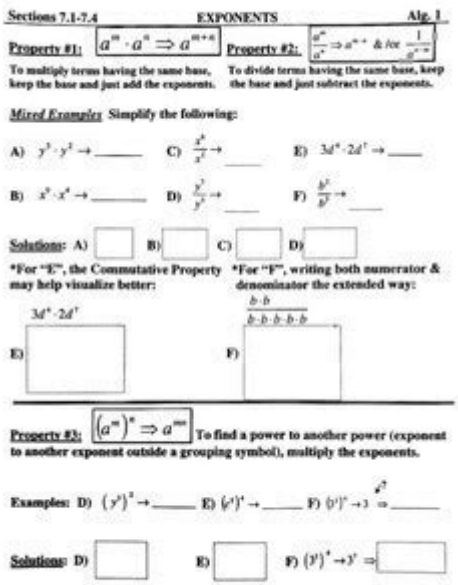
Exponents And Scientific Notation Answer Key


Sections 7.1-7.4 EXPONENTS Alg. 1

Property #1: $a^m \cdot a^n \Rightarrow a^{m+n}$ Property #2: $\frac{a^m}{a^n} \Rightarrow a^{m-n}$ & /or $\frac{1}{a^{n-m}}$

To multiply terms having the same base, keep the base and just add the exponents. To divide terms having the same base, keep the base and just subtract the exponents.

Mixed Examples Simplify the following:

A) $y^3 \cdot y^2 \rightarrow$ ____ C) $\frac{x^6}{x^2} \rightarrow$ ____ E) $3d^4 \cdot 2d^3 \rightarrow$ ____

B) $x^5 \cdot x^4 \rightarrow$ ____ D) $\frac{y^7}{y^3} \rightarrow$ ____ F) $\frac{b^2}{b^5} \rightarrow$ ____

Solutions: A) B) C) D)

*For "E", the Commutative Property may help visualize better:

$3d^4 \cdot 2d^3$

E)

*For "F", writing both numerator & denominator the extended way:

$\frac{b \cdot b}{b \cdot b \cdot b \cdot b \cdot b}$

F)

Property #3: $(a^m)^n \Rightarrow a^{mn}$ To find a power to another power (exponent to another exponent outside a grouping symbol), multiply the exponents.

Examples: D) $(y^3)^2 \rightarrow$ ____ E) $(e^4)^3 \rightarrow$ ____ F) $(y^3)^3 \rightarrow 3^{e^2} \Rightarrow$ ____

Solutions: D) E) F) $(y^3)^3 \rightarrow y^{\square} \Rightarrow$

Exponents and Scientific Notation Answer Key

Exponents and scientific notation are fundamental concepts in mathematics, particularly in fields such as science and engineering where they simplify complex calculations and provide clarity in expressing large or small numbers. Understanding how to use exponents and scientific notation effectively is crucial for students, professionals, and anyone who deals with numerical data. This article will delve into the definitions, rules, applications, and provide a comprehensive answer key to help you master these essential concepts.

Understanding Exponents

Exponents are a way to express repeated multiplication of a number by itself. They are written in the form a^n, where:

- a is the base.
- n is the exponent or power.

For example, 2^3 means 2 multiplied by itself three times: $2 \times 2 \times 2 = 8$.

Properties of Exponents

There are several important properties of exponents that can help simplify expressions:

1. Product of Powers: $a^m \times a^n = a^{m+n}$
- Example: $3^2 \times 3^3 = 3^{2+3} = 3^5 = 243$

2. Quotient of Powers: $\frac{a^m}{a^n} = a^{m-n}$
- Example: $\frac{5^4}{5^2} = 5^{4-2} = 5^2 = 25$

3. Power of a Power: $(a^m)^n = a^{m \cdot n}$
- Example: $(2^3)^2 = 2^{3 \cdot 2} = 2^6 = 64$

4. Power of a Product: $(ab)^n = a^n \times b^n$
- Example: $(2 \times 3)^2 = 2^2 \times 3^2 = 4 \times 9 = 36$

5. Power of a Quotient: $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$
- Example: $\left(\frac{4}{2}\right)^3 = \frac{4^3}{2^3} = \frac{64}{8} = 8$

6. Zero Exponent: $a^0 = 1$, where $a \neq 0$
- Example: $7^0 = 1$

7. Negative Exponent: $a^{-n} = \frac{1}{a^n}$
- Example: $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$

Scientific Notation

Scientific notation is a method of expressing numbers that are too large or too small in a more manageable form. It typically takes the form $N \times 10^n$, where:

- N is a number greater than or equal to 1 and less than 10.
- n is an integer.

For example, the number 4,500 can be expressed in scientific notation as 4.5×10^3.

Converting Between Standard and Scientific Notation

To convert a number from standard form to scientific notation, follow these steps:

1. Identify the first non-zero digit and place the decimal point immediately after it.
2. Count how many places the decimal point has moved to determine n.
- If you moved the decimal to the left, n is positive.
- If you moved the decimal to the right, n is negative.

Example: Convert 0.00056 to scientific notation.
- Step 1: First non-zero digit is 5. Place the decimal after it: 5.6.
- Step 2: Move the decimal 4 places to the right. Thus, $n = -4$.
- Final answer: 5.6×10^{-4}.

To convert from scientific notation to standard form:

1. If n is positive, move the decimal point to the right n times.
2. If n is negative, move the decimal point to the left n times.

Example: Convert 3.2×10^2 to standard notation.
- Step 1: Move the decimal point 2 places to the right.
- Final answer: 320.

Applications of Exponents and Scientific Notation

Exponents and scientific notation are widely used in various fields. Here are some applications:

1. Science: In fields like chemistry and physics, scientific notation is used to express very large numbers, such as the speed of light (approximately 3.00×10^8 m/s), or very small numbers, like the mass of an electron (9.11×10^{-31} kg).

2. Engineering: Engineers use exponents to represent measurements and specifications, often requiring precision and clarity.

3. Finance: In finance, exponents can represent compound interest calculations, where the amount grows exponentially over time.

4. Computing: In computer science, data storage, processing power, and speeds can be expressed in exponential terms.

Practice Problems with Answer Key

To solidify your understanding of exponents and scientific notation, here are some practice problems along with their answers.

Exponents Practice Problems:

1. Simplify $4^3 \times 4^2$.
2. Simplify $\frac{6^5}{6^3}$.
3. Calculate $(5^2)^3$.
4. Evaluate $2^4 \times 2^{-2}$.
5. Simplify $(3 \times 2^2)^2$.

Answers:
1. $4^3 \times 4^2 = 4^{3+2} = 4^5 = 1024$
2. $\frac{6^5}{6^3} = 6^{5-3} = 6^2 = 36$
3. $(5^2)^3 = 5^{2 \cdot 3} = 5^6 = 15625$
4. $2^4 \times 2^{-2} = 2^{4-2} = 2^2 = 4$
5. $(3 \times 2^2)^2 = 3^2 \times (2^2)^2 = 9 \times 4 = 36$

Scientific Notation Practice Problems:

1. Convert 12,000 to scientific notation.
2. Convert 0.00000789 to scientific notation.
3. Express $5.6 \times 10^3 + 3.2 \times 10^3$ in scientific notation.
4. Convert 2.5×10^{-3} to standard notation.
5. Convert 8.9×10^5 to standard notation.

Answers:
1. 1.2×10^4
2. 7.89×10^{-6}
3. 8.8×10^3
4. 0.0025
5. 890000

Conclusion

Understanding exponents and scientific notation is essential for anyone working with numbers in scientific or mathematical contexts. By mastering the rules and properties of exponents and learning how to convert between standard and scientific notation, you can simplify complex calculations and express data clearly and efficiently. With practice, you will be able to tackle a wide range of mathematical problems with confidence.

Frequently Asked Questions

What is the definition of an exponent in mathematics?

An exponent refers to the number of times a base is multiplied by itself. For example, in the expression 2^3, 2 is the base and 3 is the exponent, indicating 2 multiplied by itself three times (2 2 2 = 8).

How do you multiply numbers with the same base using exponents?

To multiply numbers with the same base, you add their exponents. For example, a^m a^n = a^(m+n).

What is scientific notation, and why is it useful?

Scientific notation is a way of expressing numbers that are too large or too small in a more manageable form, using powers of ten. It is written as a × 10^n, where 1 ≤ a < 10 and n is an integer. It's useful for simplifying calculations and clearly representing very large or very small values.

How do you convert a number into scientific notation?

To convert a number into scientific notation, move the decimal point in the number to create a new number between 1 and 10, counting the number of places moved as the exponent of 10. For example, 4500 becomes 4.5 × 10^3.

What are the rules for dividing numbers with exponents?

To divide numbers with the same base, you subtract the exponent of the denominator from the exponent of the numerator. For example, a^m / a^n = a^(m-n).

How do you handle exponents when raising a power to a power?

When raising a power to a power, you multiply the exponents. For example, (a^m)^n = a^(mn).

What is the scientific notation for the number 0.00056?

The scientific notation for 0.00056 is 5.6 × 10^-4.

How can you add or subtract numbers in scientific notation?

To add or subtract numbers in scientific notation, first ensure they have the same exponent. If not, adjust one or both numbers to have a common exponent, then perform the addition or subtraction on the coefficients. Finally, express the result in scientific notation if necessary.

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