1. Find the reduced row echelon form of the matrix
\[
\begin{pmatrix}
0 & 0 & 2 & 0 \\
-1 & 4 & 0 & 2 \\
3 & -2 & 0 & 1 \\
0 & 1 & -1 & 0
\end{pmatrix}
\].

2. Find the determinant of the 3 \times 3 matrix
\[
\begin{pmatrix}
0 & 1 & 2 \\
1 & 0 & 1 \\
2 & 1 & 0
\end{pmatrix}
\].

3. Find the inverse of the orthogonal matrix
\[
\frac{1}{7}
\begin{pmatrix}
2 & 3 & 6 \\
6 & 2 & -3 \\
3 & -6 & 2
\end{pmatrix}
\].

4. Let \( T \) be the linear transformation from \( \mathbb{R}^3 \) to \( \mathbb{R}^2 \) given by
\[
T(x_1, x_2, x_3) = (3x_2 - x_3, x_1 + 4x_2 + x_3)
\].

Find the unique 2 \times 3 matrix \( A \) such that
\[
T(x) = Ax
\]
for each \( x \) in \( \mathbb{R}^3 \).

5. Find a basis for the vector subspace of \( \mathbb{R}^4 \) that consists of all solutions of the system of linear equations
\[
\begin{align*}
x_1 - 2x_3 + x_4 &= 0 \\
x_2 + 3x_3 - 2x_4 &= 0
\end{align*}
\]

6. Let \( f \) be the linear function from \( \mathbb{R}^4 \) to \( \mathbb{R}^4 \) that is defined by \( f(x) = Mx \) where \( M \) is the matrix
\[
\begin{pmatrix}
1 & -1 & -2 & 0 \\
-1 & 2 & 0 & -3 \\
2 & 0 & -1 & 1 \\
0 & -1 & 2 & 3
\end{pmatrix}
\].

(a) Find a basis of the kernel of \( f \).

(b) Find one or more non-redundant linear equations that characterize the image of \( f \), i.e., equations for which the set of common solutions is the image of \( f \).

7. Give an explicit description of the set of all \( n \times n \) matrices that are similar to the \( n \times n \) identity matrix.

8. Let \( g \) be the linear function from \( \mathbb{R}^3 \) to \( \mathbb{R}^3 \) that is defined by \( g(x) = Rx \) where \( R \) is the matrix
\[
\begin{pmatrix}
2 & 1 & 2 \\
2 & -2 & -1 \\
1 & 2 & -2
\end{pmatrix}
\].

Find as many as possible non-parallel eigenvectors of \( g \), i.e., non-zero vectors \( x \) in \( \mathbb{R}^3 \) for which \( g(x) \) is a scalar multiple of \( x \).