1. Let $\vec{u} = \begin{bmatrix} 3 \\ 4 \\ 1 \end{bmatrix}$, $\vec{v} = \begin{bmatrix} 4 \\ -4 \\ -4 \end{bmatrix}$, and $\vec{w} = \begin{bmatrix} 14 \\ 0 \\ d \end{bmatrix}$.

   (a) For what value(s) of d is $\operatorname{span}\{\vec{u}, \vec{v}, \vec{w}\}$ a plane?

   (b) Is there a value of d so $\operatorname{span}\{\vec{u}, \vec{v}, \vec{w}\}$ a line? Explain.

2. Let $G \subseteq \mathbb{R}^2$ be the graph of the line given by the equation $y = 3x + 2$. Find vectors $\vec{d}$ and $\vec{p}$ so that
$$G = \{\vec{x} \in \mathbb{R}^2 : \vec{x} = t\vec{d} + \vec{p} \text{ for some } t \in \mathbb{R}\}.$$

3. Let $\vec{v} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$,
$$X = \{\vec{x} \in \mathbb{R}^2 : \vec{x} \cdot \vec{v} = 0\}$$
$$Y = \{\vec{x} \in \mathbb{R}^2 : \vec{x} \cdot \vec{v} = -3\}.$$

   (a) Draw X and Y. What do you notice? Are either of them subspaces?

   (b) Find a vector $\vec{w}$ so that
$$Y = \{\vec{x} + \vec{w} : \vec{x} \in X\}.$$

4. Let $\vec{x} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ and $\vec{y} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$. Prove that $\{\vec{x}, \vec{y}\}$ is a basis for $\mathbb{R}^2$.

5. Let
$$U = \operatorname{span}\left\{ \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}, \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}, \begin{bmatrix} 4 \\ 4 \\ 4 \end{bmatrix} \right\},$$
$$V = \left\{ \vec{x} \in \mathbb{R}^3 : \vec{x} \cdot \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = 0 \right\},$$
$$W = U \cup V.$$

   For each subset U, V, W of $\mathbb{R}^3$, show whether it is a subspace or not. If it is a subspace, classify it as a point, line, plane, or all of $\mathbb{R}^3$. Further, if it is a subspace, give a basis for it.