Scientific Notation

Name: _____ Date: _____ Score: _____ / 24

Quick Review

A number is in **proper scientific notation** when it's written as $a \times 10^n$ where $1 \leq |a| < 10$ and n is an integer. The coefficient a has exactly one nonzero digit to the left of the decimal point. To convert from standard form, count how many places the decimal needs to move to land in that one-digit-left position. If you started with a *huge* number, the exponent is *positive*. If you started with a tiny decimal (less than 1), the exponent is *negative*. **Multiplying**: multiply the coefficients, *add* the exponents. **Dividing**: divide the coefficients, *subtract* the exponents. **Adding or subtracting**: first match the powers of 10, then add/subtract the coefficients (the exponent comes along for the ride). If your final coefficient drifts out of $[1, 10)$, renormalize by shifting one more place and adjusting the exponent.

PRACTICE

Convert, compute, or compare. Final answers in scientific notation unless noted.

1. Write 0.00000042 in scientific notation. _____

2. The table lists several numbers in scientific notation and their standard forms, but one row is blank. Fill in the standard form of 4.06×10^5. _____

scientific notation	standard form
4.06×10^3	$4{,}060$
4.06×10^4	$40{,}600$
4.06×10^5	?

3. $(3.2 \times 10^5)(2.5 \times 10^{-3})$ _____

4. $\dfrac{8.4 \times 10^{-2}}{2.1 \times 10^4}$ _____

5. $(4.8 \times 10^6) + (1.3 \times 10^5)$ _____

6. $(6.80 \times 10^9) - (4.25 \times 10^9)$ _____

7. $(3.0 \times 10^1)(4.2 \times 10^4)$ _____

8. $\dfrac{5.97 \times 10^{24}}{7.35 \times 10^{22}}$ (to nearest whole) _____

9. Is 12.3×10^{-2} proper scientific notation? _____

10. Is 0.45×10^6 proper scientific notation? _____

11. The table lists four measured masses (in kg). Using the table, which object has the smallest mass? _____

object	mass (kg)
A	5.23×10^{-4}
B	5.23×10^{-2}
C	9.10×10^{-4}
D	1.20×10^{-3}

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12. The table shows three distances in meters. Using the table, write the distance to the nearest star in proper scientific notation. _____

object	distance (m)
to the Moon	3.8×10^8
to the Sun	1.5×10^{11}
to nearest star	$40{,}000{,}000{,}000{,}000{,}000$

13. $(2.0 \times 10^3)(4.5 \times 10^6)$ _____

14. $\dfrac{6.0 \times 10^8}{1.5 \times 10^2}$ _____

15. $(5.0 \times 10^4)^2$ _____

16. $(7.2 \times 10^{-3})(2.5 \times 10^{-2})$ _____

17. Write 0.000000901 in scientific notation. _____

18. Write 4.5×10^{-3} in standard form. _____

19. $(9.0 \times 10^5) + (3.0 \times 10^5)$ _____

20. $\dfrac{2.4 \times 10^{-5}}{8.0 \times 10^2}$ _____

♦ Word Problems

21. Light travels 3.0×10^8 m/s. The Sun is 1.5×10^{11} m away. How many seconds? ____

22. 3.0×10^1 trays hold 4.2×10^4 cells each. How many cells total? ____

23. A file shrinks from 6.80×10^9 bytes to 4.25×10^9 bytes. How many bytes were saved? ____

24. Fine dust is 0.00000042 m across. Write the measure in scientific notation. ____

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Answer Keys

1. $\boxed{4.2 \times 10^{-7}}$
2. $\boxed{406{,}000}$
3. $\boxed{8.0 \times 10^{2}}$
4. $\boxed{4.0 \times 10^{-6}}$
5. $\boxed{4.93 \times 10^{6}}$
6. $\boxed{2.55 \times 10^{9}}$
7. $\boxed{1.26 \times 10^{6}}$
8. $\boxed{81}$
9. $\boxed{\text{no}}$
10. $\boxed{\text{no}}$
11. $\boxed{A}$
12. $\boxed{4 \times 10^{16}}$
13. $\boxed{9.0 \times 10^{9}}$
14. $\boxed{4.0 \times 10^{6}}$
15. $\boxed{2.5 \times 10^{9}}$
16. $\boxed{1.8 \times 10^{-4}}$
17. $\boxed{9.01 \times 10^{-7}}$
18. $\boxed{0.0045}$
19. $\boxed{1.2 \times 10^{6}}$
20. $\boxed{3.0 \times 10^{-8}}$
21. $\boxed{500 \text{ sec}}$
22. $\boxed{1.26 \times 10^{6} \text{ cells}}$
23. $\boxed{2.55 \times 10^{9} \text{ bytes}}$
24. $\boxed{4.2 \times 10^{-7} \text{ m}}$

Step-by-Step Explanations

1. Slide the decimal right until one nonzero digit sits in front of it: 4.2. Count the slides — seven. The original number was tiny (less than 1), so the exponent is negative: 4.2×10^{-7}.

2. Each row down the table slides the decimal one more place right, so the exponent grows by one and a zero gets tacked on. Following the pattern, $4.06 \times 10^{5} = 406{,}000$. (It's easy to stop at $40{,}600$ — that's only four moves.)

3. One steady path is: Coefficients multiply: $3.2 \cdot 2.5 = 8.0$. Exponents add: $5 + (-3) = 2$. That gives a quick check on the answer.

4. Coefficients divide: $8.4 \div 2.1 = 4.0$. Exponents subtract (top minus bottom): $-2 - 4 = -6$. The negative exponent makes sense — we divided a small number by a big one.

5. Match the exponents before adding. Rewrite 1.3×10^{5} as 0.13×10^{6}. Now the powers line up: $4.8 + 0.13 = 4.93$, so 4.93×10^{6}.

6. Exponents already match, so just subtract the coefficients: $6.80 - 4.25 = 2.55$. Keep the 10^{9}.

7. Multiply: $3.0 \cdot 4.2 = 12.6$. Add exponents: $1 + 4 = 5$. That gives 12.6×10^{5}, but 12.6 is too big for proper form. Slide the decimal one more place: 1.26×10^{6}.

8. Coefficients: $\frac{5.97}{7.35} \approx 0.812$. Exponents subtract: $24 - 22 = 2$. That's $0.812 \times 10^{2} = 81.2$, so about 81. (Earth is roughly 81 times the Moon's mass.)

9. The coefficient $|12.3| \geq 10$ is too big. Proper form needs $1 \leq |a| < 10$. Renormalize to 1.23×10^{-1}.

10. Keep the rule visible: The coefficient $|0.45| < 1$ is too small. Renormalize to 4.5×10^{5}. That gives a quick check on the answer.

11. With negative exponents, the more negative the exponent, the smaller the number. The smallest exponent here is -4, shared by A and C; between those two compare the coefficients, and $5.23 < 9.10$. So object A at 5.23×10^{-4} kg is the lightest.

12. Read the last entry as a standard-form number and slide the decimal left until one nonzero digit sits in front: that lands at 4. Count the moves — 16 of them. The number is huge, so the exponent is positive: 4×10^{16}.

13. Multiply the coefficients and add the exponents: $2.0 \cdot 4.5 = 9.0$ and $3 + 6 = 9$. The coefficient 9.0 is already between 1 and 10, so 9.0×10^{9} is in proper form.

14. Keep the rule visible: Coefficients: $6.0 \div 1.5 = 4.0$. Exponents: $8 - 2 = 6$. This is the part to check before moving on, because it keeps the answer tied to the original question.

15. Square each part. $(5.0)^{2} = 25$ and $(10^{4})^{2} = 10^{8}$. So 25×10^{8}, which renormalizes to 2.5×10^{9}.

16. Start with the key idea: $7.2 \cdot 2.5 = 18$, and $-3 + (-2) = -5$. That's $18 \times 10^{-5} = 1.8 \times 10^{-4}$. That gives a quick check on the answer.

17. Decimal moves seven places right to reach 9.01. Tiny number $\Rightarrow$ negative exponent.

18. Negative exponent of 3 means slide three places left from 4.5. Pad with zeros: 0.0045.

19. Exponents match, so coefficients add: $9.0 + 3.0 = 12.0$. That gives 12.0×10^{5}, which renormalizes to 1.2×10^{6}.

20. Coefficients: $\frac{2.4}{8.0} = 0.3$. Exponents: $-5 - 2 = -7$. That's $0.3 \times 10^{-7} = 3.0 \times 10^{-8}$.

21. Time equals distance over rate. $t = \frac{1.5 \times 10^{11}}{3.0 \times 10^{8}}$. Coefficients: $1.5 \div 3.0 = 0.5$. Exponents: $11 - 8 = 3$. So $t = 0.5 \times 10^{3} = 500$ seconds. That's a little over eight minutes — the lag every photon takes to reach us.

22. Multiply trays by cells per tray. Coefficients: $3.0 \cdot 4.2 = 12.6$. Exponents: $1 + 4 = 5$. That gives 12.6×10^{5} — but the coefficient is too big for proper form. Slide one more place: 1.26×10^{6} cells.

23. The exponents are already the same, so the coefficients subtract directly: $6.80 - 4.25 = 2.55$. Answer: 2.55×10^{9} bytes, or roughly 2.55 billion bytes recovered.

24. Slide the decimal right until exactly one nonzero digit sits in front of it: that lands at 4.2. Count the slides: 7. The original is much less than 1, so the exponent gets a minus sign: 4.2×10^{-7} meters.

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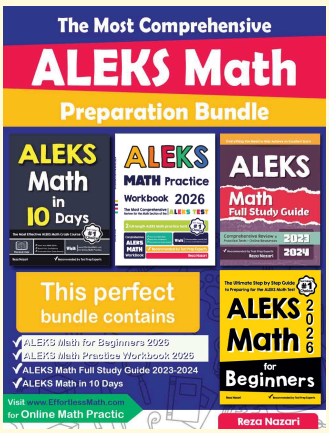

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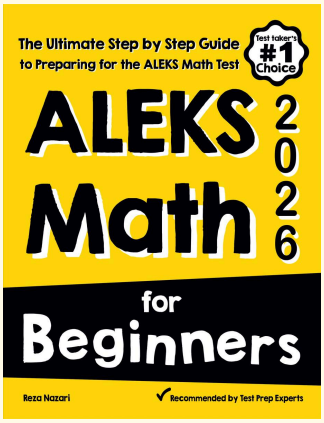

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