# Find Each Indicated Quantity If It Exists. Let F(x)={ X 2, For X<12x, For X>1. Complete Parts (A)

**Find Each Indicated Quantity If It Exists. Let F(x)={ X 2, For X<12x, For X>1. Complete Parts (A)**

Understanding how to find specific quantities related to a function is a fundamental aspect of calculus and mathematical analysis. This article provides a comprehensive guide to analyzing a piecewise function, specifically focusing on identifying key quantities such as limits, derivatives, and function values at particular points. We will explore the process systematically, ensuring clarity and depth for learners and enthusiasts alike.

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## Introduction to Piecewise Functions

## What Is a Piecewise Function?

A piecewise function is a function defined by different expressions based on the value of the independent variable x. These functions are common in real-world applications where behavior changes over different intervals.

Example:

$$
F(x) = \begin{cases}
x^2 & \text{for } x < 12 \\
x & \text{for } x > 1
\end{cases}
$$

Note: The problem statement appears to have a typo; typically, a piecewise function is defined with disjoint intervals, such as:

$$
F(x) = \begin{cases}
x^2 & \text{for } x < 12 \\
x & \text{for } x \geq 12
\end{cases}
$$

or similar. For this guide, we will interpret the function as:

\[

F(x) = \begin{cases}
x^2 & \text{for } x < 12 \\
x & \text{for } x > 1
\end{cases}
\]

with the understanding that the domain is divided accordingly.

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# Understanding the Function Definition

## Analyzing the Given Function

The piecewise function provided appears to have some ambiguity, but for the purpose of this article, we will assume the following:

\[
F(x) = \begin{cases}
x^2 & \text{for } x < 12 \\
x & \text{for } x > 1
\end{cases}
\]

This suggests a domain split at specific points, with the function taking different forms depending on the value of x.

Key points to consider:

- The function's behavior as x approaches critical points (like 1 and 12)
- Whether the function is continuous at those points
- The derivatives at various points for slope analysis

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# Part (A): Analyzing the Function at Specific Points

## 1. Finding the Function Value at a Given Point

Question: What is \(F(3)\)?

Since 3 is greater than 1 and less than 12, it falls into the domain where \(F(x) = x^2\).

\[

F(3) = 3^2 = 9
\]

Similarly, for \(x = 15\):

\[
F(15) = 15 \quad \text{(since for } x > 1, F(x) = x)
\]

---

## 2. Computing Limits at Critical Points

a. Limit as \(x\) approaches 1 from the left (\(x \to 1^{-}\))

Since \(x < 12\), and approaching 1 from the left:

\[
\lim_{x \to 1^-} F(x) = \lim_{x \to 1^-} x^2 = 1^2 = 1
\]

b. Limit as \(x\) approaches 1 from the right (\(x \to 1^{+}\))

Since \(x > 1\):

\[
\lim_{x \to 1^+} F(x) = \lim_{x \to 1^+} x = 1
\]

c. Conclusion:

\[
\lim_{x \to 1} F(x) = 1
\]

and the function's value at \(x=1\) can be evaluated if defined.

Is the function continuous at \(x=1\)?

- Since both limits are 1, and assuming \(F(1) = 1\) (if defined), the function is continuous at \(x=1\).

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## 3. Limit as \(x\) approaches 12 from the left (\(x \to 12^{-}\)) and right (\(x \to 12^{+}\))

a. Approaching from the left:

$$
\lim_{x \to 12^-} F(x) = (12)^2 = 144
$$

b. Approaching from the right:

Since for $x > 1$, $F(x) = x$:

$$
\lim_{x \to 12^+} F(x) = 12
$$

c. Is the function continuous at $x=12$?

- No, because the left-hand limit is 144, and the right-hand limit is 12; they are not equal.

d. Function value at $x=12$:

- Not specified directly; if undefined, the function is discontinuous at $x=12$.

---

# Derivatives and Rates of Change

## 1. Derivative for $x < 12$: $F(x) = x^2$

$$
F'(x) = 2x
$$

At $x=3$:

$$
F'(3) = 2 \times 3 = 6
$$

At $x=1$:

$$
F'(1) = 2 \times 1 = 2
$$

---

## 2. Derivative for $x > 1$: $F(x) = x$

$$
F'(x) = 1
$$

At $x=15$:

$$
F'(15) = 1
$$

---

# Additional Important Quantities

## 1. Find the Average Rate of Change between Two Points

Between $x=2$ and $x=4$:

- $F(2) = 4$ (since $2^2=4$)
- $F(4) = 4$ (since 4 > 1)

Average rate of change:

$$
\frac{F(4) - F(2)}{4 - 2} = \frac{4 - 4}{2} = 0
$$

---

## 2. Find the Instantaneous Rate of Change at a Point

- At $x=3$:

$$
F'(3) = 6
$$

- At $x=15$:

$$
F'(15) = 1
$$

---

# Summary of Key Findings

- The function $F(x)$ is continuous at $x=1$ with $F(1) = 1$.
- Discontinuity exists at $x=12$ due to different limits from the left and right.
- Derivatives are straightforward for each piece: $F'(x) = 2x$ for $x<12$, and $F'(x) = 1$ for $x>1$.
- Function values at specific points help understand the behavior and slopes.

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# Practical Applications and Further Study

Understanding how to find each indicated quantity in piecewise functions is essential in fields such as physics, engineering, economics, and data analysis. For example, modeling scenarios where behavior changes at certain thresholds often requires analyzing such functions.

Further topics to explore:

- Continuity and discontinuity in piecewise functions
- Differentiability at boundary points
- One-sided limits and derivatives
- Real-world modeling with piecewise functions

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# Conclusion

Mastering the process of analyzing piecewise functions like the one described — including calculating function values, limits, derivatives, and understanding points of continuity — is crucial for advanced mathematical problem-solving. By following systematic steps and considering the behavior at critical points, learners can develop a solid foundation for tackling more complex functions and applications.

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Keywords for SEO optimization:

- Find each quantity in piecewise functions
- Calculus analysis of functions
- Limits and derivatives of piecewise functions
- Continuity at boundary points
- Mathematical analysis tutorials

- Piecewise function examples
- Derivative calculations
- Limits at critical points

This comprehensive guide aims to enhance your understanding of analyzing piecewise functions and finding various quantities if they exist, empowering you with the skills to solve complex mathematical problems confidently.

# Frequently Asked Questions

## What is the domain of the function $F(x) = \{x^2 \text{ for } x < 1, 2 \text{ for } x > 1\}$?

The domain is all real numbers except possibly at $x=1$, since the function is defined as $x^2$ for $x<1$ and 2 for $x>1$. Typically, if the value at $x=1$ is not specified, the domain is $x<1$ and $x>1$, excluding $x=1$.

## How do you find F(0) for the given piecewise function?

Since $0 < 1$, $F(0) = 0^2 = 0$.

## What is F(2) in the function?

Since $2 > 1$, $F(2) = 2$.

## Is the function F(x) continuous at x=1?

No, because the limit from the left as x approaches 1 is $1^2=1$, and from the right is 2. Since these are not equal, F(x) is not continuous at $x=1$.

## Find the value of F(x) when x approaches 1 from the left.

As x approaches 1 from the left, $F(x) = x^2$, so the limit is $1^2=1$.

## Find the value of F(x) when x approaches 1 from the right.

As x approaches 1 from the right, $F(x) = 2$, since for $x>1$, $F(x)=2$.

## Does the function F(x) have a jump discontinuity at x=1?

Yes, because the left limit is 1, the right limit is 2, and the function values are different, indicating a jump discontinuity at $x=1$.

## What is the value of F(0.5)?

Since $0.5 < 1$, $F(0.5) = (0.5)^2 = 0.25$.

## Can F(x) be differentiable at x=1?

No, because F(x) is not continuous at x=1, and differentiability requires continuity. Therefore, F(x) is not differentiable at x=1.

## Complete the statement: F(x) is defined as x^2 for x<1 and as 2 for x>1. What is F(1)?

The value at x=1 is not specified in the piecewise definition, so F(1) is undefined unless explicitly defined.

# Additional Resources

Understanding Piecewise Functions and Their Quantities: A Detailed Exploration

In the realm of mathematics, particularly in calculus and algebra, piecewise functions stand out as versatile tools that model situations where different rules apply in different regions of the domain. Today, we delve into an intriguing example: the function \( F(x) = \begin{cases} x^2, & \text{for } x < 12 \\ 2x, & \text{for } x > 1 \end{cases} \). Our goal is to explore how to find various quantities associated with this function, focusing on the instruction "Find each indicated quantity if it exists," especially in the context of Part (A).

This comprehensive analysis aims to clarify the concepts, step through the calculations, and shed light on the significance of each quantity, all while adopting a clear, expert tone suitable for learners and educators alike.

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# Understanding the Function \(F(x)\): Definition and Domain

Before diving into calculations, it’s essential to comprehend the structure of \(F(x)\):

\[
F(x) =
\begin{cases}
x^2, & \text{for } x < 12 \\
2x, & \text{for } x > 1
\end{cases}
\]

Key observations:

- The function is piecewise, with two different expressions based on the value of \(x\).
- The domain is split at \(x=12\) and \(x=1\), but note that the function's definitions are only explicitly given for \(x<12\) and \(x>1\); the point \(x=12\) and \(x=1\) are not included unless

specified.
- This setup suggests that the function is defined except possibly at $x=1$ and $x=12$, which prompts questions about continuity, limits, and the function's behavior at these points.

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# Part (A): Finding Quantities Based on $F(x)$

Given the instruction, Part (A) likely involves calculating specific quantities such as:

- $F(a)$ for a given $a$,
- $\lim_{x \to a} F(x)$,
- the domain or range of $F$,
- the points of discontinuity,
- the values of $F(x)$ at boundary points,
- or other related quantities.

While the exact "indicated quantities" are not specified in the prompt, a typical problem set might include:

1. Finding $F(3)$ — the value of the function at a specific point.
2. Finding $\lim_{x \to 1^+} F(x)$ and $\lim_{x \to 1^-} F(x)$ — the left and right limits at $x=1$.
3. Determining whether $F$ is continuous at $x=1$.
4. Finding $\lim_{x \to 12^-} F(x)$ and $\lim_{x \to 12^+} F(x)$.
5. Evaluating $F(12)$ if defined, or explaining why it isn't.
6. Identifying the domain and range of $F$.
7. Finding the inverse function $F^{-1}(x)$, if it exists.

In the absence of explicit quantities, we'll proceed to analyze these common types of questions, offering a detailed, step-by-step guide.

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# Analyzing $F(x)$ at Specific Points

## 1. Calculating $F(3)$

Step 1: Determine which piece applies at $x=3$.

- Since $3<12$, use $F(x)=x^2$.

Step 2: Compute $F(3)$.

$$
F(3) = 3^2 = 9
$$

$$

Result: $F(3) = 9$.

---

## 2. Calculating $F(13)$

Step 1: Check the domain region for $x=13$.

- Because $13>1$, and the second piece applies when $x>1$, use $F(x)=2x$.

Step 2: Compute $F(13)$.

$$
F(13) = 2 \times 13 = 26
$$

Result: $F(13) = 26$.

---

# Limit Analysis at Key Points

Understanding the behavior of $F(x)$ near the boundary points $x=1$ and $x=12$ is crucial for analyzing continuity and potential discontinuities.

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## 3. Limits as $x \to 1$

Since the domain parts are $x<12$ and $x>1$, and the definitions are different on either side of $x=1$, we examine:

- Left-hand limit: $\lim_{x \to 1^-} F(x)$
- Right-hand limit: $\lim_{x \to 1^+} F(x)$

Note: The function is defined as $F(x) = x^2$ for $x<12$. Since $x<12$ includes $x<1$, the first piece applies for $x\to 1^-$.

Calculations:

- $\lim_{x \to 1^-} F(x) = \lim_{x \to 1^-} x^2 = 1^2=1$

- For $x \to 1^+$, because $x>1$, the second piece applies: $F(x)=2x$.

$$
\lim_{x \to 1^+} F(x) = 2 \times 1 = 2
$$

Conclusion:

- The left limit is 1.
- The right limit is 2.

Since these are not equal, the limit $\lim_{x \to 1} F(x)$ does not exist, and $F$ is discontinuous at $x=1$.

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## 4. Limits as $x \to 12$

Similarly, evaluate:

- $\lim_{x \to 12^-} F(x)$
- $\lim_{x \to 12^+} F(x)$

Calculations:

- For $x \to 12^-$, $x<12$, so $F(x)=x^2$:

$$
\lim_{x \to 12^-} F(x) = 12^2=144
$$

- For $x \to 12^+$, $x>12$, but the function is defined as $F(x)=2x$ for $x>1$, so at $x>12$:

$$
\lim_{x \to 12^+} F(x) = 2 \times 12 = 24
$$

Conclusion:

- The left limit is 144.
- The right limit is 24.

Since these are not equal, the limit $\lim_{x \to 12} F(x)$ does not exist, indicating a jump discontinuity at $x=12$.

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# Evaluating Function Values at Key Points

## 5. Is $F(12)$ defined?

- The function's first piece applies for $x<12$, and the second for $x>1$.

- Typically, in piecewise functions, the value at the boundary point $x=12$ depends on whether the point is included in the domain and how the function is defined.

- Since the definition states $F(x)=x^2$ for $x<12$, and $F(x)=2x$ for $x>1$, but there is no explicit definition at $x=12$, unless specified, $F(12)$ is undefined.

Note: If the problem asks to evaluate $F(12)$, and the function is not explicitly defined at $x=12$, then:

$$
\boxed{
F(12) \text{ is undefined}
}
$$

---

# Domain and Range Considerations

Domain:

- The function is defined for $x<12$ and $x>1$.
- The union of these intervals is $(-\infty, 12) \cup (1, \infty)$.

Note: The overlapping region is $(1, 12)$, where both pieces are valid. However, the function's actual value at points in $(1,12)$ depends on which piece we use.

Range:

- For $x<12$, $F(x)=x^2$. As $x \to -\infty$, $F(x) \to \infty$, and as $x \to 12^-$, $F(x) \to 144$. The range from this piece is $[0, 144)$ (since $x^2 \to 0$ as $x \to 0$ and the maximum approaches 144).

- For $x>1$, \(F(x

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