

GRADE 8 • COMPLETE UNIT • PREMIUM EDITION

Integer Exponents & Laws of Exponents

Complete Grade 8 Math Unit — Premium Teacher & Student Edition

A premium, classroom-ready resource covering exponent notation, the five core laws of exponents, zero & negative exponents, multi-step simplification, and square & cube roots — with pattern-discovery diagrams, fully worked examples, common-misconception callouts, teaching tips, Try-It practice, drills, assessments, and complete solutions. Designed for both student self-study and teacher classroom delivery.

ALIGNED STANDARDS

CCSS.MATH.CONTENT.8.EE.A.1 • 8.EE.A.2 • 8.EE.A.3

UM Printables

Table of Contents

Standards Alignment, Pacing Guide & How to Use This Resource

Topic 1: Positive Integer Exponents — Review (with diagram)

Topic 2: The Five Laws of Exponents (with visual proofs)

2.1 Product Rule

2.2 Quotient Rule

2.3 Power Rule

2.4 Product to a Power

2.5 Quotient to a Power

Topic 3: Zero and Negative Exponents (with pattern diagram)

Topic 4: Combining the Laws (multi-step simplification)

Topic 5: Square Roots, Cube Roots & Radical Notation (with model)

Student Visual Guided Notes — Law Summary Table & Map

Drill Set A: 45-Problem Exponent Law Simplification (with solutions)

Drill Set B: 25-Problem Zero & Negative Exponents (with solutions)

Drill Set C: 20-Problem Square & Cube Root Equations (with solutions)

Activity: 15-Problem Law Identification (with answer key)

Real-World Context Problems (10, with worked solutions)

Cumulative Unit Review (with solutions)

Unit Quiz (with worked solutions)

Comprehensive Unit Test (with worked solutions)

Review Request

Topic 1: Positive Integer Exponents

TOPIC 1

CCSS 8.EE.A.1, 8.EE.A.3

1.1 Review of Exponent Notation

Exponent notation is a compact way to write repeated multiplication of the same factor. In the expression a^n , the number **a** is the **base** (the repeated factor) and **n** is the **exponent** (the number of times the base is used as a factor). The entire expression a^n is called a **power** and is read "a to the n-th power." The geometric meaning is powerful: a^2 literally represents the **area** of a square with side a, while a^3 represents the **volume** of a cube with edge a — which is why we read them as "a squared" and "a cubed."

DEFINITION: Exponential Notation

For any real number **a** and positive integer **n**:

$$a^n = a \cdot a \cdot a \cdot \dots \cdot a \quad (n \text{ factors of } a)$$

Special names: a^2 = "a squared"; a^3 = "a cubed."

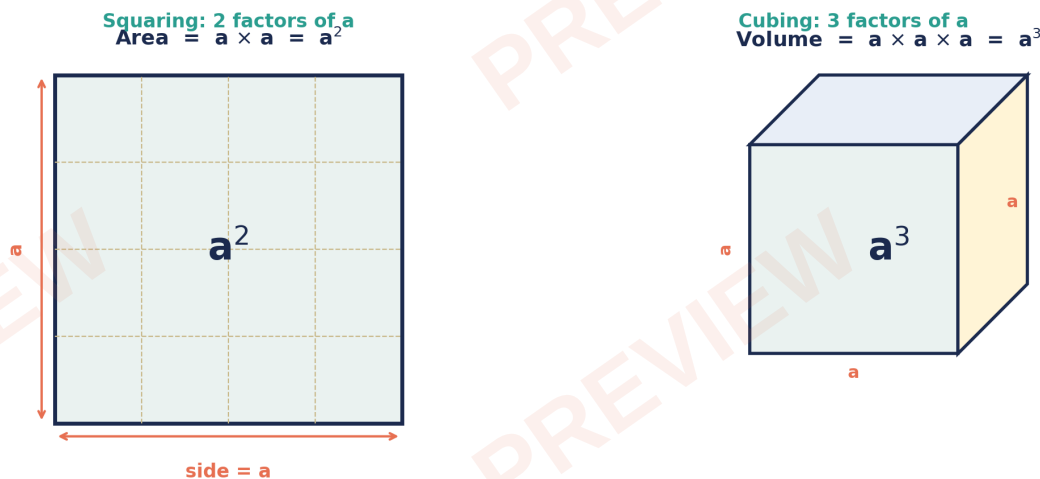


Figure 1.1 — Geometric meaning of a squared (area of a square) and a cubed (volume of a cube).

TEACHING TIP

Open this topic by drawing a 3×3 square on the board and asking students to count the unit squares inside (9). Then ask: "If the side is a, how many unit squares are inside?" The answer " $a \cdot a = a^2$ " lands naturally and motivates the word "squared." Repeat with a $2 \times 2 \times 2$ cube to motivate "cubed." This anchors the abstraction in a physical image students can recall whenever they see an exponent of 2 or 3.

1.2 Evaluating Powers

To evaluate a power, multiply the base by itself the number of times indicated by the exponent. Pay close attention to parentheses: $(-3)^4$ and -3^4 have different values because the placement of parentheses determines whether the negative sign is part of the base or applies after the power is computed.

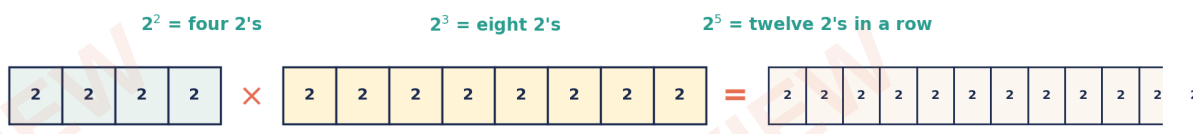
Topic 2: The Five Laws of Exponents

TOPIC 2

CCSS 8.EE.A.1

In this topic, we discover and formalize the five fundamental laws of exponents. Each law allows us to rewrite expressions in equivalent, often simpler, forms. We will use numerical patterns to understand why each law works before applying it to variables. The visual proof below shows the central idea: when multiplying powers of the same base, we are simply counting how many times the base appears as a factor — and counting is just addition.

Product Rule Visual: $2^2 \times 2^3 = 2^{2+3} = 2^5$



Count the factors of 2: $4 + 8 = 12$ factors of 2 $\rightarrow 2^{2+3} = 2^5$

Figure 2.1 — Visual proof of the Product Rule: counting factors of 2 gives $4 + 8 = 12$, so $2^2 \cdot 2^3 = 2^{12}$.

2.1 The Product Rule

When multiplying powers with the **same base**, we can discover a rule for combining the exponents. The key insight is that multiplication of powers is just the concatenation of factor lists — and the total number of factors is the sum of the two counts.

Numerical Pattern	Expanded Form	Result
$2^2 \cdot 2^3$	$(2 \cdot 2) \cdot (2 \cdot 2 \cdot 2)$	2^5
$3^1 \cdot 3^4$	$(3) \cdot (3 \cdot 3 \cdot 3 \cdot 3)$	3^5
$10^4 \cdot 10^2$	$(10 \cdot 10 \cdot 10 \cdot 10) \cdot (10 \cdot 10)$	10^6

THEOREM 1: The Product Rule

For any real number **a** and positive integers **m** and **n**:

$$a^m \cdot a^n = a^{m+n}$$

(To multiply powers with the same base, keep the base and add the exponents.)

Example 2.1 Simplify $x^5 \cdot x^2$.

$$x^5 \cdot x^2 = x^{5+2} \quad (\text{keep base, add exponents})$$

$$= x^7$$

LAW / STEP
PRODUCT RULE

TRY IT YOURSELF

Simplify $a^4 \cdot a^9$.

Answer: a^{13}

Topic 3: Zero and Negative Exponents

TOPIC 3

CCSS 8.EE.A.1

The laws of exponents allow us to extend our definitions to zero and negative exponents. By looking at the pattern of dividing powers with the same base, we can discover what these exponents mean. The big idea is that **mathematical consistency** — not arbitrary definition — forces $5^0 = 1$ and $5^{-1} = 1/5$. If we want the Product and Quotient Rules to keep working for all integers, the new exponents must take these specific values.

3.1 The Zero Exponent

Consider the quotient rule applied to a base divided by itself. We can evaluate this two ways: by arithmetic (any nonzero number divided by itself is 1) and by the quotient rule (subtracting exponents). Setting the two equal forces $5^0 = 1$. The Quotient Rule would break *unless* a^0 equals 1 for every nonzero base a .

Quotient	By Arithmetic	By Quotient Rule
$5^3 \div 5^3$	$125 \div 125 = 1$	$5^{3-3} = 5^0$
$2^4 \div 2^4$	$16 \div 16 = 1$	$2^{4-4} = 2^0$

THEOREM 6: The Zero Exponent

For any nonzero real number a :

$$a^0 = 1$$

(Any nonzero base raised to the zero power is exactly 1.)

Example 3.1 Evaluate 10^0 .

$$10^0 = 1 \text{ (any nonzero number to the 0 power is 1)}$$

$$\text{Verification: } 10^2 \div 10^2 = 100 \div 100 = 1. \text{ (verified)}$$

LAW / STEP
ZERO EXPONENT

TRY IT YOURSELF

Evaluate $(-42)^0 + 7^0$.

Answer: $1 + 1 = 2$

Example 3.2 Evaluate $(-7)^0 + 4^0$.

$$(-7)^0 = 1 \text{ (base is -7)}$$

$$4^0 = 1 \text{ (base is 4)}$$

$$(-7)^0 + 4^0 = 1 + 1$$

$$= 2$$

LAW / STEP
ZERO EXPONENT

COMMON MISCONCEPTION

Two persistent myths about 0^0 : (1) students write $0^0 = 0$, and (2) students write $0^0 = 1$. The honest answer is that 0^0 is **indeterminate** — the rule $a^0 = 1$ applies only when $a \neq 0$. At Grade 8 we simply state: "the base must be nonzero."

Student Visual Guided Notes — The Exponent Law Family

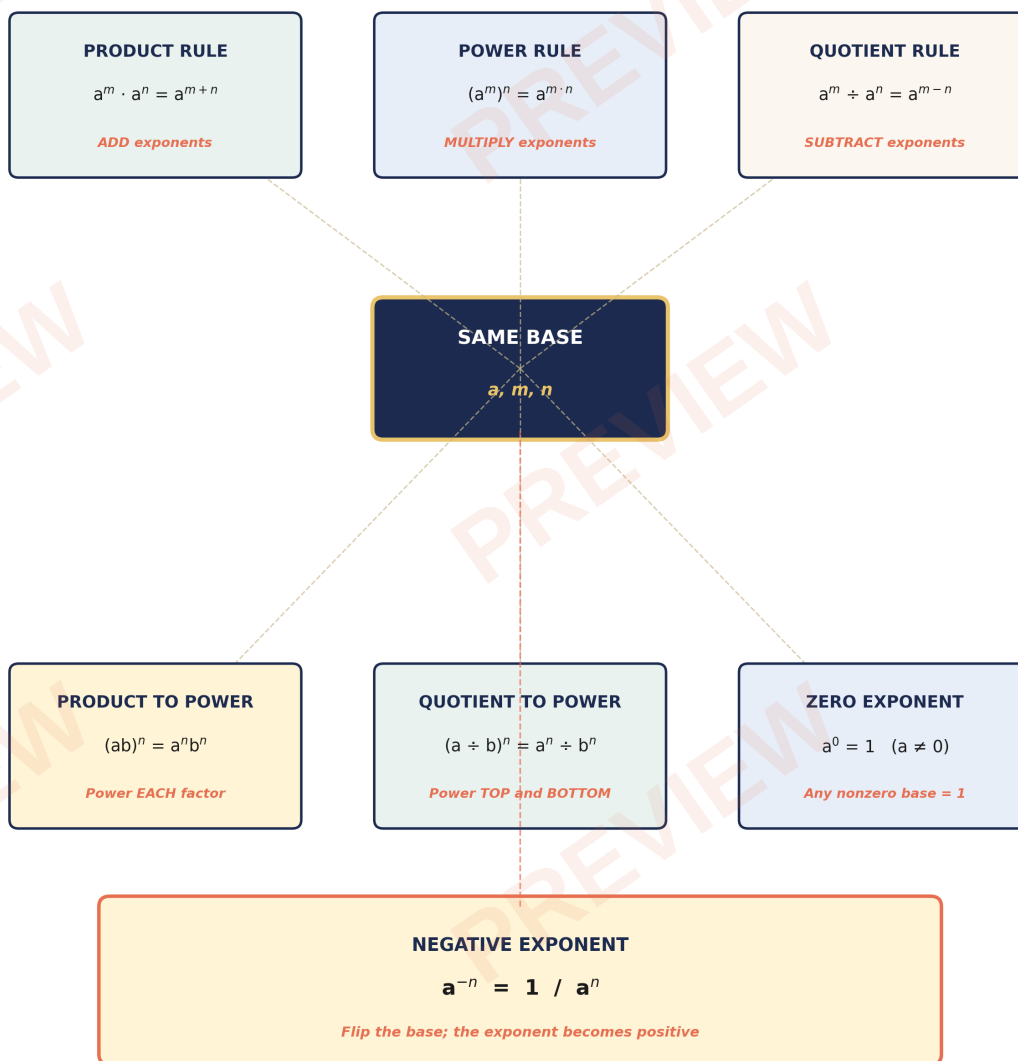
VISUAL MAP

CCSS 8.EE.A.1

This full-page visual map shows all seven exponent laws in one view. The central node reminds you that every law shares the same base a ; the six surrounding nodes give the symbolic rule and a one-line memory hook; the highlighted box at the bottom captures the negative-exponent rule. Use this map as a wall poster or a study-sheet cover.

THE EXPONENT LAW FAMILY

One-Page Visual Map of All Seven Rules



How to read: every law shares the same base a . The five inner laws govern how exponents COMBINE; the two outer laws (Zero, Negative) EXTEND the system to all integers.

Figure 6.1 — The Exponent Law Family: a one-page visual map of all seven rules.

Drill Set A: Exponent Law Simplification

DRILL A

CCSS 8.EE.A.1

Directions: Simplify the following 45 expressions using the laws of exponents. Write all answers with positive exponents. Single-law problems appear first, followed by multi-law combinations.

1. $x^5 \cdot x^7$

2. $y^9 \div y^4$

3. $(a^3)^4$

4. $(2b)^3$

5. $m^2 \cdot m^8$

6. $k^{11} \div k^3$

7. $(c^5)^2$

8. $(3xy)^2$

9. $p^4 \cdot p^2$

10. $z^6 \div z^5$

11. $(x^2y)^4$

12. $(m^3 \div n^2)^5$

13. $(2a^3)^3$

14. $(a^3b^2)^3$

15. $(4x^5)^2$

16. $(r^4 \div s^2)^3$

17. $(2m^2n^3)^4$

18. $(x^5y^2)^3$

19. $(a^7 \div b)^2$

20. $(5c^6)^3$

21. $x^3 \cdot x^4 \cdot x^2$

22. $(x^5 \cdot x^2)^3$

23. $(2x^3)^2 \cdot x^4$

24. $a^5b^3 \div (a^2b)$

25. $(3x^2)^3 \cdot (2x^4)$

26. $x^{12} \div (x^2)^4$

27. $(y^3)^5 \cdot y^2$

28. $(4m^3n^2)^2 \div (2m^2n)^3$

29. $(a^2b)^4 \div (a^3)^2$

30. $(5x^2y)^2 \cdot x^3$

31. $(2x^3 \div y^2)^4$

32. $(3a^2b)^3 \cdot (ab^2)^2$

33. $x^7 \div (x^4 \cdot x^2)$

34. $(m^5n^3) \div (m^2n^4)^2$

35. $(10x^5)^2 \div (5x^3)^3$

36. $(-2x^2y)^3$

37. $(-3a^3b)^2$

38. $(-x^4)^5 \div x^7$

39. $(2/3 \cdot x^2y^3)^2$

40. $(x^4y^2)^3 \div (x^2y)^5$

41. $(4a^3b^2)^3 \div (8a^2b)^2$

42. $(2x^2 \div 3y)^3 \cdot (9y^4 \div 4x)^2$

43. $(m^2n^3)^4 \div (m^3n)^2$

44. $(2x^3y^2)^5 \div (4x^2y)^3$

45. $(3p^4q)^3 \cdot (p^2q^3)^4$

Real-World Context Problems

APPLICATION

CCSS 8.EE.A.1, 8.EE.A.2, 8.EE.A.3

Directions: Apply the laws of exponents, scientific notation, and radicals to solve the following real-world problems. Show your work. Each problem connects an exponent-law skill to a concrete context that students may encounter in science, engineering, or everyday life.

1. A square computer chip has a side length of 3×10^{-3} meters. What is the area of the chip in square meters?

2. A cubic shipping container has a side length of 2×10^2 cm. What is the volume of the container in cubic centimeters?

3. A bacteria culture starts with 10^4 cells. The population triples every hour. What is the population after 3 hours?

4. A high-speed computer can perform 10^9 calculations per second. How many calculations can it perform in 4×10^2 seconds?

5. The distance to a star is 4×10^{13} km. If light travels at 10^7 km per year, how many years does it take light to reach the star?

6. A square garden has an area of 225 square feet. What is the length of each side of the garden?

7. A Rubik's cube has a volume of 216 cubic inches. What is the length of one edge of the cube?

8. The mass of the Earth is approximately 6×10^{24} kg. The mass of a human is about 6×10^1 kg. How many times larger is the Earth's mass than the human's mass?

9. A rectangular park has an area of 8×10^5 square meters and a length of 2×10^2 meters. What is the width of the park?

10. A perfect square solar panel has an area of 9×10^4 square centimeters. What is the length of one side of the panel?

GET THE FULL 43-PAGE UNIT

Integer Exponents & Laws of Exponents

Complete Grade 8 Math Unit — Premium Teacher & Student Edition

WHAT YOU GET IN THE FULL UNIT:

- **43 pages** of classroom-ready content
- **5 Topic Progressions** with Visual Guided Notes
- **6 Custom Diagrams** for visual learners
- **110+ Practice Problems** across 3 drill sets (45 + 25 + 20)
- **Fully Worked Solutions** for every problem, drill, and assessment
- **Teaching Tips & Common Misconceptions** callouts throughout
- **Try-It-Yourself** micro-practice problems with answers
- **Activity, Real-World Problems, Cumulative Review, Quiz, and Unit Test**
- **CCSS-Aligned:** 8.EE.A.1, 8.EE.A.2, 8.EE.A.3

SHOP NOW ON TPT

Search "UM Printables Integer Exponents"

Be sure to follow UM Printables on TPT for more premium math resources!