(1) For each system below, write it as $Ax = b$. Find all solutions, and sketch the graph of the lines in each system on the same axis. Are the resulting lines intersecting, parallel, or coincident?
   (a) $x_1 + 3x_2 = 0$, $2x_1 - x_2 = 0$
   (b) $-x_1 + 2x_2 = 4$, $2x_1 - 4x_2 = -6$
   (c) $2x_1 - 3x_2 = 4$, $x_1 + 2x_2 = -5$
   (d) $3x_1 - 2x_2 = 0$, $-6x_1 + 4x_2 = 0$
   (e) $2x_1 - 3x_2 = 6$, $-4x_1 + 6x_2 = -12$

(2) For each part, find the determinant, eigenvalues and eigenvectors of the given matrix. If the matrix is invertible, find its inverse.
   (a) $A = \begin{pmatrix} 3 & -2 \\ 2 & -2 \end{pmatrix}$
   (b) $A = \begin{pmatrix} 3 & -2 \\ 4 & -1 \end{pmatrix}$
   (c) $A = \begin{pmatrix} 3 & -4 \\ 1 & -1 \end{pmatrix}$
   (d) $A = \begin{pmatrix} 1 & -2 \\ 3 & -4 \end{pmatrix}$
   (e) $A = \begin{pmatrix} -1 & -4 \\ 1 & -1 \end{pmatrix}$
   (f) $A = \begin{pmatrix} 5/4 & 3/4 \\ -3/4 & -1/4 \end{pmatrix}$

(3) For each problem below, find the eigenvalues of the given matrix, and then describe how the nature of the eigenvalue depends on the parameter $\alpha$.
   (a) $A = \begin{pmatrix} 1 & 2 \\ 3 & \alpha \end{pmatrix}$
   (b) $A = \begin{pmatrix} 1 & -\alpha \\ 2\alpha & 3 \end{pmatrix}$

(4) In this problem we will show that $\lambda = 0$ is an eigenvalue of a matrix $A$ if and only if $\det(A) = 0$.
   • Show that if $\lambda = 0$ is an eigenvalue of $A$, then $\det(A) = 0$.
   • Show that if $\det(A) = 0$, then $\lambda = 0$ is an eigenvalue of $A$. 