1. Find the characteristic polynomial (or equation) for the matrix
\[
\begin{bmatrix}
3 & -2 & 8 \\
0 & 5 & -2 \\
0 & -4 & 3
\end{bmatrix}
\]

2. Find the characteristic polynomial and the eigenvalues of the matrix
\[
\begin{bmatrix}
3 & -1 \\
1 & -1
\end{bmatrix}
\]

3. Given an \( n \times n \) matrix, say \( A \), explain when \( 0 \) is an eigenvalue of \( A \).
4. Let $T : \mathbb{R}^n \rightarrow \mathbb{R}^m$ be a linear transformation.
   a) Define the null space of $T$, denoted $\text{nul}(T)$.
   
   b) Prove that $\text{nul}(T)$ is a subspace.

5. True or False: If $A\mathbf{x} = \lambda \mathbf{x}$ for some scalar $\lambda$, then $\mathbf{x}$ is an eigenvector of $A$.

6. The eigenvalues of a matrix are on its main diagonal.

7. For a given matrix $A$ an elementary row operation on $A$ does not change the determinant.
8. Let 

\[ P = \begin{bmatrix} 5 & -2 \\ -7 & 3 \end{bmatrix} \] \text{ and } \ D = \begin{bmatrix} 1 & 0 \\ 0 & -13 \end{bmatrix}. \]

If \( A = PDP^{-1} \), then find \( A^4 \).

9. Consider the matrix

\[ A = \begin{bmatrix} 5 & -2 & 6 & -1 \\ 0 & 3 & h & 0 \\ 0 & 0 & 5 & 4 \\ 0 & 0 & 0 & 1 \end{bmatrix} \]

Find \( h \) so that the dimension of the eigenspace corresponding to \( \lambda = 5 \) is 2.
10. a) Find the characteristic polynomial for the following matrix.
   b) Find the eigenvalues.
   c) Find a basis for the eigenspace for each eigenvalue.
   d) Diagonalize the matrix, if possible. (Otherwise, explain why you cannot.)

\[ A = \begin{bmatrix} 3 & -1 \\ 1 & 5 \end{bmatrix} \]
11. a) Find the characteristic polynomial for the following matrix.
   b) Find the eigenvalues.
   c) Find a basis for the eigenspace for each eigenvalue.
   d) Diagonalize the matrix, if possible. (Otherwise, explain why you cannot.)
   [Hint: one of the eigenvalues of $A$ is $\lambda = 1$.]

$$A = \begin{bmatrix} 7 & 4 & 16 \\ 2 & 5 & 8 \\ -2 & -2 & -5 \end{bmatrix}$$