MATHEMATICS · GRADES 10-12

Exponent laws with rational exponents

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

These are the shortcuts for combining powers that are fractions. Powers like that show up in formulas for growth and decay, where the exponent is not a whole number. The laws let you multiply, divide, and raise them without converting back to roots first. They keep the calculation short and the answer clean.



Rule

Exponent laws: when the bases match, $x^a \times x^b = x^{a+b}$, $x^a \div x^b = x^{a-b}$, and $(x^a)^b = x^{ab}$.

These laws work for fraction exponents too.

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Worked examples

EXAMPLE 1

Q Simplify $x^{\frac{1}{2}} \times x^{\frac{1}{3}}$

SOLUTION

Use the product law: add the exponents.

Add the fractions: $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$

So the result is $x^{\frac{5}{6}}$

EXAMPLE 2

Q Simplify $(x^{\frac{1}{2}})^4$

SOLUTION

Use the power law: multiply the exponents.

Multiply: $(\frac{1}{2}) \times 4 = 2$

So the result is x^2

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Practice questions

1 $x^{\frac{1}{2}} \times x^{\frac{1}{2}}$. Simplify it.

- **A** $x^{\frac{1}{2}}$
- **B** x
- **C** x^2
- **D** $x^{\frac{1}{4}}$

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2 $x^{\frac{2}{3}} \times x^{\frac{2}{3}}$. Simplify it.

- **A** $x^{\frac{4}{3}}$
- **B** $x^{\frac{2}{3}}$
- **C** $x^{\frac{4}{9}}$
- **D** x

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3 Divide $x\frac{3}{4}$ by $x\frac{1}{2}$. Simplify the quotient.

- **A** $x\frac{1}{4}$
- **B** $x\frac{1}{2}$
- **C** $x\frac{3}{8}$
- **D** $x\frac{5}{4}$

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4 $(x\frac{1}{3})^3$. Simplify it.

- **A** x^3
- **B** $x\frac{1}{3}$
- **C** x
- **D** $x\frac{1}{9}$

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5 Divide $x\frac{5}{6}$ by $x\frac{1}{6}$. Simplify the quotient.

- **A** $x\frac{5}{6}$
- **B** $x\frac{2}{3}$
- **C** $x\frac{1}{2}$
- **D** $x\frac{1}{6}$

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6 $(x\frac{1}{2})\frac{1}{2}$. Simplify it.

- **A** $x\frac{1}{4}$
- **B** $x\frac{1}{2}$
- **C** x
- **D** x^2

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7 $x^{\frac{1}{2}} \times x^{\frac{1}{4}}$. Simplify it.

- **A** $x^{\frac{3}{4}}$
- **B** $x^{\frac{1}{8}}$
- **C** $x^{\frac{1}{2}}$
- **D** x

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8 Divide $x^{\frac{1}{4}}$ by $x^{\frac{3}{4}}$. Simplify the quotient.

- **A** $x^{-\frac{1}{2}}$
- **B** $x^{\frac{1}{2}}$
- **C** x^2
- **D** $x^{-\frac{1}{4}}$

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9 $(x\frac{3}{4})^2$. Simplify it.

- **A** $x\frac{3}{4}$
- **B** $x\frac{3}{8}$
- **C** $x\frac{3}{2}$
- **D** x^3

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10 Multiply $x\frac{1}{4}$ by $x\frac{1}{4}$ by $x\frac{1}{4}$ and simplify.

- **A** $x\frac{3}{4}$
- **B** $x\frac{1}{4}$
- **C** $x\frac{3}{16}$
- **D** x

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ANSWER KEY

1. x

2. $x \frac{4}{3}$

3. $x \frac{1}{4}$

4. x

5. $x \frac{2}{3}$

6. $x \frac{1}{4}$

7. $x \frac{3}{4}$

8. $x -\frac{1}{2}$

9. $x \frac{3}{2}$

10. $x \frac{3}{4}$

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