Matrix Form of Spin Operators

1. Find the matrix whose eigenvalues are $\hbar/2$ and $-\hbar/2$ and whose eigenvectors are $|+\rangle$ and $|-\rangle$. Write the matrix in the z-basis.

2. Find the matrix whose eigen values are $\hbar/2$ and $-\hbar/2$ and whose eigenvectors are $|+\rangle_x$ and $|-\rangle_x$. Write the matrix in the z-basis.

3. Find the matrix whose eigen values are $\hbar/2$ and $-\hbar/2$ and whose eigenvectors are $|+\rangle_y$ and $|-\rangle_y$. Write the matrix in the z-basis.

4. Show that each of the above matrices can be written as a linear combination of projection operators, where the projection operators are outer products of the eigenvectors with themselves and the coefficient of each term is the eigenvalue associated with the eigenvector used to make the projection operators.

5. The above matrices are the spin operators S_z, S_x, and S_y. If a spin operator acts on a vector, what transformation does the operator correspond to? Does this transformation correspond to making a spin measurement on an initial state?