Problem 1. a- (4 points) Show that the set of vectors
\[
\begin{pmatrix} 2 \\ 0 \\ 1 \end{pmatrix}, \begin{pmatrix} 1 \\ 3 \\ 2 \end{pmatrix}, \begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix}
\]
form a basis of \( \mathbb{R}^3 \).
b- (4 points) Find the coordinates of
\[
\begin{pmatrix}
1 \\
-6 \\
-4
\end{pmatrix}
\quad \text{and} \quad
\begin{pmatrix}
4 \\
3 \\
2
\end{pmatrix}
\]
in this basis and double check your answer.
Problem 2. (6 points) Find every value of $a$ such that the null space of

$$\begin{bmatrix}
a & 0 & -a \\
1 & a & 1 \\
3 & 1 & 3
\end{bmatrix}$$

is not $\{\vec{0}\}$. Double check your answer.
Problem 3. (6 points) Let \( f \) be the linear transformation defined by

\[
\begin{pmatrix}
  x \\
  y \\
  z
\end{pmatrix}
\mapsto
\begin{pmatrix}
  x + 4y - z \\
  2x - 3z
\end{pmatrix}
\]

Find a matrix \( A \) such that \( f(\vec{u}) = A\vec{u} \) for every \( \vec{u} \). Show that \( \text{col}(A) = \mathbb{R}^2 \). Find a basis of \( \text{null}(A) \).