1. Let $M = \begin{bmatrix} 5 & 3 & 3 & 21 \\ 2 & 1 & 0 & 6 \\ 7 & 3 & 3 & 27 \end{bmatrix}$; then its RREF is $\begin{bmatrix} 1 & 0 & 0 & 3 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 2 \end{bmatrix}$. Label the columns of M as $\mathbf{m}_1$, $\mathbf{m}_2$, $\mathbf{m}_3$, and $\mathbf{m}_4$.

1A.) Use the RREF of M to express $\mathbf{m}_4$ as a linear combination of the other columns and verify your LC "adds up" to $\mathbf{m}_4$, or explain correctly why no such LC can be found.

1B.) Use the RREF of M to express $\mathbf{m}_2$ as a linear combination of the other columns and verify your LC "adds up" to $\mathbf{m}_2$, or explain correctly why no such LC can be found.

2. Suppose that T is a transformation from $\mathbb{R}^n$ to $\mathbb{R}^m$. There are two conditions that T must satisfy in order to be a *linear* transformation. They are:

2a. the equation [ ] is true for every pair of vectors $\mathbf{u}$ and $\mathbf{v}$ in $\mathbb{R}^n$, and

2b. the equation [ ] is true for any scalar $\alpha \in \mathbb{R}$ and vector $\mathbf{w} \in \mathbb{R}^n$.

2c. Define $T : \mathbb{R}^2 \to \mathbb{R}^2$ by $T\left(\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}\right) = \begin{bmatrix} 3x_1 + 4x_2 + 10 \\ x_1 x_2 \end{bmatrix}$. Show that T fails to satisfy the equation in (2a) using the vectors $\mathbf{u} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$ and $\mathbf{v} = \begin{bmatrix} 6 \\ 5 \end{bmatrix}$.