# Matrix multiplication and non-commutativity

6 questions | 12 marks

Equivalent correct methods earn the corresponding marks.

**1.** Find $\begin{pmatrix}2 & 1\end{pmatrix}\begin{pmatrix}3\\-4\end{pmatrix}$. [2 marks]

The product is $2(3)+1(-4)=2$.

**Answer:** 2.

**2.** Find $\begin{pmatrix}1 & 2\\3 & 0\end{pmatrix}\begin{pmatrix}2 & 1\\1 & 4\end{pmatrix}$. [2 marks]

Rows dotted with columns give $(2+2, 1+8)$ and $(6+0, 3+0)$.

**Answer:** $\begin{pmatrix}4 & 9\\6 & 3\end{pmatrix}$.

**3.** A is $3\times 2$ and B is $2\times 5$. State the order of AB and explain whether BA exists. [2 marks]

The AB inner dimensions are both 2.

For BA the inner dimensions would be 5 and 3, which do not match.

**Answer:** AB is $3\times 5$; BA is not defined.

**4.** Find $\begin{pmatrix}1\\2\end{pmatrix}\begin{pmatrix}3 & 4\end{pmatrix}$. [2 marks]

A $2 \times 1$ by $1 \times 2$ product has order $2 \times 2$.

Multiply each column-vector entry by the row.

**Answer:** $\begin{pmatrix}3 & 4\\6 & 8\end{pmatrix}$.

**5.** For $A = \begin{pmatrix}0 & 1\\1 & 0\end{pmatrix}$, calculate $A^2$. [2 marks]

Each output column is found by applying A twice.

Direct multiplication gives diagonal entries 1 and off-diagonal entries 0.

**Answer:** $I = \begin{pmatrix}1 & 0\\0 & 1\end{pmatrix}$.

**6.** A shop sells 6 notebooks at 4 dollars each and 3 folders at 5 dollars each. Express the total as a row-column matrix product and evaluate it. [2 marks]

Quantities form a row and prices form a column.

$6(4) + 3(5) = 39$.

**Answer:** $\begin{pmatrix}6 & 3\end{pmatrix}\begin{pmatrix}4\\5\end{pmatrix} = 39$ dollars.