MATHEMATICS · GRADES 10-12

Continuity

Difficulty level: Advanced

Mathematics: Grades 10-12

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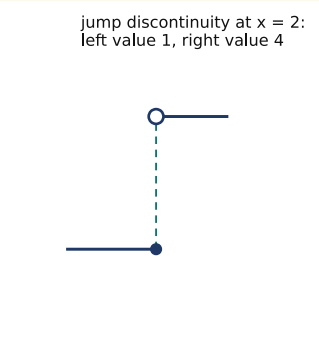
Overview of the concept

This is how you tell whether a graph can be drawn without lifting your pen. A smooth temperature curve through the day is continuous, while a price that suddenly changes at midnight jumps and breaks the line. Knowing where a graph jumps matters, because a lot of calculus only works on the smooth, unbroken parts.





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Worked examples

EXAMPLE 1

Q Is $f(x) = x^2$ continuous at $x = 2$?

SOLUTION

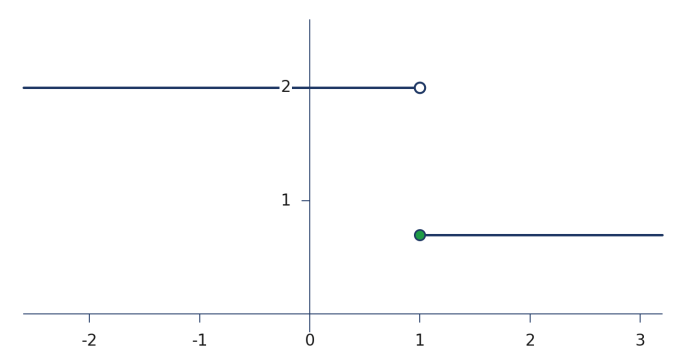
The function value at 2 is 4.

The limit as x approaches 2 is also 4.

Value equals limit, so it is continuous at 2.

EXAMPLE 2

Q Is a function with a jump at $x = 1$ continuous there?



SOLUTION

At a jump, the left and right limits disagree.

So the limit at 1 does not exist.

So the function is not continuous at 1.

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Practice questions

1 Is $f(x) = 2x + 1$ continuous at $x = 5$?

- A Yes
- B No

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2 Is a function with a hole at $x = 3$ continuous at 3?

- A Yes
- B No

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3

What three things must match for continuity at a point?

A The function value, the limit, and they must be equal

B The function value and the limit, and they must both be zero

C The slope, the intercept, and the function value

D The function value, the derivative, and they must be equal

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4 Is $f(x) = \frac{1}{x}$ continuous at $x = 0$?

- **A** Yes, it is continuous at 0
- **B** No, it is undefined at 0
- **C** No, it has a hole at 0
- **D** Yes, the limit equals the function value

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5 Is $f(x) = x^3$ continuous everywhere?

- **A** Yes
- **B** No

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6 What is a removable discontinuity?

- **A** A jump where the left and right limits disagree
- **B** An asymptote where the function grows without bound
- **C** A hole that could be filled by redefining one value
- **D** A point where the function is undefined and the limit does not exist

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7 Is a step function continuous at its jump?

- **A** Yes
- **B** No

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8 What does continuous mean in plain words?

- **A** No breaks, holes, or jumps: the graph can be drawn without lifting the pen
- **B** The limit exists at every point
- **C** The function is a straight line
- **D** The function has a derivative everywhere

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9 Is f(x) = 5 continuous everywhere?

- **A** Yes
- **B** No

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10 **If the limit exists but does not equal the function value, is the function continuous?**

A Yes

B No

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ANSWER KEY

1. Yes

2. No

3. The function value, the limit, and they must be equal

4. No, it is undefined at 0

5. Yes

6. A hole that could be filled by redefining one value

7. No

8. No breaks, holes, or jumps: the graph can be drawn without lifting the pen

9. Yes

10. No

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