**Eigenvalues and Eigenvectors**

Find the eigenvalues and eigenvectors for the given matrices.

**1.** $A=\begin{bmatrix}10 & 1\\ -4 & 6\end{bmatrix}$

**2.** $B=\begin{bmatrix}\frac{3}{4} & \frac{1}{4}\\ -37 & -\frac{1}{4}\end{bmatrix}$

**3.** $C=\begin{bmatrix}4 & 7\\ 1 & -2\end{bmatrix}$

**Systems of Differential Equations**

Convert the IVP into a system of differential equations and give your answer in matrix form.

**4.** $7y''-9y'+21y=0,\quad y(0)=4, y'(0)=-6$

**5.** $y^{(4)}-16y'+y=0,\quad y(3)=0, y'(3)=-8, y''(3)=-5, y'''(3)=10$

**Real, Distinct Eigenvalues**

**6.** Find the general solution to the following system

$$\vec{x}'=\begin{bmatrix}-9 & 5\\ 4 & -3\end{bmatrix}\vec{x}$$

For problems 7 solve the system, sketch the phase portrait for the system and determine the stability of the equilibrium solution.

**7.** $\vec{x}'=\begin{bmatrix}4 & 5\\ 3 & 2\end{bmatrix}\vec{x}$ $\qquad$ $\vec{x}(0)=\begin{pmatrix}-8\\ 7\end{pmatrix}$

**8.** Answer each of the following questions about the given IVP.

**(a)** Convert the IVP into a system.

**(b)** Solve the system and use this solution to find the solution to the original IVP.

**(c)** Sketch the phase portrait for the system and determine the stability of the equilibrium solution.

$$y''-8y'+12y=0 \qquad y(0)=3,\quad y'(0)=1$$

**Continued on Back** $\Rightarrow$

**Complex Eigenvalues**

Solve the system, sketch the phase portrait for the system and determine the stability of the equilibrium solution.

**9.** $\vec{x}' = \begin{bmatrix} -3 & -13 \\ 1 & 3 \end{bmatrix} \vec{x}$ $\qquad \vec{x}(0) = \begin{pmatrix} -2 \\ 6 \end{pmatrix}$

**10.** $\vec{x}' = \begin{bmatrix} 6 & 5 \\ -10 & -4 \end{bmatrix} \vec{x}$ $\qquad \vec{x}(0) = \begin{pmatrix} -5 \\ 0 \end{pmatrix}$

**Repeated Eigenvalues**

Solve the system, sketch the phase portrait for the system and determine the stability of the equilibrium solution.

**11.** $\vec{x}' = \begin{bmatrix} -10 & -4 \\ 9 & 2 \end{bmatrix} \vec{x}$ $\qquad \vec{x}(0) = \begin{pmatrix} 4 \\ -1 \end{pmatrix}$

**12.** $\vec{x}' = \begin{bmatrix} 1 & \frac{1}{3} \\ -\frac{1}{3} & \frac{1}{3} \end{bmatrix} \vec{x}$ $\qquad \vec{x}(0) = \begin{pmatrix} 2 \\ 2 \end{pmatrix}$