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Topic 9:
Matrices (4048)

THE ABOUT

CHAPTER ANALYSIS

MASTERY

- Relatively straight forward chapter
- 2 **key** concepts

EXAM

- Concepts usually tested as a stand-alone topic
- Easy to make careless mistakes if not weary on the placement of matrices

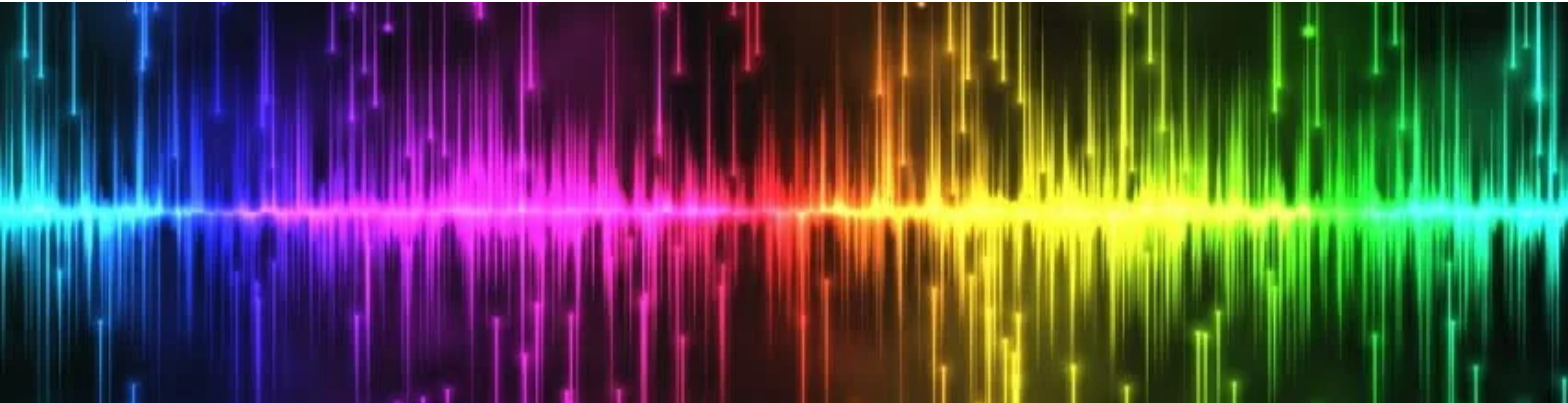
WEIGHTAGE

- High overall weightage
- Tested consistently every year
- Typically, a 10m question, 1 question in one of the papers

KEY CONCEPT

Matrices

Operations on Matrices



Special Matrices

Name	Definition	Example
Column	Only 1 column	$\begin{bmatrix}1\\2\end{bmatrix}$
Row	Only 1 row	$\begin{bmatrix}1 & 2\end{bmatrix}$
Square	Same number of rows and columns	$\begin{bmatrix}1 & 2\\3 & 4\end{bmatrix}$
Zero	Elements are all zeros	$\begin{bmatrix}0 & 0\\0 & 0\end{bmatrix}$
Identity	Elements along the diagonal from the upper left-hand corner to the bottom right-hand corner are 1s and the rest are 0s	$\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$

Knowledge on the usage of the Zero and Identity matrices is not necessary in 'O' Level Mathematics

Matrices

A two-dimensional array of numbers or expressions arranged in a set of **rows** and **columns** within brackets

$$\boldsymbol{A} = \begin{bmatrix}\mathbf{1} & \mathbf{2}\\ \mathbf{3} & \mathbf{4}\end{bmatrix}$$

Row

Bold capital letters

Column

Elements

Number of rows and columns are known as the order / dimension, the number of rows is specified first, followed by the columns

$$\boldsymbol{A} = \begin{bmatrix}\mathbf{1} & \mathbf{2} & \mathbf{3}\\ \mathbf{4} & \mathbf{5} & \mathbf{6}\end{bmatrix}$$

Order 2×3

Positions of elements in the matrix can be defined as $\boldsymbol{a_{ij}}$ where $\boldsymbol{a}$ is the element, $\boldsymbol{i}$ is the row number, and $\boldsymbol{j}$ is the column number

$$\boldsymbol{A} = \begin{bmatrix}\boldsymbol{a_{11}} & \boldsymbol{a_{12}} & \boldsymbol{a_{13}}\\ \boldsymbol{a_{21}} & \boldsymbol{a_{22}} & \boldsymbol{a_{23}}\end{bmatrix}$$

Take Note:

In order to perform any of the Operations of Matrices, the matrices **MUST** have the same order / dimension

When attempting such operations, map each element accurately before applying the operation

$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \quad B = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}$$

$$A + B = \begin{bmatrix} a_{11} + b_{11} & a_{12} + b_{12} \\ a_{21} + b_{21} & a_{22} + b_{22} \end{bmatrix}$$

Take Note:

$$A - B \neq B - A$$
$$AB \neq BA$$

Be careful of the way the matrices are ordered as the solution is dependent on the ordering

Operation on Matrices

1. Matrix Addition

Process of adding the corresponding elements of two or more matrices of the SAME order

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \quad B = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$$

$$A + B = \begin{bmatrix} 1+2 & 2+3 \\ 3+4 & 4+5 \end{bmatrix}$$

$$= \begin{bmatrix} 3 & 5 \\ 7 & 9 \end{bmatrix}$$

2. Matrix Subtraction

Process of subtracting the corresponding elements of two or more matrices of the SAME order

$$A = \begin{bmatrix} 2 & 4 \\ 6 & 8 \end{bmatrix} \quad B = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$$

$$A - B = \begin{bmatrix} 2-2 & 4-3 \\ 6-4 & 8-5 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 1 \\ 2 & 3 \end{bmatrix}$$

More information on Matrix Multiplication

How to determine the order of the resultant matrix?

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \end{bmatrix} \qquad B = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \\ b_{31} & b_{32} \end{bmatrix}$$

$$2 \times 3 \qquad\qquad 3 \times 2$$

Ensure that the column of the first matrix and the row of the second matrix are the same

The order of the resultant matrix will be the row of the first matrix and the column of the second matrix

Hence, the order of AB is 2×2

Operation on Matrices

3. Scalar Multiplication of Matrices

Process of **multiplying** each element of a matrix by a scalar

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

$$2A = \begin{bmatrix} 1(2) & 2(2) \\ 3(2) & 4(2) \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 4 \\ 6 & 8 \end{bmatrix}$$

4. Matrix Multiplication

Process of **multiplying** two or more matrices to obtain a single matrix

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \qquad B = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$$

$$AB = \begin{bmatrix} a_{11}(b_{11}) + a_{12}(b_{21}) & a_{11}(b_{12}) + a_{12}(b_{22}) \\ a_{21}(b_{11}) + a_{22}(b_{21}) & a_{21}(b_{22}) + a_{22}(b_{22}) \end{bmatrix}$$

$$= \begin{bmatrix} 1(2) + 2(4) & 1(3) + 2(5) \\ 3(2) + 4(4) & 3(3) + 4(5) \end{bmatrix}$$

$$= \begin{bmatrix} 10 & 13 \\ 22 & 29 \end{bmatrix}$$

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