Matrix Form of Spin Operators

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

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

3. Find the matrix $\hat{n} \cdot \vec{S}$. What are its eigenvectors and eigenvalues?