

CLASS 11 MATHEMATICS — FORMULA SHEET

Chapter 2 : Relations and Functions (NCERT)

2.1 Ordered Pairs & Cartesian Product

Concept	Definition / Formula
Ordered pair	(a, b) ; order matters $\rightarrow (a, b) \neq (b, a)$ unless $a = b$
Equality of pairs	$(a, b) = (c, d) \Leftrightarrow a = c$ and $b = d$
Cartesian product $A \times B$	$\{(a, b) : a \in A, b \in B\}$
Cardinality	$n(A \times B) = n(A) \times n(B)$
$A \times B$ vs $B \times A$	$A \times B \neq B \times A$ (unless $A = B$ or one is empty)
$A \times A \times A$	Set of ordered triplets (a, b, c)
If $n(A) = p, n(B) = q$	$n(A \times B) = pq$; number of relations $= 2^{pq}$

2.2 Relations

Concept	Definition
Relation R (from A to B)	A subset of $A \times B$; $R \subseteq A \times B$
Domain of R	Set of all first elements (a) of the ordered pairs in R
Range of R	Set of all second elements (b) of the ordered pairs in R
Codomain of R	The set B (range $\subseteq$ codomain)
Number of relations	If $n(A) = p, n(B) = q \rightarrow$ total relations $= 2^{pq}$
Identity relation	$R = \{(a, a) : a \in A\}$
Empty & universal relation	$\emptyset$ (no pair) and $A \times A$ (all pairs)

2.3 Functions (Mappings)

Concept	Definition
Function $f : A \rightarrow B$	A relation where EVERY element of A has EXACTLY ONE image in B
Image & pre-image	If $f(a) = b$, then b is the image of a, and a is a pre-image of b
Domain	Set A (all inputs)
Codomain	Set B (all possible outputs)
Range	Set of actual outputs $\{f(a) : a \in A\}$; Range $\subseteq$ Codomain
Real function	Domain and range are subsets of R
Vertical line test	A graph is a function if every vertical line cuts it at most once

2.4 Standard Real Functions

Function	Definition	Domain & Range
Identity	$f(x) = x$	Domain R, Range R

Function	Definition	Domain & Range
Constant	$f(x) = c$	Domain $\mathbb{R}$, Range $\{c\}$
Polynomial	$f(x) = a_0 + a_1x + \dots + a_nx^n$	Domain $\mathbb{R}$
Modulus	$f(x) = x $	Domain $\mathbb{R}$, Range $[0, \infty)$
Signum	$f(x) = 1 \ (x>0), 0 \ (x=0), -1 \ (x<0)$	Range $\{-1, 0, 1\}$
Greatest integer $[x]$	Greatest integer $\leq x$	Domain $\mathbb{R}$, Range $\mathbb{Z}$
Reciprocal	$f(x) = 1/x$	Domain $\mathbb{R} - \{0\}$, Range $\mathbb{R} - \{0\}$
Square root	$f(x) = \sqrt{x}$	Domain $[0, \infty)$, Range $[0, \infty)$
Exponential	$f(x) = a^x, a > 0$	Domain $\mathbb{R}$, Range $(0, \infty)$
Logarithmic	$f(x) = \log_a x, a > 0, a \neq 1$	Domain $(0, \infty)$, Range $\mathbb{R}$

2.5 Algebra of Real Functions

Operation	Definition
Sum	$(f + g)(x) = f(x) + g(x)$
Difference	$(f - g)(x) = f(x) - g(x)$
Product	$(f \cdot g)(x) = f(x) \cdot g(x)$
Scalar multiple	$(c \cdot f)(x) = c \cdot f(x)$
Quotient	$(f/g)(x) = f(x) \div g(x)$, provided $g(x) \neq 0$
Domain of combination	Intersection of domains of f and g (exclude $g(x)=0$ for quotient)

2.6 Finding Domain & Range — Quick Rules

Form of $f(x)$	Domain Rule
Polynomial	All real numbers, $\mathbb{R}$
$1 \div g(x)$	All x except where $g(x) = 0$
$\sqrt{g(x)}$	$g(x) \geq 0$
$1 \div \sqrt{g(x)}$	$g(x) > 0$ (strictly)
$\log(g(x))$	$g(x) > 0$
Range tip	Express x in terms of y , or analyse min/max of $f(x)$

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Counting	$n(A \times B) = n(A) \cdot n(B)$; number of relations = 2 raised to (pq) — that's a LOT for big sets.
Function rule	Every input ONE output. Same x can't go to two different y 's.
Domain detectives	Denominator $\neq 0$; inside $\sqrt{\quad}$ must be ≥ 0 ; inside $\log$ must be > 0 .
Vertical line test	Function $\Leftrightarrow$ no vertical line meets the graph more than once.
$ x $ range	Modulus is always ≥ 0 , so range of $ x $ is $[0, \infty)$.

Greatest integer	$[2.7] = 2$, $[-2.3] = -3$ (goes DOWN to the lower integer).
Range $\subseteq$ Codomain	Range is what actually comes out; codomain is what could come out.
exp & log	They are inverses: domain of one = range of the other.