Key

5.02 Matrix Multiplication Extra Practice

State the dimensions of each matrix and, if multiplication is possible, give the dimensions of the answer.

1. $\begin{bmatrix} 8 & -7 & 0 \\ 3 & 4 & -5 \end{bmatrix} \cdot \begin{bmatrix} 6 \\ -2 \\ 1 \end{bmatrix} = ?$

A · B = AB

2×3 3×1

A = 2×3

B = 3×1

AB = 2×1

2. $\begin{bmatrix} 6 & -2 \\ 0 & -9 \\ 4 & 5 \end{bmatrix} \cdot \begin{bmatrix} 6 \\ -7 \\ 8 \end{bmatrix} = ?$

A · B = AB

3×2 × 3×1

A = 3×2

B = 3×1

AB = not possible

3. $\begin{bmatrix} 11 \\ -3 \\ 0 \end{bmatrix} \cdot [7 \quad 2 \quad -5] = ?$

A · B = AB

3×1 1×3

A = 3×1

B = 1×3

AB = 3×3

Evaluate.

2×2 2×1

4. $\begin{bmatrix} -6 & -2 \\ -4 & 3 \end{bmatrix} \cdot \begin{bmatrix} -1 \\ -6 \end{bmatrix}$

$\begin{bmatrix} -6 & -2 \\ -4 & 3 \end{bmatrix} \begin{bmatrix} -1 \\ -6 \end{bmatrix} \begin{matrix} -6(-1)+-2(-6) \\ -4(-1)+3(-6) \end{matrix} \rightarrow \begin{bmatrix} 18 \\ -14 \end{bmatrix}$

5. $\begin{bmatrix} -2 & 6 \\ 3 & -3 \end{bmatrix} \cdot \begin{bmatrix} -2 & 1 \\ 4 & 1 \end{bmatrix}$

2×2 2×2

$\begin{bmatrix} -2 & 6 \\ 3 & -3 \end{bmatrix} \begin{bmatrix} -2 & 1 \\ 4 & 1 \end{bmatrix} \begin{matrix} -2(-2)+6(4) & -2(1)+6(1) \\ 3(-2)+-3(4) & 3(1)+-3(1) \end{matrix} \rightarrow \begin{bmatrix} 28 & 4 \\ -18 & 0 \end{bmatrix}$

6. $\begin{bmatrix} 1 & 4 & 2 \\ -1 & 3 & -4 \end{bmatrix} \cdot \begin{bmatrix} -3 \\ 4 \\ -1 \end{bmatrix}$

2×3 3×1

$\begin{bmatrix} 1 & 4 & 2 \\ -1 & 3 & -4 \end{bmatrix} \begin{bmatrix} -3 \\ 4 \\ -1 \end{bmatrix} \begin{matrix} 1(-3)+4(4)+2(-1) \\ -1(-3)+3(4)+-4(-1) \end{matrix}$

$\begin{bmatrix} 11 \\ 19 \end{bmatrix}$

7. $\begin{bmatrix} 6 & -5 \\ 4 & -1 \\ 0 & -5 \end{bmatrix} \cdot \begin{bmatrix} -2 & 6 \\ 4 & 5 \\ 5 & 6 \end{bmatrix}$

3×2 3×2

not possible

8. $\begin{bmatrix} -3 & -1 \\ 0 & -1 \\ -4 & 2 \end{bmatrix} \cdot \begin{bmatrix} 0 & -4 \\ 6 & 3 \end{bmatrix}$

$3 \times 2 \quad 2 \times 2$

$\begin{bmatrix} 0 & -4 \\ 6 & 3 \end{bmatrix}$

$\begin{bmatrix} -3 & -1 \\ 0 & -1 \\ -4 & 2 \end{bmatrix} \begin{matrix} -3(0)+-1(6) & -3(-4)+-1(3) \\ 0(0)+-1(6) & 0(-4)+-1(3) \\ -4(0)+2(6) & -4(-4)+2(3) \end{matrix}$

$\begin{bmatrix} -6 & 9 \\ -6 & -3 \\ 12 & 22 \end{bmatrix}$

multiply this first!

9. $\begin{bmatrix} -5 & 1 \end{bmatrix} \cdot \left(\begin{bmatrix} 4 & -1 \\ -5 & -6 \end{bmatrix} \cdot \begin{bmatrix} 0 & 2 & 0 \\ 0 & 5 & 5 \end{bmatrix} \right)$

$2 \times 2 \quad 2 \times 3$

$\begin{bmatrix} 0 & 2 & 0 \\ 0 & 5 & 5 \end{bmatrix}$

$\begin{bmatrix} 4 & -1 \\ -5 & -6 \end{bmatrix} \begin{matrix} 4(0)+-1(0) & 4(2)-5 & 0-5 \\ -5(0)-6(0) & -10-30 & 0-30 \end{matrix} \rightarrow \begin{bmatrix} 0 & 3 & -5 \\ 0 & -40 & -30 \end{bmatrix}$

$\begin{bmatrix} -5 & 1 \end{bmatrix} \cdot \begin{bmatrix} 0 & 3 & -5 \\ 0 & -40 & -30 \end{bmatrix} \rightarrow 1 \times 2 \quad 2 \times 3$

$\begin{bmatrix} 0 & 3 & -5 \\ 0 & -40 & -30 \end{bmatrix}$

$\begin{bmatrix} -5 & 1 \end{bmatrix} \begin{matrix} -5(0)+1(0) & 3(-5)+1(-40) & -5(-5)+1(-30) \end{matrix}$

$\rightarrow \begin{bmatrix} 0 & -55 & -5 \end{bmatrix}$

Use matrix multiplication to determine if the matrices are inverses.

10. $A = \begin{bmatrix} 2 & -3 \\ -3 & 5 \end{bmatrix}$ *and* $B = \begin{bmatrix} 5 & 3 \\ -3 & 2 \end{bmatrix}$

$\begin{bmatrix} 5 & 3 \\ -3 & 2 \end{bmatrix}$

$\begin{bmatrix} 2 & -3 \\ -3 & 5 \end{bmatrix} \begin{matrix} 2(5)+-3(-3) & 2(3)+-3(2) \\ -3(5)+5(-3) & -3(3)+5(2) \end{matrix} \rightarrow \begin{bmatrix} 19 & 0 \\ -30 & 1 \end{bmatrix}$

No, matrix A and B are not inverses since $[A][B] \neq I$

identity matrix

11. $A = \begin{bmatrix} 5 & 11 \\ -4 & -9 \end{bmatrix}$ *and* $B = \begin{bmatrix} 9 & 11 \\ -4 & -5 \end{bmatrix}$

$\begin{bmatrix} 9 & 11 \\ -4 & -5 \end{bmatrix}$

$\begin{bmatrix} 5 & 11 \\ -4 & -9 \end{bmatrix} \begin{matrix} 5(9)+11(-4) & 5(11)+11(-5) \\ -4(9)+-9(-4) & -4(11)+-9(-5) \end{matrix} \rightarrow \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Yes, matrix A and B are inverses since $[A][B] = I$

Identity matrix