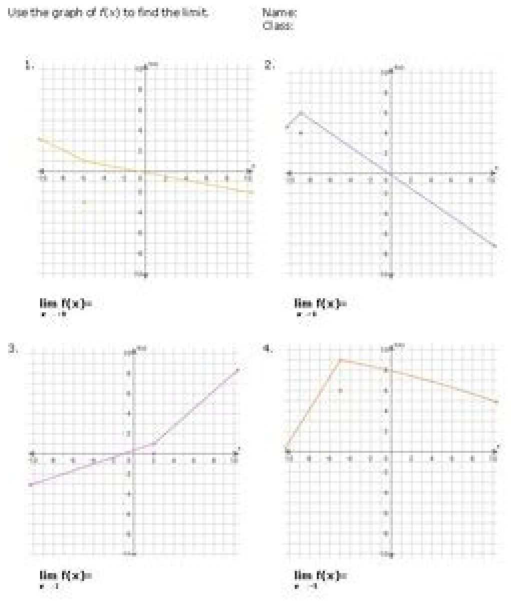
13 Finding Limits From Graphs Answer Key



Use the graph of f(x) to find the limit.

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Finding limits from graphs is a fundamental concept in calculus that allows students and mathematicians alike to evaluate the behavior of functions as they approach specific points. Understanding limits is crucial for studying continuity, derivatives, and integrals. This article will provide a comprehensive overview of how to find limits from graphs, offer clear examples, and present an answer key for 13 common limit problems.

Understanding Limits in Graphs

When we talk about limits in the context of graphs, we are referring to the value that a function approaches as the input approaches a particular value. The limit can be influenced by several factors, including the function's behavior near the point of interest and whether the function approaches the limit from the left or right.

Key Concepts in Finding Limits

1. Left-Hand Limit: The limit of a function as the input approaches a value from the left side (denoted as \(\lim_{x \to c^-} f(x) \)).
2. Right-Hand Limit: The limit of a function as the input approaches a value from the right side (denoted as \(\lim_{x \to c^+} f(x) \)).
3. Existence of Limit: A limit exists at a point \(c \) if both the left-hand limit and right-hand limit are equal to the same value. If they differ, the limit does not exist.
4. Continuous Functions: If a function is continuous at a point, the limit as \(x \) approaches that point is equal to the function's value at that point.

5. Discontinuities: Points where the function is not continuous can have different implications for limits, such as removable discontinuities (holes) and non-removable discontinuities (jumps or vertical asymptotes).

How to Find Limits from Graphs

Finding limits from graphs involves observing the behavior of the function visually. Here are the steps to effectively analyze a graph for limit evaluation:

1. Identify the Point of Interest: Determine the value c at which you want to find the limit.
2. Examine the Graph: Look at the left and right sides of the graph as they approach c.
3. Determine Left and Right Limits: Observe the values that $f(x)$ approaches as x approaches c from the left and right.
4. Compare the Limits: If the left-hand limit and right-hand limit are equal, that value is the limit. If they differ, the limit does not exist.
5. Consider Discontinuities: Note any discontinuities at c that may affect the limit.

Example Problems

To solidify your understanding, we will present 13 example problems of finding limits from graphs, along with their corresponding answer key.

Example Limit Problems

1. Limit at a Point with No Discontinuity
- Find $\lim_{x \to 2} f(x)$ where $f(x)$ is a continuous function.

2. Limit Approaching a Hole
- Find $\lim_{x \to 3} f(x)$ where $f(x)$ has a removable discontinuity at $x = 3$.

3. Limit with a Jump Discontinuity
- Find $\lim_{x \to 1} f(x)$ where $f(x)$ has a jump at $x = 1$.

4. Limit with a Vertical Asymptote
- Find $\lim_{x \to 0} f(x)$ where $f(x)$ approaches infinity as x approaches 0.

5. Limit at Infinity
- Find $\lim_{x \to \infty} f(x)$ where $f(x)$ approaches a horizontal asymptote.

6. Limit from the Left
- Find $\lim_{x \to -2^-} f(x)$ where $f(x)$ approaches a specific value from the left.

7. Limit from the Right
- Find $\lim_{x \to 4^+} f(x)$ where $f(x)$ approaches a specific value from the right.

8. Limit with Oscillation
- Find $\lim_{x \to 0} f(x)$ where $f(x)$ oscillates between two values.

9. Limit of a Piecewise Function
- Find $\lim_{x \to -1} f(x)$ for a piecewise function defined differently on either side of $x = -1$.

10. Limit Involving a Root Function
- Find $\lim_{x \to 4} f(x)$ where $f(x) = \sqrt{x}$.

11. Limit of a Trigonometric Function
- Find $\lim_{x \to \pi/2} f(x)$ where $f(x) = \tan(x)$.

12. Limit of a Rational Function
- Find $\lim_{x \to 3} f(x)$ where $f(x) = \frac{x^2 - 9}{x - 3}$.

13. Limit of an Exponential Function
- Find $\lim_{x \to 0} f(x)$ where $f(x) = e^x$.

Answer Key

Here is the answer key for the above limit problems:

1. $\lim_{x \to 2} f(x) = f(2)$
2. $\lim_{x \to 3} f(x) = L$ (where L is the value approached from both sides)
3. $\lim_{x \to 1} f(x) = L_1$ (left) or L_2 (right) - does not exist if $L_1 \neq L_2$
4. $\lim_{x \to 0} f(x) = \infty$
5. $\lim_{x \to \infty} f(x) = L$ (horizontal asymptote)
6. $\lim_{x \to -2^-} f(x) = L$
7. $\lim_{x \to 4^+} f(x) = L$
8. $\lim_{x \to 0} f(x)$ does not exist (oscillates)
9. $\lim_{x \to -1} f(x) = L$ (depending on the piecewise definition)
10. $\lim_{x \to 4} f(x) = 2$
11. $\lim_{x \to \pi/2} f(x) = \infty$
12. $\lim_{x \to 3} f(x) = 6$
13. $\lim_{x \to 0} f(x) = 1$

Conclusion

Finding limits from graphs is an essential skill in calculus that requires careful observation and understanding of function behavior. By following the outlined steps and practicing with various examples, students can become proficient in evaluating limits both graphically and analytically. The answer key provided can serve as a guide for self-assessment and reinforcement of concepts learned.

Frequently Asked Questions

What are the common methods for finding limits from graphs?

Common methods include observing the value that the function approaches as the input approaches a certain point, checking for continuity, and identifying any vertical or horizontal asymptotes.

How do you determine if a limit exists from a graph?

A limit exists if the function approaches the same value from both the left and right as the input approaches a specific point. If the values differ or if there is a jump or asymptote, the limit does not exist.

What does it mean if a graph has a hole at a point?

A hole in a graph indicates that the function is not defined at that point, but the limit as the input approaches that point still exists if the function approaches a specific value.

How can you identify one-sided limits from a graph?

One-sided limits can be identified by observing the behavior of the graph as it approaches a specific point from the left (left-hand limit) or from the right (right-hand limit).

What should you do if a graph shows a vertical asymptote?

If a graph shows a vertical asymptote at a point, the limit does not exist at that point, as the function tends to infinity or negative infinity.

How can you tell if a function is continuous at a point from its graph?

A function is continuous at a point if the graph is unbroken at that point, meaning the limit as you approach the point from both sides equals the function's value at that point.

What tools or technology can assist in finding limits from graphs?

Graphing calculators and software like Desmos or GeoGebra can help visualize functions and their limits, allowing for easier identification of behaviors near specific points.

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