1. Let $T : \mathbb{R}^2 \to \mathbb{R}^3$ be defined by $T(x_1, x_2) = (x_1 - x_2, x_1, 2x_1 + x_2)$.

(a) Show that T is a linear map.

(b) Find dimensions of null(T) and Im(T).

(c) Write matrix representation of T with respect to standard bases of $\mathbb{R}^2$ and $\mathbb{R}^3$.

(d) Write matrix representation of T with respect to bases $\{(1, 2), (0, 1)\}$ of $\mathbb{R}^2$ and $\{(1, 1, 0), (0, 1, 1), (2, 2, 3)\}$ of $\mathbb{R}^3$.