The Domain For Each Relation Described Below Is The Set Of All Positive Real Numbers. Select The Correct

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Understanding the domain of relations is fundamental in mathematics, especially in the study of functions and their properties. When dealing with relations where the domain is specified as the set of all positive real numbers, it becomes essential to analyze each relation carefully to determine the correct domain, range, and other characteristics. This article aims to provide a comprehensive overview of how to interpret such relations, with detailed examples and explanations to enhance your understanding.

Introduction to Domains in Relations

Before delving into specific relations, it’s crucial to grasp the basic concept of a domain. In mathematics, the domain of a relation or a function is the set of all possible input values (independent variables) for which the relation is defined.

- Relation: A relationship between two quantities or sets, often expressed as an equation or a set of ordered pairs.
- Function: A special type of relation where each input has exactly one output.

When the domain is specified as the set of all positive real numbers ($\mathbb{R}^+$), it indicates that the relation is only defined for numbers greater than zero. This restriction influences the range and the behavior of the relation significantly.

Understanding the Set of All Positive Real Numbers ($\mathbb{R}^+$)

The set $\mathbb{R}^+$ includes all real numbers greater than zero:

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$$
\mathbb{R}^+ = \{ x \in \mathbb{R} \mid x > 0 \}
$$

This set excludes zero and all negative numbers, focusing solely on positive values. Many real-world phenomena involve positive quantities, such as distances, areas, and other measurements, making this set particularly relevant.

Analyzing Relations with Domain as All Positive Real Numbers

When a relation is defined over $\mathbb{R}^+$, the key considerations include:

- Definition Domain: Confirming the relation is valid for all $x > 0$.
- Potential Restrictions: Identifying any conditions within the relation that might restrict the domain further.
- Range: Determining the set of possible output values based on the domain.

Below are common types of relations with domain $\mathbb{R}^+$, along with detailed methods to analyze them.

Common Types of Relations and How to Select the Correct Domain

1. Rational Functions

Example: $y = \frac{1}{x}$

- Domain Analysis:
- The only restriction is when the denominator equals zero.
- Since x must be positive, $x \neq 0$, and $x > 0$, so the domain is $(0, \infty)$.
- Range:
- y can be any positive or negative real number, except zero.
- For $y = \frac{1}{x}$, as $x \to 0^+$, $y \to +\infty$; as $x \to +\infty$, $y \to 0^+$.

2. Exponential and Logarithmic Functions

Exponential: $y = a^x$, with $a > 0$

- Domain: $\mathbb{R}^+$ (since $x > 0$)
- Range:
- For a^x, $y > 0$
- All positive real numbers are achievable depending on a.

Logarithm: $y = \log_a x$

- Domain:
- $x > 0$, matching the set of all positive real numbers.
- Range:
- $(-\infty, \infty)$

3. Power Functions

Example: $y = x^n$, where n is a real number

- For n even, $y = x^n$, the domain is $(0, \infty)$
- For n odd, the domain is $(0, \infty)$ (since the domain is given as all positive real numbers)

4. Roots and Radicals

Example: $y = \sqrt{x}$

- Domain:
- $x \geq 0$, but since the domain is only positive real numbers, $x > 0$.
- Range:
- $y > 0$

Steps to Determine the Correct Domain for Relations with $\mathbb{R}^+$

When faced with a relation and asked to select the correct domain, follow these steps:

1. Identify the relation’s formula: Understand the mathematical expression representing the relation.
2. Check for restrictions:
- Division by zero
- Even roots of negative numbers
- Logarithms of non-positive numbers
- Any other algebraic constraints
3. Apply the given domain:
- Since the domain is $\mathbb{R}^+$, ensure the relation is defined for all $x > 0$.

4. Verify the relation’s behavior:
- Confirm that the relation is valid for all positive real numbers, considering its algebraic form.
5. Determine the range:
- Based on the relation and domain, identify the set of possible outputs.

Examples of Relations with $\mathbb{R}^+$ Domain and Their Correct Domains

Example 1: $y = \frac{1}{x}$

- Question: Is this relation defined for all positive real numbers?
- Analysis:
- Yes, for every $x > 0$, $y = \frac{1}{x}$ is defined.
- Correct domain: $(0, \infty)$

Example 2: $y = \sqrt{x - 2}$

- Question: With domain $\mathbb{R}^+$, is this relation valid?
- Analysis:
- The radicand $x - 2$ must be non-negative.
- Since the domain is $x > 0$, for the relation to be defined, $x - 2 \geq 0 \Rightarrow x \geq 2$.
- Given the domain is $\mathbb{R}^+$, the intersection is $x \geq 2$.
- Correct domain: $[2, \infty)$

Example 3: $y = \log(x - 1)$

- Question: Is this relation defined for all positive real numbers?
- Analysis:
- The argument of the logarithm must be positive: $x - 1 > 0 \Rightarrow x > 1$.
- Since the domain is $\mathbb{R}^+$, the actual domain is $(1, \infty)$.
- Correct domain: $(1, \infty)$

Example 4: $y = x^2 + 3x$

- Question: Is this relation defined for all positive real numbers?
- Analysis:
- Polynomial functions are defined for all real numbers, especially positive real numbers.
- Correct domain: $(0, \infty)$

Key Points for Selecting the Correct Domain

- Always verify the algebraic form of the relation to identify domain restrictions.
- Remember that the specified domain is \(\mathbb{R}^+ \), so the relation must be valid for all \(x > 0 \).
- For relations involving roots, logarithms, or divisions, check for domain restrictions directly from the formula.
- When in doubt, test specific positive values to see if the relation produces valid outputs.

Conclusion and Tips for Mastery

Understanding how to select the correct domain for relations where the set of all positive real numbers is involved is essential for solving many mathematical problems. Here are some practical tips:

- Always start by understanding the formula of the relation.
- Check for algebraic restrictions such as division by zero, negative radicands, or non-positive arguments in logarithms.
- Remember that the domain \(\mathbb{R}^+ \) excludes zero and negative numbers.
- Use inequalities to determine the valid input range.

By applying these principles systematically, you'll be able to accurately determine the correct domain for any relation described over the set of all positive real numbers.

SEO Keywords: domain of relations, positive real numbers, relation analysis, functions with domain, algebraic restrictions, rational functions, exponential functions, logarithmic functions, roots and radicals, selecting correct domain, mathematical relations, positive real domain restrictions, relation examples, how to find the domain

Frequently Asked Questions

What is the domain for the relation defined by y = 3x + 5, where x is a positive real number?

The domain is all positive real numbers, since x > 0.

If a relation is given as $y = \sqrt{x}$, what is its domain considering x is positive real numbers?

The domain is all positive real numbers, because $x > 0$ ensures the square root is defined and real.

For the relation $y = 1/x$, where x is a positive real number, what is the domain?

The domain is all positive real numbers except $x = 0$; since $x > 0$ by definition, the domain is all positive real numbers.

How does the domain change for the relation $y = \ln(x)$ when x is a positive real number?

The domain is all positive real numbers, as the natural logarithm is defined only for $x > 0$.

What is the domain of the relation $y = x^2 + 2x + 1$, given x is a positive real number?

The domain is all positive real numbers, since $x > 0$.

Is the domain of $y = e^x$ limited or unlimited when x is a positive real number?

The domain is all positive real numbers, which is an unlimited interval from 0 to infinity.

If a relation is defined as $y = (x + 1)/(x - 2)$, with x positive real numbers, what is the domain?

Since $x > 0$ and $x \neq 2$ to avoid division by zero, the domain is all positive real numbers except $x = 2$.

For the relation $y = x / (x + 1)$, where x is positive real, what is the domain?

The domain is all positive real numbers, since $x > 0$ ensures the denominator $x + 1 \neq 0$.

Why is the set of all positive real numbers chosen as the domain for these relations?

Because the relations involve functions like square roots, logarithms, or divisions that are only defined for positive real numbers, making this the natural domain.

Additional Resources

The Domain For Each Relation Described Below Is The Set Of All Positive Real Numbers. Select The Correct – this phrase signals a fundamental exploration into the concept of domains in mathematical relations, especially within the context of positive real numbers. Understanding how to determine the domain of a relation is crucial for students and professionals alike, as it underpins the very foundation of functions, mappings, and their applications across various fields such as physics, engineering, economics, and computer science. In this comprehensive guide, we will delve into what it means for a set to be the domain of a relation, how to identify the domain when it is specified as the set of all positive real numbers, and how to interpret and select the correct options in problems or real-world scenarios.

Understanding the Concept of Domain in Relations

What Is a Relation?

In mathematics, a relation is a connection or association between elements of two sets. More formally, a relation R from a set A (domain) to a set B (codomain) is a subset of the Cartesian product $A \times B$. For example, if A and B are sets of numbers, then a relation might be the set of pairs (a, b) where b is related to a in some specific way.

What Is the Domain of a Relation?

The domain of a relation refers to the set of all possible input values (or first elements in ordered pairs) for which the relation is defined or produces an output. For example, if the relation is "y is the square root of x," then the domain includes all x-values for which the square root is defined, typically $x \geq 0$.

Importance of the Domain

Knowing the domain helps in understanding the scope of the relation, ensuring that the relation makes sense within the context of the problem, and avoiding undefined or extraneous values. It also plays a crucial role when graphing functions or analyzing their behavior.

The Significance of "The Set Of All Positive Real Numbers" as a Domain

What Are Positive Real Numbers?

The set of positive real numbers, often denoted as $(0, \infty)$, includes all real numbers greater than zero. This excludes zero itself and all negative numbers. The positive real numbers are fundamental in many areas, representing quantities like lengths, areas, probabilities, and other measurements that cannot be negative or zero.

Why Is the Domain Restricted to Positive Real Numbers?

In certain relations, the domain is explicitly restricted to positive real numbers because:

- The relation is only defined for positive inputs (e.g., square roots, logarithms, certain physical measurements).
- The context of the problem involves quantities that are inherently positive.
- The mathematical function or relation doesn't make sense outside this set due to issues like division by zero or taking logarithms of non-positive numbers.

Examples of Relations with Domain as All Positive Real Numbers

- Square root function: $y = \sqrt{x}$, where $x > 0$ (or $x \geq 0$ if including zero). The domain is all positive real numbers because the square root of negative numbers is undefined in real numbers.
- Logarithmic function: $y = \log(x)$, with domain $x > 0$. The logarithm is only defined for positive real numbers.
- Power functions with fractional exponents: For instance, $y = x^{(1/3)}$ is defined for all real numbers, but $y = x^{(1/2)}$ (square root) is only defined for $x \geq 0$.

How to Determine the Correct Domain for Relations

Step-by-Step Approach

1. Understand the relation's formula or rule: Identify what operation or condition defines the relation.
2. Identify restrictions imposed by the operations: For example:
- Division by an expression: the denominator cannot be zero.
- Square roots: the radicand must be non-negative.
- Logarithms: the argument must be positive.
3. Solve inequalities or conditions: Find the set of all x-values satisfying the restrictions.
4. Express the domain: Usually in interval notation or set-builder notation.

Common Restrictions and Their Implications

Operation or Condition	Restriction on x	Explanation
Division by zero	Denominator $\neq 0$	$x \neq$ value that makes denominator zero

Square root or even root	Radicand ≥ 0	The expression inside root must be ≥ 0
Logarithm	Argument > 0	The argument inside log must be positive
Exponentiation (fractional)	Usually defined for all positive x	For $x^{p/q}$, $x > 0$ unless q is odd

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Applying the Concept: The Set of All Positive Real Numbers as the Domain

Typical Scenarios

In many problems, the relation explicitly states that the domain is the set of all positive real numbers. You are expected to recognize this and select the correct relation or function that matches this domain.

Examples of Relations with Domain as All Positive Real Numbers

- Relation A: $y = 1/x$, with $x > 0$.
- Relation B: $y = \log(x)$, with $x > 0$.
- Relation C: $y = \sqrt{x}$, with $x \geq 0$.
- Relation D: $y = x^3$, with $x \in \mathbb{R}$ (all real numbers).

In these cases, the relations are defined either explicitly or implicitly for $x > 0$, making the domain the set of all positive real numbers.

How to Identify the Correct Relation When the Domain Is the Set of All Positive Real Numbers

Key Indicators

- The relation involves logarithms or roots that require positive inputs.
- The relation includes fractions with denominators involving x, requiring $x \neq 0$.
- The problem explicitly states or implies the domain as all positive real numbers.
- The relation's formula is only valid for $x > 0$.

Process for Selection

1. Review each relation's formula or description.
2. Identify restrictions or conditions within each relation.
3. Determine which relations are only defined for $x > 0$.
4. Eliminate relations that are defined for all real numbers or have different domain restrictions.
5. Select the relation(s) that are only valid for positive real numbers.

Practical Examples and Practice Problems

Example 1

Relation: $y = \sqrt{(x - 2)}$

Question: What is the domain if the set of all positive real numbers is the domain?

Solution:

- The radicand must be ≥ 0: $x - 2 \geq 0 \rightarrow x \geq 2$.
- The domain is $[2, \infty)$. Since the problem states the domain is the set of all positive real numbers, and the interval $[2, \infty)$ is a subset of positive real numbers, it is consistent.

Example 2

Relation: $y = \log(3x - 5)$

Question: What is the domain if the set of all positive real numbers is the domain?

Solution:

- Inside the log: $3x - 5 > 0 \rightarrow 3x > 5 \rightarrow x > 5/3$.
- The domain is $(5/3, \infty)$. Since $5/3 > 0$, the domain is within the positive real numbers, matching the set of all positive real numbers for $x > 0$.

Example 3

Relation: $y = 1/(x - 4)$

Question: What is the domain given that the domain is the set of all positive real numbers?

Solution:

- The denominator cannot be zero: $x \neq 4$.
- The domain is all real numbers except 4. If we restrict to positive real numbers, the domain is $(0, 4) \cup (4, \infty)$. To match the set of all positive real numbers, the domain excludes only $x = 4$, which is positive, so the domain is $(0, 4) \cup (4, \infty)$.

Summary and Key Takeaways

- The domain of a relation is the set of all input values for which the relation is defined.
- When the set of all positive real numbers is specified as the domain, it

means the relation is only defined for x > 0.
- To determine if a relation's domain is all positive real numbers, examine the defining formula and identify restrictions imposed by roots, logarithms, denominators, or other operations.
- Recognizing the domain helps in selecting the correct relation from multiple options and understanding the scope of the relation's applicability.
- Always verify the restrictions within the relation to confirm the domain matches the specified set of positive real numbers, especially in problem-solving contexts.

Final Thoughts

Understanding the domain for each relation is an essential skill in mathematics that enables you to analyze functions correctly and apply them to real-world problems accurately. When the domain is specified as the set of all positive real numbers, it indicates that the relation is only valid for positive inputs, often due to the mathematical operations involved. Being able to identify, verify, and select relations based on their domain ensures clarity, precision, and correctness in your mathematical reasoning and applications.

Remember: Always carefully analyze the formula or description of a relation to determine its domain, especially when the domain is restricted to positive real numbers. This skill will serve you well in advanced mathematics, science, and engineering disciplines.

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