[1] Let $P$ be the set of all polynomials $f(x)$, and let $Q$ be the subset of $P$ consisting of all polynomials $f(x)$ so $f(0) = f(1) = 0$. Show that $Q$ is a subspace of $P$. 
Problem: _____
[2] Let $A$ be the matrix

$$A = \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 1 & -1 & 0 \end{bmatrix}.$$ 

Compute the row space and column space of $A$. 
Problem: _____
The four vectors

\[ \mathbf{v}_1 = \begin{bmatrix} 1 \\ 0 \\ 2 \end{bmatrix}, \quad \mathbf{v}_2 = \begin{bmatrix} -1 \\ 0 \\ -2 \end{bmatrix}, \quad \mathbf{v}_3 = \begin{bmatrix} 1 \\ 2 \\ 6 \end{bmatrix}, \quad \mathbf{v}_4 = \begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix} \]

span a subspace \( V \) of \( \mathbb{R}^3 \), but are not a basis for \( V \). Choose a subset of \( \{ \mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3, \mathbf{v}_4 \} \) which forms a basis for \( V \). Extend this basis for \( V \) to a basis for \( \mathbb{R}^3 \).
Problem: _____
[4] Let $L$ be the linear transformation from $\mathbb{R}^3$ to $\mathbb{R}^3$ which rotates one half turn around the axis given by the vector $(1,1,1)$. Find a matrix $A$ representing $L$ with respect to the standard basis

$$e_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, \quad e_2 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, \quad e_3 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}.$$ 

Choose a new basis $\{v_1, v_2, v_3\}$ for $\mathbb{R}^3$ which makes $L$ easier to describe, and find a matrix $B$ representing $L$ with respect to this new basis.
Problem: _____
Let \( \{e_1, e_2\} \) and \( \{v_1, v_2\} \) be ordered bases for \( \mathbb{R}^2 \), and let \( L \) be the linear transformation represented by the matrix \( A \) with respect to \( \{e_1, e_2\} \), where

\[
\begin{align*}
e_1 &= \begin{bmatrix} 1 \\ 0 \end{bmatrix}, \quad e_2 = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, \quad v_1 = \begin{bmatrix} 2 \\ 1 \end{bmatrix}, \quad v_2 = \begin{bmatrix} 1 \\ -2 \end{bmatrix}, \quad A = \begin{bmatrix} 6 & -2 \\ -2 & 9 \end{bmatrix}.
\end{align*}
\]

Find the transition matrix \( S \) corresponding to the change of basis from \( \{e_1, e_2\} \) to \( \{v_1, v_2\} \). Find a matrix \( B \) representing \( L \) with respect to \( \{v_1, v_2\} \).
Problem: _____