MATHEMATICS · GRADES 10-12

Solving logarithmic equations

Difficulty level: Advanced

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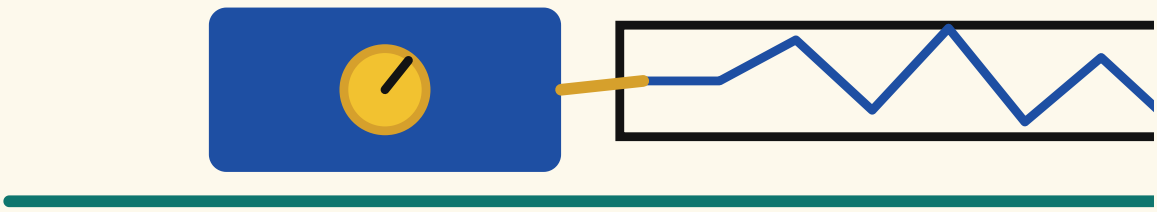
Overview of the concept

This is how you solve equations about sound levels, earthquake strength, or how fast an investment grows, and then check the answer really makes sense before trusting it. Sound, earthquakes, and compound growth are all measured on scales where each step up means a big jump, so logarithms are the natural way to work with them. Solving gives you a candidate answer, but not every candidate is allowed, so you check it against the original problem before you trust it. That check is part of the job, because a number that looks right can still be impossible in real life.



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Worked examples

EXAMPLE 1

Q Solve $\log_2(x) = 5$

SOLUTION

Convert to exponential form: $2^5 = x$.

Work out $2^5 = 32$, so $x = 32$.

Check: $\log_2(32) = 5$, and 32 is positive, so it is valid.

EXAMPLE 2

Q Solve $\log(x) + \log(x - 1) = \log(6)$

SOLUTION

Condense with the product law: $\log(x(x - 1)) = \log(6)$.

Set the arguments equal: $x^2 - x - 6 = 0$, which factors as $(x - 3)(x + 2) = 0$.

Check:

$x = -2$: $x - 1 = -3$, negative, so reject it.

$x = 3$: $x - 1 = 2$, positive, so $x = 3$.

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Practice questions

1 Find x in $\log_2(x) = 4$.

- **A** x = 8
- **B** x = 4
- **C** x = 16
- **D** x = 32

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2 Find x in $\log_3(x) = 3$.

- **A** x = 9
- **B** x = 27
- **C** x = 3
- **D** x = 81

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3 Find x in $\log_{10}(x) = 2$

- A x = 10
- B x = 1000
- C x = 100
- D x = 20

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4 Solve $\log(x) + \log(x - 1) = \log(12)$ and check your answer.

- A x = -3
- B x = 3
- C x = 12
- D x = 4

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5 Solve $\log(x) + \log(x - 2) = \log(8)$ and check your answer.

- **A** $x = 2$
- **B** $x = -2$
- **C** $x = 4$
- **D** $x = 8$

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6 Solve $\log(x) + \log(x + 3) = \log(10)$ and check your answer.

- **A** $x = -5$
- **B** $x = 2$
- **C** $x = 5$
- **D** $x = 10$

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7 Find x in $\log_2(x - 1) = 3$

- **A** x = 7
- **B** x = 8
- **C** x = 9
- **D** x = 3

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8 Find x in $\log(x) = 3$.

- **A** x = 10
- **B** x = 100
- **C** x = 3
- **D** x = 1000

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9 Find x in $\log_5(x) = 2$

- **A** x = 10
- **B** x = 5
- **C** x = 125
- **D** x = 25

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10 Solve $\log_2(x) + \log_2(x - 2) = 3$ and check your answer.

- **A** x = 8
- **B** x = -2
- **C** x = 2
- **D** x = 4

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ANSWER KEY

1. x = 16

2. x = 27

3. x = 100

4. x = 4

5. x = 4

6. x = 2

7. x = 9

8. x = 1000

9. x = 25

10. x = 4

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