MATHEMATICS · GRADES 7-9

Negative exponents

Difficulty level: Intermediate

Mathematics: Grades 7-9

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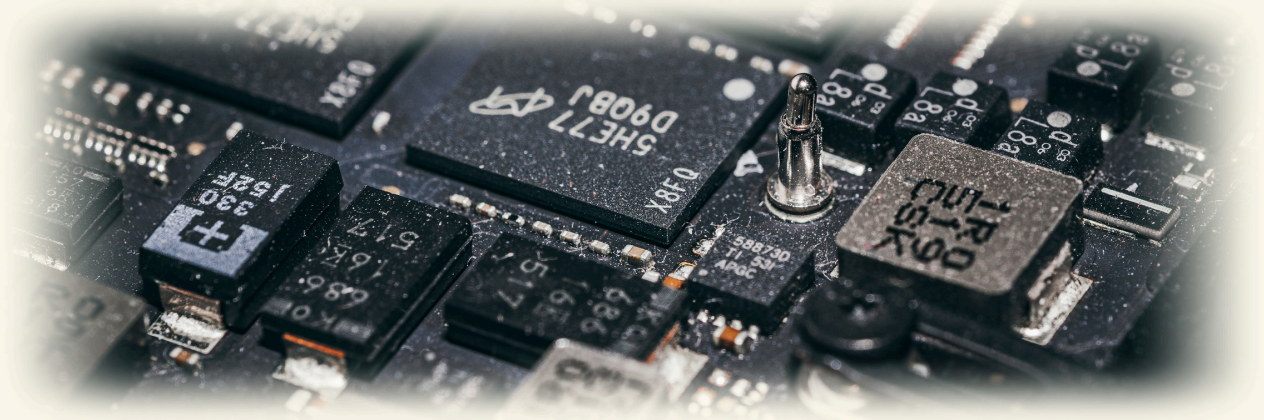
Overview of the concept

This is how you write tiny numbers like the size of a computer chip or a dose of medicine in a short, tidy way instead of a long string of zeros. Scientists write the mass of an atom or the thickness of a sheet of foil this way, because writing out all those zeros would be slow and easy to miscount. A pharmacist reads doses written this way, and an engineer reads the size of a circuit the same way. It is a shorthand that keeps tiny measurements readable and hard to get wrong.



Rule

A negative exponent means take the reciprocal: $a^{-n} = \frac{1}{a^n}$.

A negative exponent never makes the answer negative, it flips the power into a fraction.

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Worked examples

EXAMPLE 1

Q Write 2^{-3} as a fraction

SOLUTION

Picture it

Write 2^{-3} as a fraction

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

With a negative exponent, take the reciprocal of the matching positive power.

Write it as $\frac{1}{2^3} : \frac{1}{(2^3)}$

Work it out: $2^3 = 8$, so $2^{-3} = \frac{1}{8}$

EXAMPLE 2

Q Simplify x^{-2} as a fraction

SOLUTION

Picture it

Simplify x^{-2} as a fraction

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

With a negative exponent, take the reciprocal of the matching positive power.

Write it as $\frac{1}{x^2} : \frac{1}{(x^2)}$

So $x^{-2} = \frac{1}{x^2}$

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Practice questions

1 Write 2^{-3} as a fraction.

- **A** $\frac{1}{2}$
- **B** $\frac{1}{8}$
- **C** $\frac{1}{4}$
- **D** $\frac{1}{16}$

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2 Write $\frac{1}{25}$ as a power with a negative exponent.

- **A** 5^{-2}
- **B** 5^{2}
- **C** 2^{-5}
- **D** -5^{2}

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3 Is 3^{-2} positive or negative?

- A Positive
- B Negative
- C Zero
- D It depends on the base

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4 Write 10^{-3} as a decimal.

- A 0.001
- B 0.01
- C 0.0001
- D -1000

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5 Write $\frac{1}{x^5}$ as a power with a negative exponent.

- **A** x^{-5}
- **B** x^5
- **C** 5^{-x}
- **D** $-x^5$

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6 Write x^{-4} as a fraction.

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

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7 What number is $\frac{1}{3^{-2}}$?

A 9

B $\frac{1}{9}$

C -9

D $\frac{1}{3}$

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8 What number is $(\frac{1}{2})^{-1}$?

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9 **Which is greater, 2^{-2} or 2^{-3}?**

- **A** 2^{-2}
- **B** 2^{-3}
- **C** They are equal
- **D** Cannot tell

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10 **What is the reciprocal of x^{-3}?**

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

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ANSWER KEY

1. $\frac{1}{8}$

2. 5^{-2}

3. Positive

4. 0.001

5. x^{-5}

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

7. 9

8. 2

9. 2^{-2}

10. x^3

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