MATHEMATICS · GRADES 10-12

Logarithms as inverse exponents

Difficulty level: Advanced

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Overview of the concept

This is how you work backwards from a power to find its exponent, like figuring out how many years it takes savings to double at a fixed interest rate. A logarithm answers the question of how many times you have to multiply to reach a number, which is the reverse of what a power does. You use it to work out how long savings take to double, how loud a sound is on a scale, or how strong an earthquake was from the reading on a seismograph.



Rule

A logarithm asks: to what power must the base be raised to get the number?

So log base b of a = c means $b^c = a$. A logarithm is the inverse of an exponent.

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Worked examples

EXAMPLE 1

Q Evaluate $\log_2(8)$

SOLUTION

Ask: to what power must 2 be raised to get 8?

Work out the powers: $2^1 = 2$, $2^2 = 4$, $2^3 = 8$

So $\log_2(8) = 3$

EXAMPLE 2

Q Evaluate $\log_5(125)$

SOLUTION

Ask: to what power must 5 be raised to get 125?

Work out the powers: $5^1 = 5$, $5^2 = 25$, $5^3 = 125$

So $\log_5(125) = 3$

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Practice questions

1 A bacteria culture doubles until it is 16 times its starting size. How many doublings is that?

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2 What is $\log_2(32)$?

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3 Which exponential equation matches $\log_3(27) = 3$?

- **A** $3^3 = 27$
- **B** $27^3 = 3$
- **C** $3^2 = 27$
- **D** $2^3 = 27$

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4 What is $\log_{10}(1)$?

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5 $\log_5(x) = 3$. What is x?

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6 $\log_b(16) = 2$. What is b?

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7 Which of these logarithms equals 4?

A log3(27)

B log10(1000)

C log2(16)

D log10(100)

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8 A student says logarithms undo exponents. Why is that right?

- **A** It asks what number to add to the base
- **B** A logarithm asks what power the base must be raised to, which undoes raising the base to a power
- **C** It asks what number to multiply the base by
- **D** It asks how many times to add the base to itself

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9 Write $2^5 = 32$ in logarithmic form.

- **A** log2(32) = 5
- **B** log5(32) = 2
- **C** log32(2) = 5
- **D** log2(5) = 32

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10 Three of these logarithms equal 3. Which one does not?

A log2(8)

B log3(27)

C log4(64)

D log10(100)

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ANSWER KEY

1. 4

2. 5

3. $3^3 = 27$

4. 0

5. 125

6. 4

7. log2(16)

8. A logarithm asks what power the base must be raised to, which undoes raising the base to a power

9. log2(32) = 5

10. log10(100)

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