a) Given, the affine sets for $x \in \mathbb{R}^2$

$$\mathcal{X}_1 = \{x \mid x_1 + x_2 = 1, x \in \mathbb{R}^2\}$$

$$\mathcal{X}_2 = \{x \mid x_1 - x_2 = 1, x \in \mathbb{R}^2\}$$

Now, for $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and $x \in \mathcal{X}_1$.

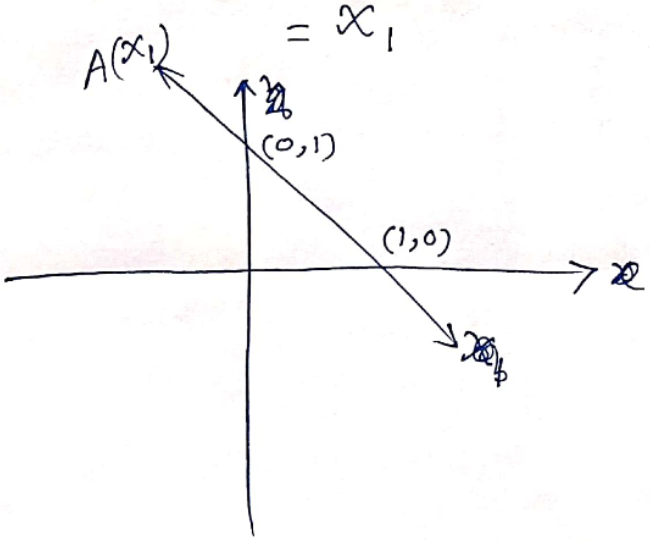
$$\mathcal{X}_1 = \{x \mid x_1 + x_2 = 1, x \in \mathbb{R}^2\}$$

$$= \{x = (x_1, 1 - x_1) : x_1 \in \mathbb{R}\}$$

$$\therefore Ax = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ 1 - x_1 \end{bmatrix} = \begin{bmatrix} x_1 \\ 1 - x_1 \end{bmatrix}, \text{ for all } x \in \mathcal{X}_1$$

$$\Rightarrow A(\mathcal{X}_1) = \{(x_1, 1 - x_1) : x_1 \in \mathbb{R}\}$$

$$= \mathcal{X}_1$$




Now, for $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and $x \in \mathcal{X}_2$.

$$\mathcal{X}_2 = \{x \mid x_1 - x_2 = 1, x \in \mathbb{R}^2\}$$

$$= \{x = (x_1, x_1 - 1) : x_1 \in \mathbb{R}\}$$