1. Give an example of a subset of $\mathbb{R}^2$ that is closed under addition but is not a subspace of $\mathbb{R}^2$.

One example is the set of vectors $\{ \begin{bmatrix} a \\ b \end{bmatrix} : a, b \geq 0 \}$.

2. Find a basis for the nullspace of the matrix:

$$\begin{bmatrix} 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

This corresponds to the linear system: $x_2 + x_4 = 0$, $x_3 + x_4 = 0$, so if we write down the general solution in vector form we see that the basis is $\{ \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ -1 \\ -1 \\ 1 \end{bmatrix} \}$. 