1. Carefully state the definition of “subspace”. Give two examples from $\mathbb{R}^2$.

2. Carefully state five of the eight vector space axioms.

3. Let $S = \{f(x) : f(17) = 0\} \subseteq \mathbb{R}[x]$ be the set of all polynomials that are zero at $x = 17$. Prove that this is a vector space.

4. Determine, with justification, whether $(1, 1, 1)$ is in $\text{Span}(S)$, for $S = \{(1, 2, 1), (0, 3, 2), (2, 1, 0)\}$.

5. Let $W_1 = \text{Span}(S)$, for $S = \{\begin{pmatrix} 1 & 1 \\ 0 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 0 \\ 1 & 1 \end{pmatrix}\}$. Let $W_2 = \text{Span}(T)$, for $T = \{\begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 0 \\ 1 & 1 \end{pmatrix}\}$. Prove that $W_1 \oplus W_2 = M_{22}(\mathbb{R})$ (the set of all $2 \times 2$ matrices).

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Please write all solutions on this page (front and back if necessary).