Show your work in the space provided. Unsupported answers may not receive full credit.

1. Solve the linear system below, using the method of row reduction. You must show all of your steps in converting the augmented matrix to reduced row echelon form.

\[
\begin{align*}
  x + 2y + 3z &= 9 \\
  2x - y + z &= 8 \\
  3x - z &= 3
\end{align*}
\]

2. Solve the homogeneous linear system below, using the method of row reduction. You must show all of your steps in converting the augmented matrix to reduced row echelon form.

\[
\begin{align*}
  x + 2y - 3z + 2w &= 0 \\
  2x + 4y - 6z + w &= 0 \\
  3x + 6y - 9z - 6w &= 0
\end{align*}
\]

3. Write your solution to the previous problem as a linear combination of vectors whose components are numbers.

4. Suppose \( u = (1, 2, -2) \) and \( v = (2, 3, -2) \) and \( S = \text{Span}\{u, v\} \). Find a vector \( b \) which is not in \( S \).

5. Let \( A \) be an \( m \times n \) matrix. Suppose that the columns of \( A \) span \( \mathbb{R}^m \). List at least two other statements that are equivalent to the columns of \( A \) spanning \( \mathbb{R}^m \).

6. Consider the vectors \( v_1 = (1, 0, 1, 2), v_2 = (0, 1, 1, 2), \) and \( v_3 = (1, 1, 1, 3) \) in \( \mathbb{R}^4 \). Is \( S = \{v_1, v_2, v_3\} \) linearly independent or linearly dependent?

7. Explain why no set of three vectors in \( \mathbb{R}^4 \) can span \( \mathbb{R}^4 \).