MATHEMATICS · GRADES 10-12

Solving exponential equations

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you work out how long money takes to double in a savings account, or how long a population takes to grow to a certain size, when the unknown is in the exponent. Growth like this does not add the same amount each year, it multiplies, so the time it takes is hidden in the power. Solving the equation pulls that time out into the open. That is how you answer real questions about savings, loans, and populations that keep growing by a percentage.



Rule

Solving exponential equations: if two powers with the same base are equal, their exponents are equal.

Rewrite both sides as powers of the same base, then set the exponents equal.

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Worked examples

EXAMPLE 1

Q Solve $2^x = 32$

SOLUTION

Rewrite 32 as a power of 2: $32 = 2^5$

Set the exponents equal: $x = 5$

Check: $2^5 = 32$, so $x = 5$

EXAMPLE 2

Q Solve $3^{(x + 1)} = 81$

SOLUTION

Rewrite 81 as a power of 3: $81 = 3^4$

Set the exponents equal: $x + 1 = 4$

Subtract 1: $x = 3$

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Practice questions

1 Solve $2^x = 16$ for x.

- **A** x = 3
- **B** x = 5
- **C** x = 4
- **D** x = 2

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2 Money in an account grows by a factor of 5 each year. After x years it has grown by a factor of 125. How many years is that?

- **A** x = 5
- **B** x = 3
- **C** x = 4
- **D** x = 2

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3 Solve $3^x = 1 \div 27$ for x.

- **A** x = -3
- **B** x = 3
- **C** x = -4
- **D** x = 4

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4 Solve $2^{(x+2)} = 32$ for x.

- **A** x = 2
- **B** x = 4
- **C** x = 3
- **D** x = 5

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5 Solve $4^x = 1$ for x.

- **A** x = 0
- **B** x = 1
- **C** x = 4
- **D** x = -1

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6 A savings account doubles every year. $100 grows to $800. How many years does that take?

- **A** x = 2
- **B** x = 4
- **C** x = 3
- **D** x = 1

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7 Solve $3^{(2x)} = 81$ for x.

- **A** x = 4
- **B** x = 2
- **C** x = 3
- **D** x = 1

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8 Solve $3^{(x-2)} = 9$ for x.

- **A** x = 3
- **B** x = 5
- **C** x = 2
- **D** x = 4

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9 A population triples every day. It starts at 10 and reaches 270. How many days does that take?

- **A** x = 3
- **B** x = 2
- **C** x = 4
- **D** x = 7

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10 Solve $2^x \times 2^3 = 128$ for x.

- **A** x = 4
- **B** x = 2
- **C** x = 5
- **D** x = 3

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ANSWER KEY

1. x = 4

2. x = 3

3. x = -3

4. x = 3

5. x = 0

6. x = 3

7. x = 2

8. x = 4

9. x = 3

10. x = 4

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