CHAPTER 3

Matrices

CBSE · Mathematics · Class 12

WHAT THIS CHAPTER DOES

Boards prep that builds confidence, not anxiety.

TODAY'S MISSION

Today's Mission

WHY THIS MATTERS

What is a matrix, really?

A matrix is a rectangular arrangement of numbers in m rows and n columns, written as an m×n array. Its true power is that it represents a LINEAR MAP: multiplying a matrix by an input column vector produces an output column vector. So a matrix is not just storage — it is a machine that transforms vectors. The order m×n tells you the machine takes an n-dimensional input and returns an m-dimensional output.

TOPIC

Pre-flight Check

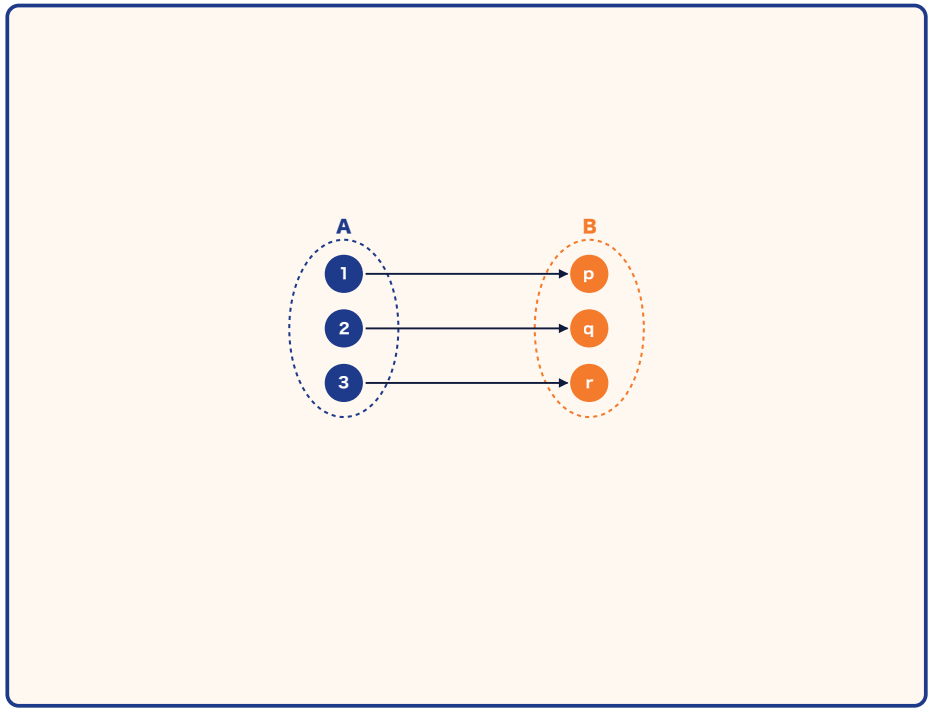
TOPIC

A

Part A — Definition, Order & Types

WORKED EXAMPLE

Worked Example 1 — A Matrix as a Map Between Vectors



TOPIC

Types of Matrices — Memorise These

POINT 1	POINT 2	POINT 3	POINT 4

WORKED EXAMPLE

Worked Example 2 — Order & Equality

TRY IT · SOLVE BEFORE YOU PEEK

Quick Test — 60 seconds

A matrix has 12 elements. How many possible orders can it have?

SOLUTION

TOPIC

Type-Recognition Reference Grid

TOPIC

B

Part B — Operations on Matrices

TOPIC

The Four Operations + Their Laws

POINT 1	POINT 2	POINT 3	POINT 4

WORKED EXAMPLE

Worked Example 3 — Multiplication is Not Commutative

TRY IT · SOLVE BEFORE YOU PEEK

Quick Test — multiplication compatibility

If A is 2×3 and B is 3×4, what is the order of AB?

SOLUTION

TOPIC

C

Part C — Transpose, Symmetry & Inverse

TOPIC

Transpose & Its Five Properties

POINT 1	POINT 2	POINT 3	POINT 4

TOPPER TEMPLATE · MARK-BY-MARK

Topper Template — Symmetric + Skew-Symmetric Split

WORKED EXAMPLE

Worked Example 4 — Inverse by Elementary Row Operations

TOPIC

Self-Assessment — Can you do these without notes?

MARKS DISTRIBUTION

Marks Heatmap — Where the Marks Hide

PYQ PATTERNS

PYQ Patterns — What CBSE Asks (2018-2024)

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Matrix multiplication is commutative: AB = BA always.

✓ **CORRECT** In general AB ≠ BA. The product AB may even be defined while BA is not, depending on orders. Order matters: A is m×n, B is n×p ⇒ AB is m×p.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Any two matrices can be multiplied.

✓ **CORRECT** AB is defined only when the number of COLUMNS of A equals the number of ROWS of B. An m×n matrix times an n×p matrix gives an m×p matrix; the inner dimensions must match.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** (AB)^T = A^T B^T (transpose distributes in the same order).

✓ **CORRECT** (AB)^T = B^T A^T — the order REVERSES. This is the reversal law for transpose.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** A scalar matrix and an identity matrix are the same thing.

✓ **CORRECT** An identity matrix has 1 on every diagonal entry. A scalar matrix has the SAME constant k on each diagonal entry (and 0 elsewhere). The identity is the special scalar matrix with k = 1.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** The diagonal entries of a skew-symmetric matrix can be any value.

✓ **CORRECT** For a skew-symmetric matrix A^T = –A, so a_ii = –a_ii forcing a_ii = 0. Every diagonal entry MUST be zero.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** When finding the inverse by elementary operations, you may mix row operations on A with column operations on I.

✓ **CORRECT** Fix ONE type at the start. For A = IA use only ROW operations on both sides; for A = AI use only COLUMN operations on both sides. Never switch midway, or the bookkeeping breaks.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Every square matrix has an inverse.

✓ **CORRECT** A square matrix A is invertible only if it is non-singular, i.e., $|A| \neq 0$. If during elementary operations a full row of zeros appears on the left, A is singular and A^{-1} does not exist.

TOPPER TEMPLATE · MARK-BY-MARK

State order of a matrix / list possible orders given number of elements (1-2 marks)

1	**RECALL ORDER MEANS ROWS × COLUMNS** 0.5 m	An m×n matrix has m rows and n columns, with mn total entries.
2	**LIST ALL FACTOR PAIRS OF THE ENTRY COUNT** 1 m	For 12 elements, mn = 12 ⇒ (m, n) ∈ {(1,12), (12,1), (2,6), (6,2), (3,4), (4,3)}.
3	**COUNT AND STATE** 0.5 m	There are 6 possible orders.

TOPPER TEMPLATE · MARK-BY-MARK

Find unknown entries by equality of matrices (1-2 marks)

1	**STATE THE EQUALITY CONDITION** 0.5 m	Two matrices are equal iff they have the same order AND corresponding entries are equal.
2	**WRITE THE ENTRYWISE EQUATIONS** 1 m	From [[x+y, 2],[5, x–y]] = [[6, 2],[5, 2]]: x + y = 6 and x – y = 2.
3	**SOLVE AND STATE** 0.5 m	Adding: 2x = 8 ⇒ x = 4; substituting, y = 2.

TOPPER TEMPLATE · MARK-BY-MARK

Verify transpose property such as (AB)^T = B^T A^T (3 marks)

1	**COMPUTE THE PRODUCT AB** 0.5 m	With A and B given, multiply rows of A by columns of B to obtain AB.
2	**TAKE THE TRANSPOSE OF THE PRODUCT** 1 m	(AB)^T is AB with rows and columns interchanged.
3	**COMPUTE B^T A^T SEPARATELY** 1 m	Find B^T and A^T, then multiply in the reversed order B^T A^T.
4	**COMPARE AND CONCLUDE** 0.5 m	Both matrices are identical, hence (AB)^T = B^T A^T is verified. ∎

PYQ PATTERNS

Top PYQ patterns to drill

#1	Order of a matrix / possible orders from element count (1 marks)	80%
#2	Unknown entries via equality of matrices (2 marks)	70%
#3	Verify (AB)^T = B^T A^T or test symmetry (3 marks)	65%
#4	Express A as symmetric + skew-symmetric (4 marks)	55%
#5	Inverse by elementary row operations (5 marks)	45%

RECAP · MEMORISE THESE

One-Slide Summary

WHAT'S NEXT

Next Class — Chapter 4: Determinants

Your 90-Minute Mastery Plan

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