Unit 6 · Matrices Cheat Sheet

Unit 6 focus: matrix operations and multiplication

1 KEY VOCABULARY

dimensions	rows × columns.	2 × 3 matrix
identity matrix	1s on the diagonal, 0s elsewhere.	AI = A
scalar	A single number multiplying every entry.	3A
square matrix	Same rows and columns.	2 × 2

2 ADDING AND SCALAR MULTIPLICATION

Add matching entries. A scalar multiplies every entry.

Example: $2\begin{bmatrix}1 & -3\\4 & 0\end{bmatrix}+\begin{bmatrix}2 & 5\\-1 & 6\end{bmatrix}$

Scale: $\begin{bmatrix}2 & -6\\8 & 0\end{bmatrix}$

Answer: $\begin{bmatrix}4 & -1\\7 & 6\end{bmatrix}$

3 MATRIX MULTIPLICATION

Row of the first times column of the second. Inner dimensions must match.

Example: $\begin{bmatrix}1 & 2\\3 & 4\end{bmatrix}\begin{bmatrix}5\\6\end{bmatrix}$

Row 1: $1\cdot5 + 2\cdot6 = 17$

Row 2: $3\cdot5 + 4\cdot6 = 39$

Answer: $\begin{bmatrix}17\\39\end{bmatrix}$

4 WHEN CAN YOU MULTIPLY?

A × B	Result
(2 × 3)(3 × 4)	2 × 4
(3 × 2)(3 × 2)	undefined
(1 × 3)(3 × 1)	1 × 1

Matrix multiplication is NOT commutative: AB ≠ BA in general.

5 MATRICES IN CONTEXT

Inventory × prices	**total cost per store**
Transformation matrix	**rotates or reflects points**
Adjacency matrix	**connections in a network**

6 QUICK REMINDERS & COMMON MISTAKES

✔ Do remember

- Write dimensions before multiplying.
- Add only matrices of the same size.
- Order matters in multiplication.

✘ Common mistakes

- Multiplying entry by entry: row × column
- AB = BA: usually not
- Adding a 2 × 2 to a 2 × 3: undefined

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More practice: determinants, inverses and solving systems

1 2 × 2 DETERMINANT

$$\det \begin{bmatrix} a & b \\ c & d \end{bmatrix} = ad - bc$$

Example: $\begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix}$

ad − bc: 20 − 6

Answer: 14

2 2 × 2 INVERSE

$$A^{-1} = \frac{1}{ad-bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$

Example: $\begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix}$

Swap a and d, negate b and c: divide by det = 14

Answer: $\frac{1}{14} \begin{bmatrix} 5 & -3 \\ -2 & 4 \end{bmatrix}$

3 SOLVING AX = B

$X = A^{-1}B$ (multiply on the LEFT).

Example: 4x + 3y = 10, 2x + 5y = 12

Multiply: $\frac{1}{14}(5 \cdot 10 - 3 \cdot 12,\ -2 \cdot 10 + 4 \cdot 12)$

Answer: x = 1, y = 2

4 3 × 3 DETERMINANT (EXPAND ROW 1)

Term	Sign
$a_{11} \cdot \text{minor}_{11}$	+
$a_{12} \cdot \text{minor}_{12}$	−
$a_{13} \cdot \text{minor}_{13}$	+

If det = 0, the matrix has no inverse (singular).

5 CRAMER'S RULE

$x = \frac{\det A_x}{\det A}$: replace the x-column with the constants.

Example: 4x + 3y = 10, 2x + 5y = 12

det A_x: 10·5 − 3·12 = 14

Answer: $x = \frac{14}{14} = 1$

6 CHECK YOURSELF

- Is det ≠ 0 before I invert?
- Did I multiply A^{-1} on the LEFT of B?
- Did I check my solution in the original system?
- Do the dimensions allow this product?