MATHEMATICS · GRADES 10-12

Holes in graphs

Difficulty level: Advanced

Mathematics: Grades 10-12

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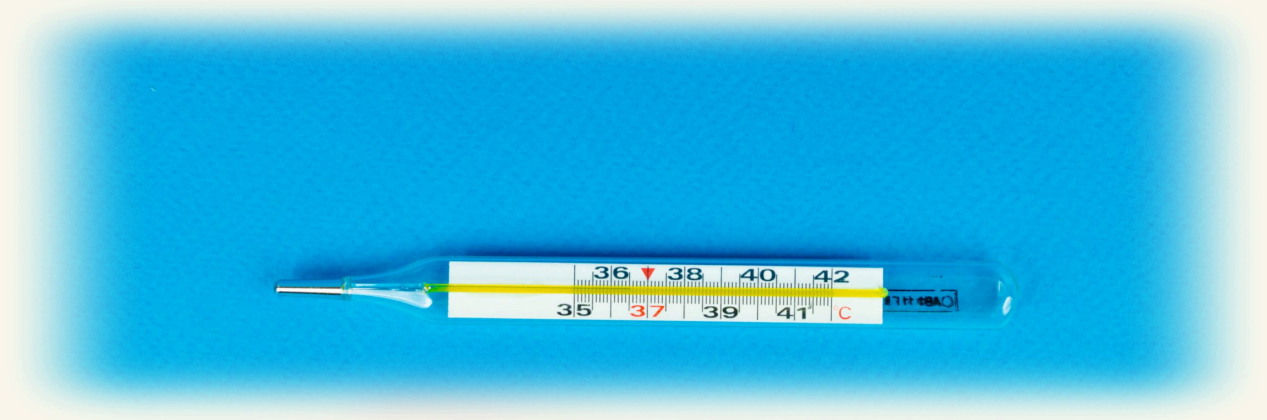
Overview of the concept

This is how you spot the one point missing from an otherwise smooth graph, like a single skipped reading in a set of temperature measurements. Most of the graph follows a clean pattern, but one point is simply not there, and knowing how to spot it keeps you from drawing the wrong conclusion. You meet this when a sensor misses a reading, when a value is undefined in a formula, or when a data set has a gap you need to notice instead of filling in by guesswork.



Rule

Holes in graphs: when a factor cancels from the top and bottom of a fraction, the graph has a hole where that factor is zero.

The hole's x value comes from the cancelled factor, and its y value comes from the simplified form.

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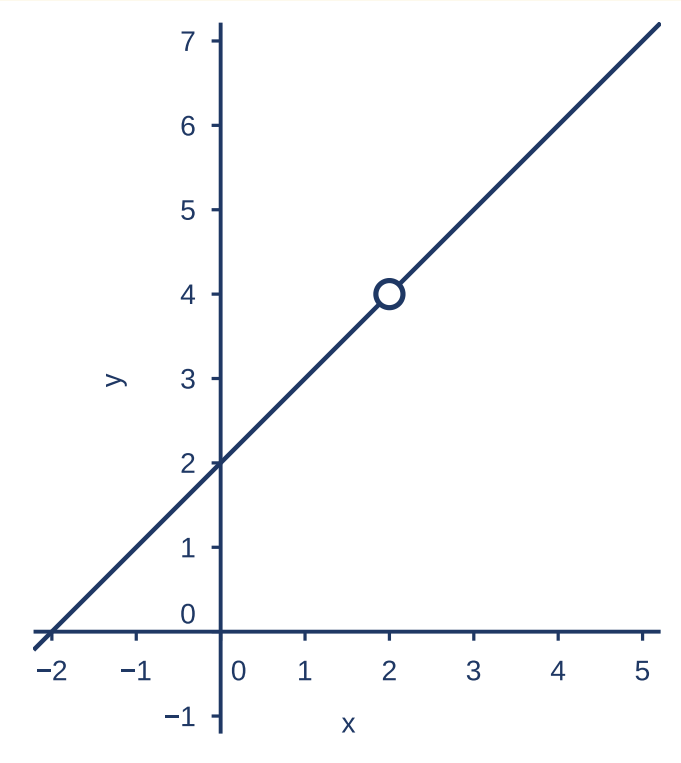
Worked examples

EXAMPLE 1

Q Find the hole in $f(x) = \dfrac{(x^2 - 4)}{(x - 2)}$



SOLUTION

Factor the top: $(x - 2)(x + 2)$. The simplified form is $x + 2$, with x not 2.

The cancelled bracket gives the hole's x-value: $x = 2$

Find y from the simplified form: $2 + 2 = 4$, so the hole is at $(2, 4)$.

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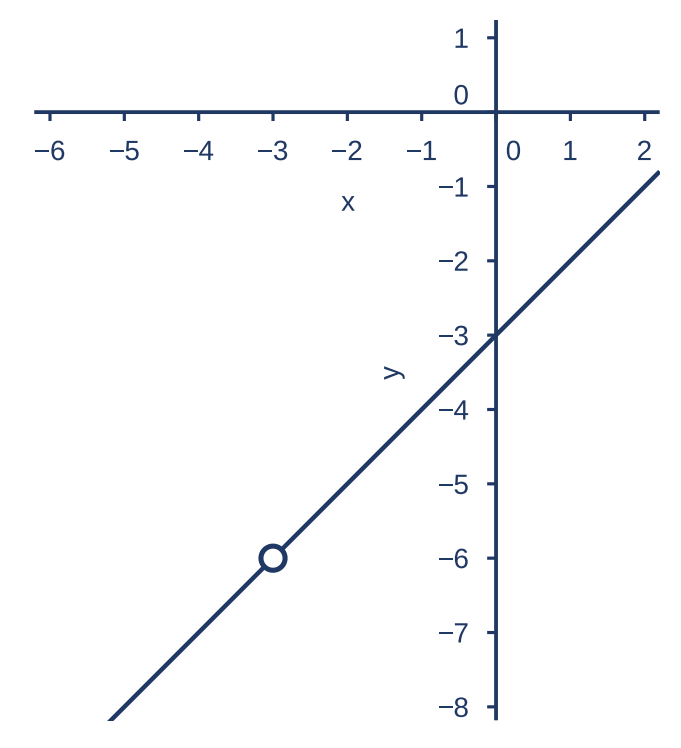
EXAMPLE 2

Q Find the hole in $f(x) = \frac{(x^2 - 9)}{(x + 3)}$



SOLUTION

Factor the top: (x - 3)(x + 3). The simplified form is x - 3, with x not -3.

The cancelled bracket gives x = -3

Find y: -3 - 3 = -6, so the hole is at (-3, -6).

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Practice questions

1 Find the hole in $f(x) = \frac{(x^2 - 25)}{(x - 5)}$.

A (5, 10)

B (5, -10)

C (-5, 10)

D (10, 5)

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2 In $f(x) = \frac{(x^2 - 1)}{(x + 1)}$, which factor cancels to give the hole?

A (x - 1)

B (x + 1)

C (x^2 - 1)

D None of these

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3 What is the simplified form of $f(x) = \frac{(x^2 - 36)}{(x + 6)}$, with its restriction?

- **A** x - 6, with x not -6
- **B** x + 6, with x not -6
- **C** x - 6, with x not 6
- **D** x + 6, with x not 6

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4 What is the y-value of the hole in $f(x) = \frac{(x^2 - 49)}{(x - 7)}$?

- **A** 7
- **B** 14
- **C** -14
- **D** 49

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5 Find the hole in $f(x) = \frac{(x^2 - 4x + 4)}{(x - 2)}$.

- **A** (2, 0)
- **B** (-2, 0)
- **C** (2, 4)
- **D** (0, 2)

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6 For $f(x) = \frac{(x^2 - 16)}{(x - 4)}$, which x-value can you not use?

- **A** -4
- **B** 4
- **C** 8
- **D** 16

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7 How many holes does the graph of $f(x) = \frac{(x^2 + 6x + 9)}{(x + 3)}$ have?

- A 0
- B 1
- C 2
- D 3

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8 Which of these points IS on the graph of $f(x) = \frac{(x^2 - 64)}{(x + 8)}$?

- A (-8, -16)
- B (0, -8)
- C (-8, 16)
- D (8, 8)

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9 Find the hole in $f(x) = \frac{(x^2 - 9x + 20)}{(x - 4)}$.

A (4, -1)

B (4, 1)

C (-4, -1)

D (-1, 4)

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10 The hole in $f(x) = \frac{(x^2 - 100)}{(x - 10)}$ is at (10, 20). Which line does the rest of the graph follow?

A $y = x + 10$

B $y = x - 10$

C $y = 10x$

D $y = x + 20$

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ANSWER KEY

1. (5, 10)

2. (x + 1)

3. x - 6, with x not -6

4. 14

5. (2, 0)

6. 4

7. 1

8. (0, -8)

9. (4, -1)

10. y = x + 10

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