MATHEMATICS · GRADES 7-9

Quotient rule of exponents

Difficulty level: Intermediate

Mathematics: Grades 7-9

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Overview of the concept

This is how you simplify a division of powers into one short power, like working out how many times bigger one file is than another when both sizes are powers of two. A file of 256 megabytes next to one of 32 megabytes is eight times bigger, and writing that as a single power keeps the comparison clean. A scientist comparing two populations that both grow by doubling uses the same shortcut. Dividing powers this way turns a messy division into one short, readable number.



Rule

To divide powers with the same base, $x^a \div x^b = x^{a-b}$. Subtract the exponents.

The base stays the same. For example, $\frac{x^8}{x^3}$ is x^5.

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Worked examples

EXAMPLE 1

Q Simplify $x^8 \div x^3$

SOLUTION

Picture it

Simplify $x^8 \div x^3$

Work it one step at a time, top to bottom.

Check the bases: both are x, so the quotient rule applies.

Subtract the exponents: $8 - 3 = 5$.

So $x^8 \div x^3 = x^5$

EXAMPLE 2

Q Simplify $5^6 \div 5^4$

SOLUTION

Picture it

Simplify $5^6 \div 5^4$

Work it one step at a time, top to bottom.

Check the bases: both are 5, so the quotient rule applies.

Subtract the exponents: $6 - 4 = 2$.

So $5^6 \div 5^4 = 5^2 = 25$

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Practice questions

1 What is $2^9 \div 2^4$ as a single power?

- **A** 2^4
- **B** 2^5
- **C** 2^{13}
- **D** 2^{36}

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2 What is $a^2 \div a^5$ as a single power?

- **A** a^3
- **B** a^{-3}
- **C** a^7
- **D** a^{10}

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3 Which division gives 6^5?

- **A** $6^8 \div 6^3$
- **B** $6^8 \div 6^5$
- **C** $6^3 \div 6^8$
- **D** $6^5 \div 6^3$

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4 Write $5^4 \div 5^4$ as a single power.

- **A** 5^1
- **B** 5^8
- **C** 5^{16}
- **D** 5^0

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5 Maya writes $y^9 \div y^5 = y^{14}$. What is her mistake?

- **A** She added the exponents instead of subtracting
- **B** She subtracted the bases
- **C** She multiplied the exponents
- **D** She divided the exponents

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6 What is $3^7 \div 3^2$ as a number?

- **A** 243
- **B** 27
- **C** 81
- **D** 729

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7 What is $6x^8 \div 2x^3$ as a single term?

- A $3x^5$
- B $4x^5$
- C $3x^{11}$
- D $6x^5$

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8 What is $8^6 \div 8^1$ as a single power?

- A 8^6
- B 8^7
- C 8^1
- D 8^5

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9 What is $b^{10} \div b^4 \div b^2$ as a single power?

- A b^4
- B b^6
- C b^8
- D b^{16}

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10 One file is 4^9 bytes and another is 4^4 bytes. How many times bigger is the first file?

- A 4^5 times
- B 4^{13} times
- C 4^4 times
- D 4^{36} times

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ANSWER KEY

1. 2^5

2. a^{-3}

3. $6^8 \div 6^3$

4. 5^0

5. She added the exponents instead of subtracting

6. 243

7. $3x^5$

8. 8^5

9. b^4

10. 4^5 times

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