# Combined transformations and their order

6 questions | 12 marks

Equivalent correct methods earn the corresponding marks.

**1.** First dilate by factor 3, then reflect in the $y$-axis. Give the matrix. [2 marks]

Multiply the reflection matrix by $3I$.

**Answer:** $\begin{pmatrix} -3 & 0 \\ 0 & 3 \end{pmatrix}$.

**2.** First reflect in $y = x$, then in the $x$-axis. Describe the result. [2 marks]

The coordinate rule is $(x, y)$ to $(y, x)$, then $(y, -x)$.

**Answer:** Rotation $90^\circ$ clockwise.

**3.** For $A = \begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$, find $BA$. [2 marks]

Use row-column multiplication in the written order.

**Answer:** $\begin{pmatrix} 0 & -1 \\ 2 & 0 \end{pmatrix}$.

**4.** For those $A$ and $B$, find $AB$ and compare. [2 marks]

The off-diagonal entries are different.

**Answer:** $AB = \begin{pmatrix} 0 & -2 \\ 1 & 0 \end{pmatrix} \neq BA$.

**5.** Explain why dilation $kI$ commutes with every linear transformation $A$. [2 marks]

The scalar multiplies each entry of $A$ on either side.

**Answer:** $A(kI) = (kI)A = kA$.

**6.** Project $(2, 5)$ onto the $x$-axis, then rotate $90^\circ$ counterclockwise. [2 marks]

Projection gives $(2, 0)$.

The rotation gives $(0, 2)$.

**Answer:** $(0, 2)$.