1. Consider the differential equation \( y'' - 2y' + 5y = 0 \).
   a) Find the general solution.
   b) Find the solution with the initial conditions \( y(0) = 1 \) and \( y'(0) = 5 \).
   c) Find a particular solution to \( y'' - 2y' + 5y = 17 \cos(2t) \).

2. Consider the differential equation \( y''' - 3y'' + 2y' = 0 \).
   a) Find the general solution.
   b) Find a particular solution to \( y''' - 3y'' + 2y' = 6e^{-t} \).
   c) Find the solution to \( y''' - 3y'' + 2y' = 6e^{-t} \) with initial conditions \( y(0) = 18 \), \( y'(0) = 25 \), \( y''(0) = 35 \).

3a. Let \( A \) be a 4 by 6 matrix whose reduced row-echelon form is

\[
A_{RREF} = \begin{pmatrix}
1 & 2 & 0 & 3 & 0 & 5 \\
0 & 0 & 1 & 4 & 0 & 6 \\
0 & 0 & 0 & 0 & 1 & 7 \\
0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}.
\]

Find all solutions to \( A\vec{x} = 0 \).

b) Consider the matrix \( A = \begin{pmatrix}
1 & 1 & 1 & -2 \\
1 & 2 & 4 & -3 \\
2 & 4 & 9 & -7 \\
4 & 7 & 14 & -12
\end{pmatrix} \). Are the columns of this matrix linearly independent? If so, express \( \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \end{pmatrix} \) as a linear combination of the columns of \( A \). If not, find a nontrivial linear combination of the columns that equals zero.

4a) Find the eigenvalues and eigenvectors of the matrix \( \begin{pmatrix} 4 & 2 \\ 5 & 1 \end{pmatrix} \).

b) The matrix \( \begin{pmatrix} 6 & 5 \\ 2 & 3 \end{pmatrix} \) has eigenvalues 1 and 8, with corresponding eigenvectors \( \begin{pmatrix} 1 \\ -1 \end{pmatrix} \) and \( \begin{pmatrix} 5 \\ 2 \end{pmatrix} \). Find the general solution to the equations

\[
x'_1 = 6x_1 + 5x_2 \\
x'_2 = 2x_1 + 3x_2.
\]

c) Find the solution with initial conditions \( x_1(0) = 7 \), \( x_2(0) = 7 \).