4.2(10000) = 4(10000) + 2(1000) = 42000$.

Problem 2

1. The coefficient 6.5 satisfies $1 \le 6.5 < 10$.
2. $10^{-3} = 0.001$; multiply by 6.5 to obtain 0.0065.
3. Check: $0.0065 \div (0.001) = 6.5$.
4. $0.0065(1000) = 6.5$ mm.

Problem 3

1. The coefficient 8 satisfies $1 \le 8 < 10$.
2. $10^5 = 100000$; multiply by 8 to obtain 800000.
3. Check: $800000 \div (100000) = 8$.
4. Coefficient difference $= 9 - (8) = 1$; length difference $= 1(10^5) = 100000$ m.
5. Ratio $(8 \times 10^5)/10^5 = 8$.

Problem 4

1. The coefficient 1.25 satisfies $1 \le 1.25 < 10$.
2. $10^{-4} = 0.0001$; multiply by 1.25 to obtain 0.000125.
3. Check: $0.000125 \div (0.0001) = 1.25$.
4. $0.000125/1.25 = 0.0001 = 10^{-4}$, so exponent -4.

Problem 5

1. The coefficient 3.1 satisfies $1 \le 3.1 < 10$.
2. $10^3 = 1000$; multiply by 3.1 to obtain 3100.
3. Check: $3100 \div (1000) = 3.1$.
4. Coefficient difference $= \frac{41}{10} - (\frac{31}{10}) = 1$; length difference $= 1(10^3) = 1000$ m.
5. $3100/10 = 310$ and $3100(10) = 31000$.

Problem 6

1. The coefficient 9 satisfies $1 \le 9 < 10$.
2. $10^{-2} = 0.01$; multiply by 9 to obtain 0.09.
3. Check: $0.09 \div (0.01) = 9$.
4. $0.1 - 0.09 = 0.01$; the value is smaller by 0.01.

Problem 7

1. $10^6 = 1000000$.
2. $2.7(1000000) = 2700000$.
3. Millimeters $= 2700000(1000) = 2700000000 = 2.7 \times 10^9$ mm.

Problem 8

1. $10^{-5} = 0.00001$.
2. $4.8(0.00001) = 0.000048$.
3. Second minus first $= (5.8 - 4.8)(10^{-5}) = 1(10^{-5}) = 0.00001$ m, positive, so the second length is larger.

Problem 9

1. $10^2 = 100$.
2. $6.25(100) = 625$.
3. Millimeters $= 625(1000) = 625000 = 6.25 \times 10^5$ mm.

Problem 10

1. $10^{-2} = 0.01$.
2. $1.2(0.01) = 0.012$.
3. Second minus first $= (2.2 - 1.2)(10^{-2}) = 1(10^{-2}) = 0.01$ m, positive, so the second length is larger.

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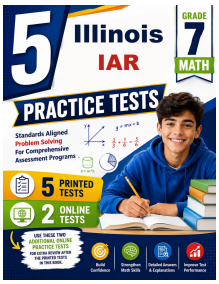

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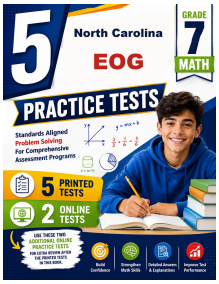

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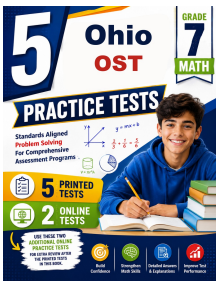

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