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 timing questions about growth and decay, like when an investment reaches a target or how old a sample is, even when the numbers do not line up neatly. Real growth rarely lands on a round number of years, so the answer is usually not a whole number you can guess. These equations handle that, giving you the exact time even when it falls between whole years. That is what lets you date a sample, plan an investment, or predict when something will run out.



## *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 $2^x = 16$

SOLUTION

Rewrite 16 as a power of 2: $16 = 2^4$

Set the exponents equal: $x = 4$

Check: $2^4 = 16$, so $x = 4$

EXAMPLE 2

**Q** Solve $3^{(x-1)} = 27$

SOLUTION

Rewrite 27 as a power of 3: $27 = 3^3$

Set the exponents equal: $x - 1 = 3$

Add 1: $x = 4$

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## Practice questions

**1** $2^x = 64$. Solve for x.

- **A** x = 5
- **B** x = 7
- **C** x = 6
- **D** x = 8

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**2** $2^{-x} = 8$. Solve for x.

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

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**3** $3^x = 1$. Find x.

- **A** x = 1
- **B** x = 3
- **C** x = 0
- **D** x = -1

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**4** $3^{(x+1)} = 81$. Solve for x.

- **A** x = 4
- **B** x = 3
- **C** x = 2
- **D** x = 9

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**5** $4^x = 16^{(x-1)}$. Solve for x.

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

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**6** $2^x + 2^x = 32$. Find x.

- **A** x = 5
- **B** x = 4
- **C** x = 3
- **D** x = 16

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**7** $2 \times 3^x = 54$. Solve for x.

A x = 3

B x = 2

C x = 6

D x = 9

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**8** $2^{(3x)} = 64$. Find x.

A x = 6

B x = 2

C x = 3

D x = 32

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**9** $2^{(x+1)} = 8^{(x-1)}$. Solve for x.

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

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**10** $9^x = 3^{(x+1)}$. Solve for x.

- **A** x = 2
- **B** x = 3
- **C** x = 0
- **D** x = 1

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## ANSWER KEY

**1.** x = 6

**2.** x = -3

**3.** x = 0

**4.** x = 3

**5.** x = 2

**6.** x = 4

**7.** x = 3

**8.** x = 2

**9.** x = 2

**10.** x = 1

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