

Linear Algebra

Instructions Please write your name in the upper right-hand corner of the page. Use complete sentences, along with any necessary supporting calculations, to answer the following questions.

1. Suppose $A = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$. The matrix A represents the linear operator

$$\begin{pmatrix} x_1 \\ x_2 \end{pmatrix} \mapsto \begin{pmatrix} -x_1 \\ x_2 \end{pmatrix}$$

on \mathbb{R}^2 with respect to the standard basis $\left[\begin{pmatrix} 1 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \end{pmatrix} \right]$, and the matrix B represents the same operator with respect to the nonstandard basis $\left[\begin{pmatrix} 1 \\ 1 \end{pmatrix}, \begin{pmatrix} -1 \\ 1 \end{pmatrix} \right]$. Find a matrix S such that $S^{-1}AS = B$.

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2. In the space R^3 equipped with its standard scalar product, find the vector projection of the vector $\begin{pmatrix} 2 \\ 4 \\ 3 \end{pmatrix}$ onto the vector $\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$.

[This is exercise 3(c) on page 224 of the textbook.]