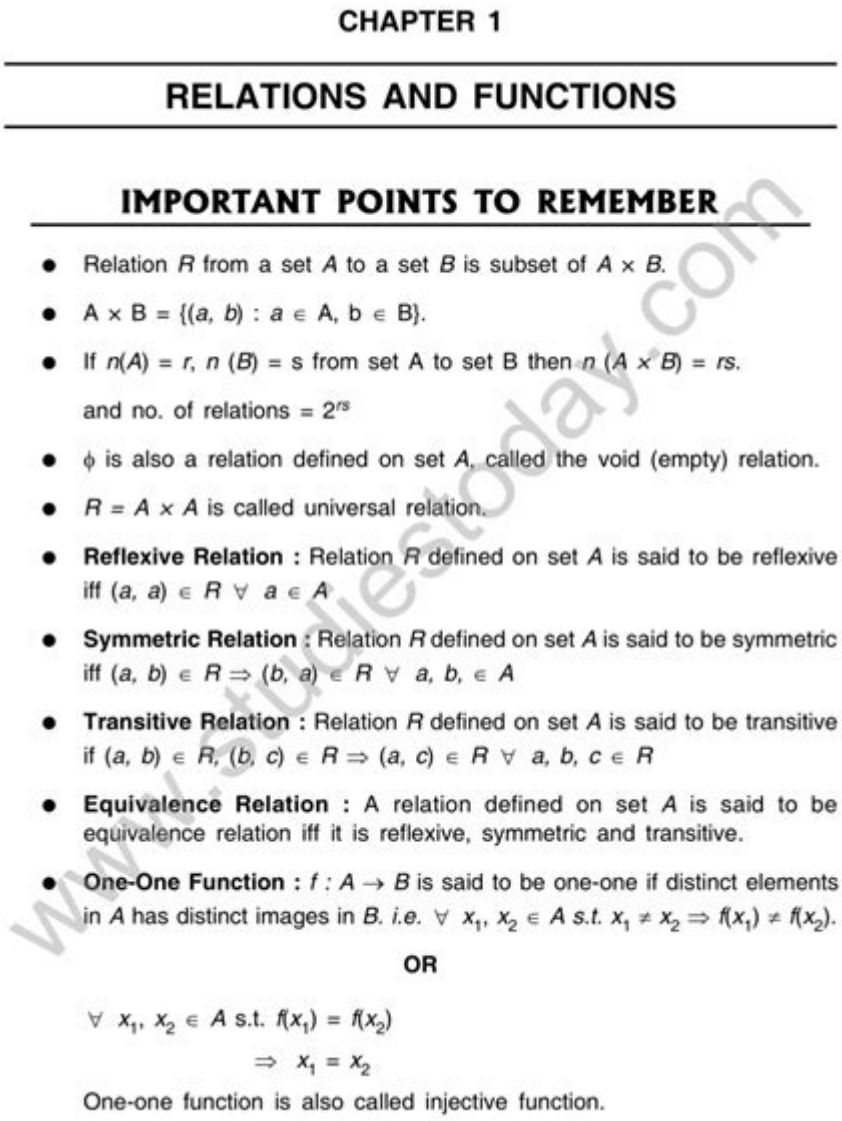
Relations And Functions Questions And Answers



CHAPTER 1

RELATIONS AND FUNCTIONS

IMPORTANT POINTS TO REMEMBER

- Relation R from a set A to a set B is subset of $A \times B$.
- $A \times B = \{(a, b) : a \in A, b \in B\}$.
- If $n(A) = r$, $n(B) = s$ from set A to set B then $n(A \times B) = rs$.

  and no. of relations = 2^{rs}
- ϕ is also a relation defined on set A, called the void (empty) relation.
- $R = A \times A$ is called universal relation.
- **Reflexive Relation :** Relation R defined on set A is said to be reflexive iff $(a, a) \in R \ \forall \ a \in A$
- **Symmetric Relation :** Relation R defined on set A is said to be symmetric iff $(a, b) \in R \Rightarrow (b, a) \in R \ \forall \ a, b, \in A$
- **Transitive Relation :** Relation R defined on set A is said to be transitive if $(a, b) \in R$, $(b, c) \in R \Rightarrow (a, c) \in R \ \forall \ a, b, c \in R$
- **Equivalence Relation :** A relation defined on set A is said to be equivalence relation iff it is reflexive, symmetric and transitive.
- **One-One Function :** $f : A \to B$ is said to be one-one if distinct elements in A has distinct images in B. *i.e.* $\forall \ x_1, x_2 \in A$ *s.t.* $x_1 \neq x_2 \Rightarrow f(x_1) \neq f(x_2)$.

OR

$\forall \ x_1, x_2 \in A$ s.t. $f(x_1) = f(x_2)$

$\Rightarrow \ x_1 = x_2$

One-one function is also called injective function.

Relations and functions questions and answers are essential components in the study of mathematics, particularly in algebra and calculus. Understanding the concepts of relations and functions lays the groundwork for more advanced mathematical topics. This article aims to provide a comprehensive overview of relations and functions, their definitions, properties, and examples, along with frequently asked questions that will enhance your understanding of these important concepts.

Understanding Relations

Definition of a Relation

A relation is a set of ordered pairs where each pair consists of an input and an output. In mathematical terms, a relation can be defined as follows:

- Let A and B be two sets. A relation R from set A to set B is a subset of the Cartesian product $A \times B$.

This means that R consists of pairs (a, b) where $a \in A$ and $b \in B$.

Types of Relations

Relations can be classified into several types based on their characteristics:

1. Reflexive Relation: A relation R on set A is reflexive if every element is related to itself. Formally, $\forall a \in A, (a, a) \in R$.

2. Symmetric Relation: A relation R is symmetric if whenever $(a, b) \in R$, then $(b, a) \in R$.

3. Transitive Relation: A relation R is transitive if whenever $(a, b) \in R$ and $(b, c) \in R$, then $(a, c) \in R$.

4. Anti-symmetric Relation: A relation R is anti-symmetric if whenever $(a, b) \in R$ and $(b, a) \in R$, then $a = b$.

5. Total Relation: A relation R is total if for every $a \in A$, there exists a $b \in B$ such that $(a, b) \in R$.

Understanding Functions

Definition of a Function

A function is a special type of relation that assigns exactly one output for each input. Formally, a function f from set A to set B is a relation $f \subseteq A \times B$ such that:

- For every $a \in A$, there exists a unique $b \in B$ such that $(a, b) \in f$.

In this case, we denote $f(a) = b$.

Types of Functions

Functions can also be classified into several categories:

1. One-to-One Function (Injective): A function $f: A \rightarrow B$ is one-to-one if $f(a_1)$

= f(a_2) \) implies \(a_1 = a_2 \).

2. Onto Function (Surjective): A function \(f: A \rightarrow B \) is onto if for every \(b \in B \), there exists an \(a \in A \) such that \(f(a) = b \).

3. One-to-One Correspondence (Bijective): A function is bijective if it is both one-to-one and onto.

4. Constant Function: A function \(f(x) = c \) is constant if it always returns the same value \(c \) for every input \(x \).

5. Linear Function: A function of the form \(f(x) = mx + c \) where \(m \) and \(c \) are constants.

Properties of Functions

Domain and Range

- Domain: The set of all possible inputs for a function is called its domain. It is crucial to determine the domain to avoid undefined operations.

- Range: The set of all possible outputs of a function is known as its range. This is derived from applying the function to all elements in the domain.

Composition of Functions

The composition of two functions \(f \) and \(g \) is denoted as \((f \circ g)(x) = f(g(x)) \). This means that the output of function \(g \) becomes the input for function \(f \).

Inverse Functions

The inverse of a function \(f \) is denoted as \(f^{-1} \) and is defined such that if \(f(a) = b \), then \(f^{-1}(b) = a \). A function must be bijective to have an inverse.

Common Questions and Answers

1. What is the difference between a relation and a function?

A relation is a set of ordered pairs, while a function is a specific type of relation where each input is associated with exactly one output. In simpler terms, all functions are relations, but not all relations are functions.

2. Can a function have two outputs for the same input?

No, a function cannot have two outputs for the same input. If a function assigns two outputs for a single input, it does not satisfy the definition of a function.

3. How do you determine if a relation is a function?

To determine if a relation is a function, check if every input value corresponds to exactly one output value. You can visualize this using the vertical line test on a graph: if a vertical line intersects the graph at more than one point, it is not a function.

4. How can you find the inverse of a function?

To find the inverse of a function f:
1. Replace $f(x)$ with y.
2. Swap x and y.
3. Solve for y.
4. Replace y with $f^{-1}(x)$.

5. What is a composite function, and how is it used?

A composite function is formed by combining two functions. It is useful in scenarios where the output of one function serves as the input for another. This is common in real-world applications, such as in physics or economics, where multiple processes are interconnected.

6. What are real-life applications of functions?

Functions are used in various fields, including:

- Economics: To model the relationship between supply and demand.
- Physics: To describe motion, such as distance versus time.
- Biology: To model population growth.
- Computer Science: In algorithms and data structures.

7. Can a function be both injective and surjective?

Yes, a function can be both injective and surjective, in which case it is called bijective. A bijective function establishes a one-to-one correspondence between the elements of its domain and range.

Conclusion

In conclusion, understanding relations and functions is foundational for mastering higher-level mathematics. This article has provided a comprehensive overview of the definitions, types, properties, and common questions surrounding these concepts. By familiarizing

yourself with these ideas, you can build a strong mathematical foundation that will support your studies in algebra, calculus, and beyond. Whether you are a student or someone simply interested in mathematics, grasping these fundamental concepts is crucial for your mathematical journey.

Frequently Asked Questions

What is the difference between a relation and a function?

A relation is a set of ordered pairs, while a function is a specific type of relation where each input (or x-value) corresponds to exactly one output (or y-value).

How can you determine if a relation is a function using the vertical line test?

If a vertical line drawn through any part of the graph intersects the graph at more than one point, the relation is not a function. If it intersects at most once, then it is a function.

What are the different types of functions?

Common types of functions include linear functions, quadratic functions, polynomial functions, rational functions, exponential functions, and logarithmic functions.

How do you find the domain and range of a function?

The domain of a function is the set of all possible input values (x-values), while the range is the set of all possible output values (y-values). You can find them by analyzing the function's equation and graph.

What is the significance of a one-to-one function?

A one-to-one function is significant because it ensures that each output is paired with exactly one input, which allows for the existence of an inverse function. This means for every y-value, there is a unique x-value.

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