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CHAPTER NOTES

Relations and Functions Class 12 Notes — CBSE Maths Chapter 1

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Relations and Functions Class 12 Notes — CBSE Maths Chapter 1

Chapter 1 — **Relations and Functions** — builds on your Class 11 knowledge and introduces types of relations, functions, composition, and inverse functions. Carries **6-8 marks** in Board exams. Focus on identifying relation types and proving functions are bijective.

Key Concepts

Types of Relations

Type	Definition	Example
Empty Relation	No element of A is related to any element	$R = \{\}$ on A
Universal Relation	Every element is related to every element	$R = A \times A$
Reflexive	$(a, a) \in R$ for all $a \in A$	“is equal to” on integers
Symmetric	If $(a, b) \in R$, then $(b, a) \in R$	“is a sibling of”
Transitive	If $(a, b) \in R$ and $(b, c) \in R$, then $(a, c) \in R$	“is less than”
Equivalence Relation	Reflexive + Symmetric + Transitive	“is congruent to (mod n)”

To prove equivalence relation: Always prove all three properties separately — reflexive, symmetric, transitive. Missing even one means it's not an equivalence relation!

Types of Functions

Type	Definition	Test
One-one (Injective)	$f(a_1) = f(a_2) \Rightarrow a_1 = a_2$	Different inputs $\rightarrow$ different outputs
Onto (Surjective)	Range = Codomain	Every element in codomain has a pre-image
Bijective	Both one-one and onto	Invertible function

Number of functions from A to B: $|B|^{|A|} = n(B)^{n(A)}$

Number of one-one functions: $P(n(B), n(A))$ if $n(B) \geq n(A)$, else 0

Number of onto functions: Uses inclusion-exclusion principle

Composition of Functions

$(g \circ f)(x) = g(f(x))$ — “g of f of x”

Read right to left: first apply f, then apply g

$g \circ f \neq f \circ g$ in general (not commutative)

$(g \circ f)$ is one-one if both f and g are one-one

$(g \circ f)$ is onto if both f and g are onto

Inverse of a Function

f^{-1} exists if and only if f is **bijective** (one-one AND onto)

$f^{-1}(y) = x$ where $f(x) = y$

$f \circ f^{-1} = I$ (identity function)

$f^{-1} \circ f = I$

Binary Operations

A binary operation $*$ on set A is a function from $A \times A \rightarrow A$

Commutative: $a * b = b * a$ for all a, b

Associative: $(a * b) * c = a * (b * c)$

Identity element e: $a * e = e * a = a$ for all a

Inverse of a: $a * b = b * a = e$

Solved Examples

Example 1

Q: Show that the relation R on Z defined by $R = \{(a,b) : a-b \text{ is divisible by } 3\}$ is an equivalence relation.

Solution:

Reflexive: $a - a = 0$, divisible by 3 ✓

Symmetric: If $a-b$ is div by 3, then $b-a = -(a-b)$ is also div by 3 ✓

Transitive: If $a-b = 3k$ and $b-c = 3m$, then $a-c = (a-b)+(b-c) = 3(k+m)$, div by 3 ✓

Hence R is an equivalence relation.

Example 2

Q: If $f(x) = 2x + 3$ and $g(x) = x^2$, find $g \circ f$ and $f \circ g$.

Solution:

$$g \circ f(x) = g(f(x)) = g(2x+3) = (2x+3)^2 = 4x^2 + 12x + 9$$

$$f \circ g(x) = f(g(x)) = f(x^2) = 2x^2 + 3$$

Clearly $g \circ f \neq f \circ g$

Important Questions

1 Mark

1. Is $\{(1,1), (2,2), (3,3)\}$ reflexive on $\{1,2,3\}$?
2. What is the identity element for addition on $\mathbb{R}$?

3-5 Mark

1. Prove that a relation is/is not an equivalence relation.
2. Show that f is bijective and find f^{-1} .
3. Find $g \circ f$ and $f \circ g$ for given functions.

Quick Revision Points

- Equivalence = reflexive + symmetric + transitive
- Bijective = one-one + onto = invertible
- Composition: $g \circ f$ means apply f first, then g
- f^{-1} exists $\iff f$ is bijective
- Binary operation: must be closed (result stays in the set)

Next: Inverse Trigonometric Functions →



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