Laws of Exponents

Name: _____	Date: _____	Score: _____ / 17

Think of the **laws of exponents** as cheat codes for simplifying—they let you combine or reduce powers without writing out every single factor! The *Product of Powers* rule says add the exponents when you multiply like bases; the *Quotient of Powers* rule says subtract when you divide; and the *Power of a Power* rule says multiply the exponents when one power is raised to another. You will also meet rules for the power of a product, the power of a quotient, the zero exponent, and negative exponents. Learn these shortcuts now and you will breeze through algebra, scientific notation, and any problem where exponents pop up!

Key Concepts & Quick Review

Law	Rule	Example
Product of Powers	$a^m \cdot a^n = a^{m+n}$	$3^2 \cdot 3^4 = 3^6$
Quotient of Powers	$\frac{a^m}{a^n} = a^{m-n}$	$\frac{5^7}{5^3} = 5^4$
Power of a Power	$(a^m)^n = a^{mn}$	$(2^3)^2 = 2^6$
Power of a Product	$(ab)^n = a^n \cdot b^n$	$(4 \cdot 3)^2 = 4^2 \cdot 3^2$
Power of a Quotient	$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$	$\left(\frac{2}{5}\right)^3 = \frac{8}{125}$
Zero Exponent	$a^0 = 1\ (a \neq 0)$	$7^0 = 1$
Negative Exponent	$a^{-n} = \frac{1}{a^n}$	$2^{-3} = \frac{1}{8}$

Examples

① Simplify $\frac{4^5 \cdot 4^2}{4^3}$.

Think It Through: First use the Product of Powers in the numerator: $4^5 \cdot 4^2 = 4^7$. Then use the Quotient of Powers: $\frac{4^7}{4^3} = 4^{7-3} = 4^4 = 256$.

Answer: $4^4 = 256$

② Simplify $(3^2)^3 \cdot 3^{-4}$.

Think It Through: Power of a Power: $(3^2)^3 = 3^6$. Product of Powers: $3^6 \cdot 3^{-4} = 3^{6+(-4)} = 3^2 = 9$.

Answer: $3^2 = 9$

Practice Problems

Simplify each expression using the laws of exponents.

1. $2^3 \cdot 2^4 =$ _____
2. $5^6 \div 5^2 =$ _____
3. $(3^2)^3 =$ _____
4. $(2 \cdot 5)^3 =$ _____
5. $\left(\frac{3}{4}\right)^2 =$ _____
6. $7^0 =$ _____
7. $4^{-2} =$ _____
8. $10^5 \cdot 10^{-3} =$ _____
9. $\frac{6^8}{6^5} =$ _____
10. $(4^3)^2 =$ _____
11. $2^{-4} =$ _____
12. $(3 \cdot 2)^4 =$ _____
13. $\frac{9^4}{9^4} =$ _____
14. $5^3 \cdot 5^{-1} =$ _____
15. $(10^2)^3 =$ _____

Study Tips

- The bases must be the **same** before you can add or subtract exponents. $2^3 \cdot 3^2$ cannot be combined with the Product of Powers rule.
- A **negative exponent** flips the base to a fraction — it does NOT make the answer negative.
- When in doubt, expand the expression to verify your shortcut: $2^3 \cdot 2^2 = (2 \cdot 2 \cdot 2)(2 \cdot 2) = 2^5$.

Word Problems

16. A computer stores data in bits. A kilobyte is 2^{10} bytes and a megabyte is 2^{20} bytes. How many kilobytes are in one megabyte? Express your answer as a power of 2. _____

17. A savings programme triples its value every year. After 2 years the value is 3^2 times the original. After another 4 years, the total is $3^2 \cdot 3^4$ times the original. Use the laws of exponents to write this as a single power and evaluate it. _____

Answer Keys

1) $2^7 = 128$
2) $5^4 = 625$
3) $3^6 = 729$
4) 1,000
5) $\frac{9}{16}$
6) 1
7) $\frac{1}{16}$
8) $10^2 = 100$
9) $6^3 = 216$
10) $4^6 = 4096$
11) $\frac{1}{16}$
12) 1,296
13) 1
14) 25
15) 1,000,000
16) $1{,}024$ kilobytes
17) 729 times the original value

Step-by-Step Explanations

Tutoring notes not found for this topic.

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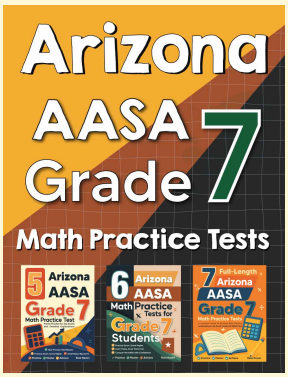

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