📘 Class 12 Mathematics – Chapter: Relations and Functions

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1. Introduction

- Relations and functions extend the idea of mapping elements from one set to another.
- Fundamental in understanding mathematical models.

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2. Relations

- A relation from set AAA to set BBB is a subset of the Cartesian product A×BA \times BA×B.
- If (a,b)∈R(a,b) \in R(a,b)∈R, then aaa is related to bbb.
- **Domain:** Set of all first elements.
- **Range:** Set of all second elements.

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3. Types of Relations

- **Reflexive:** (a,a)∈R(a,a) \in R(a,a)∈R for all a∈Aa \in Aa∈A.

- **Symmetric:** If $(a,b) \in R$, then $(b,a) \in R$.
- **Transitive:** If $(a,b) \in R$ and $(b,c) \in R$, then $(a,c) \in R$.
- **Equivalence relation:** Relation that is reflexive, symmetric, and transitive.

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4. Functions

- A function f from A to B assigns each $a \in A$ exactly one $b \in B$.
- Notation: $f: A \to B$.
- **Domain:** Set A.
- **Co-domain:** Set B.
- **Range:** Subset of B consisting of actual images.

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5. Types of Functions

- **One-to-one (Injective):** Distinct elements in domain map to distinct elements in range.
- **Onto (Surjective):** Every element of co-domain is mapped to by some element of domain.

- **Bijective:** Both one-to-one and onto.

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6. Composition of Functions

- If $f: A \to B$ and $g: B \to C$, then $g \circ f: A \to C$.
- Defined as $(g \circ f)(x) = g(f(x))$.

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7. Inverse of a Function

- For bijective function f, inverse f^{-1} exists.
- Satisfies $f^{-1}(f(x)) = x$.

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8. Graph of a Function

- Set of points $\{(x, f(x)) \mid x \in \text{domain}\}$.
- Vertical line test to check if a curve is a function.

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9. Applications

- Modeling relationships between variables.
- Used in calculus, algebra, and applied sciences.

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10. Exam Tips

- Understand definitions and properties.
- Practice proving properties of relations.
- Learn to identify function types.
- Solve problems on composition and inverses.