1. Consider the following,

$$f(x,y) = \begin{bmatrix} 2x + y \\ x - y \end{bmatrix}, \qquad g(x,y) = \begin{bmatrix} x + y \\ -y \end{bmatrix}$$

Define $h(x,y) = g \circ f(x,y)$. Find the matrix such that

$$h(x,y) = A \begin{bmatrix} x \\ y \end{bmatrix}$$

2. Let $n = (1,2,3)^T \in \mathbb{R}^3$. Let T be the orthogonal projection onto the line $\{tn : t \in \mathbb{R}\}$, and S be the reflection about the plane $\{x : n \cdot x = 0\}$. Are T and S invertible? Why and why not?

Hint: You can use the fact that an injective and surjective map is invertible. You only need to provide a prose explanation.