

1. Consider the linear map  $h : \mathbb{R}^2 \rightarrow \mathbb{R}^2$  which reflects vectors across the  $y$ -axis. Which of the following is the matrix representation of this map with respect to the standard basis on both the domain and the codomain?

(A)  $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$

(B)  $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$

(C)  $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$

(D)  $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$

2. Consider the unique linear map  $h : \mathbb{R}^2 \rightarrow \mathbb{R}^2$  which has the property that

$$\begin{pmatrix} 1 \\ 1 \end{pmatrix} \mapsto \begin{pmatrix} 2 \\ 0 \end{pmatrix} \quad \text{and} \quad \begin{pmatrix} 1 \\ 0 \end{pmatrix} \mapsto \begin{pmatrix} -1 \\ 0 \end{pmatrix}$$

Which of the following is the representation of this map with respect to the standard basis on both the domain and the codomain?

(A)  $\begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}$

(B)  $\begin{pmatrix} 2 & -1 \\ 0 & 0 \end{pmatrix}$

(C)  $\begin{pmatrix} -1 & 3 \\ 0 & 0 \end{pmatrix}$

3. Consider the linear map  $h : \mathbb{R}^3 \rightarrow \mathbb{R}^3$  which rotates vectors counterclockwise around the  $z$ -axis by  $90^\circ$ . Which of the following is the matrix representation of this map with respect to the standard basis on both the domain and the codomain?

(A) 
$$\begin{pmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

(B) 
$$\begin{pmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

(C) 
$$\begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & -1 \end{pmatrix}$$

4. True or False?

Let  $B = \left\langle \begin{pmatrix} 1 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 \\ 1 \end{pmatrix} \right\rangle$ , and let  $h : \mathbb{R}^2 \rightarrow \mathbb{R}^2$  be the linear map such that

$$\text{Rep}_{B,B}(h) = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}.$$

Then  $h$  is given by  $\begin{pmatrix} x \\ y \end{pmatrix} \mapsto \begin{pmatrix} x + 2y \\ 3x + 4y \end{pmatrix}$ .

5. Suppose a matrix  $A$  represents a linear map  $\mathbb{R}^2 \rightarrow \mathcal{M}_{2 \times 2}$ . How many rows and columns does the matrix  $A$  have?

(A) 2 rows, 2 columns

(B) 2 rows, 4 columns

(C) 4 rows, 2 columns

(D) 4 rows, 4 columns