1. The general solution of $\mathbf{x}' = \begin{pmatrix} 3 & -2 \\ 1 & 1 \end{pmatrix}\mathbf{x}$ is:

   (a) $\mathbf{x} = C_1 e^{-2t}\left[\cos t \begin{pmatrix} 1 \\ 1 \end{pmatrix} - \sin t \begin{pmatrix} -1 \\ 0 \end{pmatrix}\right] + C_2 e^{-2t}\left[\cos t \begin{pmatrix} -1 \\ 0 \end{pmatrix} + \sin t \begin{pmatrix} 1 \\ 1 \end{pmatrix}\right]$

   (b) $\mathbf{x} = C_1 e^{2t}\left[\cos t \begin{pmatrix} 1 \\ 1 \end{pmatrix} - \sin t \begin{pmatrix} 1 \\ 0 \end{pmatrix}\right] + C_2 e^{2t}\left[\cos t \begin{pmatrix} 1 \\ 0 \end{pmatrix} + \sin t \begin{pmatrix} 1 \\ 1 \end{pmatrix}\right]$

   (c) $\mathbf{x} = C_1 e^{2t}\left[\cos t \begin{pmatrix} 1 \\ 1 \end{pmatrix} + \sin t \begin{pmatrix} -1 \\ 0 \end{pmatrix}\right] + C_2 e^{2t}\left[\cos t \begin{pmatrix} -1 \\ 0 \end{pmatrix} + \sin t \begin{pmatrix} 1 \\ 1 \end{pmatrix}\right]$

   (d) $\mathbf{x} = C_1 e^{-2t}\left[\cos t \begin{pmatrix} 1 \\ 1 \end{pmatrix} + \sin t \begin{pmatrix} -1 \\ 0 \end{pmatrix}\right] + C_2 e^{-2t}\left[\cos t \begin{pmatrix} -1 \\ 0 \end{pmatrix} - \sin t \begin{pmatrix} 1 \\ 1 \end{pmatrix}\right]$

   (e) None of the above.

2. The general solution of $\mathbf{x}' = \begin{pmatrix} 2 & -1 \\ 1 & 4 \end{pmatrix}\mathbf{x}$ is:

   (a) $\mathbf{x} = C_1 e^{-3t}\begin{pmatrix} 1 \\ -1 \end{pmatrix} + C_2\left[e^{-3t}\begin{pmatrix} -2 \\ 1 \end{pmatrix} + te^{-3t}\begin{pmatrix} 1 \\ -1 \end{pmatrix}\right]$

   (b) $\mathbf{x} = C_1 e^{3t}\begin{pmatrix} 1 \\ 1 \end{pmatrix} + C_2\left[e^{3t}\begin{pmatrix} -1 \\ 1 \end{pmatrix} + te^{3t}\begin{pmatrix} 1 \\ 2 \end{pmatrix}\right]$

   (c) $\mathbf{x} = C_1 e^{-3t}\begin{pmatrix} 1 \\ 1 \end{pmatrix} + C_2\left[e^{-3t}\begin{pmatrix} -2 \\ 1 \end{pmatrix} + te^{-3t}\begin{pmatrix} 1 \\ -1 \end{pmatrix}\right]$

   (d) $\mathbf{x} = C_1 e^{3t}\begin{pmatrix} 1 \\ -1 \end{pmatrix} + C_2\left[e^{3t}\begin{pmatrix} -2 \\ 1 \end{pmatrix} + te^{3t}\begin{pmatrix} 1 \\ -1 \end{pmatrix}\right]$

   (e) None of the above.

3. A fundamental set of solutions of $\mathbf{x}' = \begin{pmatrix} -1 & -5 \\ 2 & -3 \end{pmatrix}\mathbf{x}$ is:

   (a) $\left\{e^{-2t}\left[\cos 3t \begin{pmatrix} 1 \\ 2 \end{pmatrix} - \sin 3t \begin{pmatrix} 3 \\ 0 \end{pmatrix}\right],\ e^{-2t}\left[\cos 3t \begin{pmatrix} 3 \\ 0 \end{pmatrix} + \sin 3t \begin{pmatrix} 1 \\ 2 \end{pmatrix}\right]\right\}$

   (b) $\left\{e^{2t}\left[\cos 3t \begin{pmatrix} 3 \\ 0 \end{pmatrix} + \sin 3t \begin{pmatrix} 1 \\ 2 \end{pmatrix}\right],\ e^{2t}\left[\cos 3t \begin{pmatrix} 1 \\ 2 \end{pmatrix} - \sin 3t \begin{pmatrix} 3 \\ 0 \end{pmatrix}\right]\right\}$

   (c) $\left\{e^{-2t}\left[\cos 3t \begin{pmatrix} -1 \\ 2 \end{pmatrix} - \sin 3t \begin{pmatrix} 3 \\ 0 \end{pmatrix}\right],\ e^{-2t}\left[\cos 3t \begin{pmatrix} 3 \\ 0 \end{pmatrix} + \sin 3t \begin{pmatrix} -1 \\ 2 \end{pmatrix}\right]\right\}$

   (d) $\left\{e^{3t}\left[\cos 2t \begin{pmatrix} 1 \\ 2 \end{pmatrix} + \sin 2t \begin{pmatrix} 3 \\ 0 \end{pmatrix}\right],\ e^{3t}\left[\cos 2t \begin{pmatrix} 3 \\ 0 \end{pmatrix} + \sin 2t \begin{pmatrix} 1 \\ 2 \end{pmatrix}\right]\right\}$

(e) None of the above.

4. A fundamental set of solutions of $\mathbf{x}' = \begin{pmatrix} 6 & -1 \\ 1 & 4 \end{pmatrix} \mathbf{x}$ is:

(a)

(b) $\left\{ e^{5t} \begin{pmatrix} 1 \\ -1 \end{pmatrix},\ e^{5t} \begin{pmatrix} 1 \\ 1 \end{pmatrix} + te^{5t} \begin{pmatrix} 1 \\ -1 \end{pmatrix} \right\}$

(c) $\left\{ e^{5t} \begin{pmatrix} 1 \\ 1 \end{pmatrix},\ e^{5t} \begin{pmatrix} 1 \\ 0 \end{pmatrix} + te^{5t} \begin{pmatrix} 1 \\ 1 \end{pmatrix} \right\}$

(d) $\left\{ e^{5t} \begin{pmatrix} 1 \\ 1 \end{pmatrix},\ e^{5t} \begin{pmatrix} 1 \\ 1 \end{pmatrix} + te^{5t} \begin{pmatrix} 1 \\ 0 \end{pmatrix} \right\}$

(e) $\left\{ e^{5t} \begin{pmatrix} 1 \\ 1 \end{pmatrix},\ e^{5t} \begin{pmatrix} 1 \\ 0 \end{pmatrix} \right\}$

(f) None of the above.

5. The general solution of $\mathbf{x}' = \begin{pmatrix} 6 & 2 \\ -2 & 2 \end{pmatrix} \mathbf{x}$ is:

(a) $\mathbf{x} = C_1 e^{4t} \begin{pmatrix} 1 \\ 1 \end{pmatrix} + C_2 \left[e^{4t} \begin{pmatrix} -\frac{1}{2} \\ 0 \end{pmatrix} + te^{4t} \begin{pmatrix} 1 \\ 1 \end{pmatrix} \right]$

(b) $\mathbf{x} = C_1 e^{4t} \begin{pmatrix} -1 \\ 1 \end{pmatrix} + C_2 \left[e^{4t} \begin{pmatrix} -1 \\ 1 \end{pmatrix} + te^{4t} \begin{pmatrix} -1/2 \\ 0 \end{pmatrix} \right]$

(c) $\mathbf{x} = C_1 e^{4t} \begin{pmatrix} -1 \\ 1 \end{pmatrix} + C_2 \left[e^{4t} \begin{pmatrix} -\frac{1}{2} \\ 0 \end{pmatrix} + te^{4t} \begin{pmatrix} -1 \\ 1 \end{pmatrix} \right]$

(d) $\mathbf{x} = C_1 e^{4t} \begin{pmatrix} -1 \\ 1 \end{pmatrix} + C_2 te^{4t} \begin{pmatrix} -1 \\ 1 \end{pmatrix}$

(e) None of the above.

6. The characteristic equation of the matrix $A = \begin{pmatrix} 9 & 8 & 2 \\ -6 & -5 & -2 \\ 3 & 4 & 4 \end{pmatrix}$ is $\lambda^3 - 8\lambda^2 + 21\lambda - 18 = 0$.

A fundamental set of solutions of $\mathbf{x}' = A\mathbf{x}$ is:

(a) $\left\{ e^{2t} \begin{pmatrix} 2 \\ -2 \\ 1 \end{pmatrix},\ e^{3t} \begin{pmatrix} 1 \\ 0 \\ -3 \end{pmatrix},\ e^{3t} \begin{pmatrix} 0 \\ 1 \\ -4 \end{pmatrix} \right\}$

(b) $\left\{ e^{2t} \begin{pmatrix} 2 \\ -2 \\ 1 \end{pmatrix},\ e^{3t} \begin{pmatrix} 1 \\ 0 \\ -3 \end{pmatrix},\ te^{3t} \begin{pmatrix} 0 \\ 1 \\ -4 \end{pmatrix} \right\}$

(c) $\left\{ e^{2t}\begin{pmatrix} 2 \\ -2 \\ 1 \end{pmatrix},\ e^{3t}\begin{pmatrix} 1 \\ 0 \\ -3 \end{pmatrix},\ \left[e^{3t}\begin{pmatrix} 0 \\ 1 \\ -4 \end{pmatrix} te^{3t}\begin{pmatrix} 0 \\ 1 \\ -4 \end{pmatrix} \right] \right\}$

(d) $\left\{ e^{2t}\begin{pmatrix} 2 \\ -2 \\ 1 \end{pmatrix},\ e^{3t}\begin{pmatrix} 1 \\ 0 \\ 3 \end{pmatrix},\ e^{3t}\begin{pmatrix} 0 \\ 1 \\ 4 \end{pmatrix} \right\}$

(e) None of the above.

7. The characteristic equation of $A = \begin{pmatrix} -2 & 1 & -1 \\ 3 & -3 & 4 \\ 3 & -1 & 2 \end{pmatrix}$ is $\lambda^3 + 3\lambda^2 - 4 = 0$. A fundamental set of solutions of $\mathbf{x}' = A\,\mathbf{x}$ is:

(a) $\mathbf{x}_1 = e^t\begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix},\ \mathbf{x}_2 = e^{-2t}\begin{pmatrix} -1 \\ 1 \\ 1 \end{pmatrix}$

(b) $\mathbf{x}_1 = e^t\begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix},\ \mathbf{x}_2 = e^{-2t}\begin{pmatrix} -1 \\ 1 \\ 1 \end{pmatrix},\ \mathbf{x}_3 = te^{-2t}\begin{pmatrix} -1 \\ 1 \\ 1 \end{pmatrix}$

(c) $\mathbf{x}_1 = e^t\begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix},\ \mathbf{x}_2 = e^{-2t}\begin{pmatrix} -1 \\ 1 \\ 1 \end{pmatrix},\ \mathbf{x}_3 = e^{-2t}\begin{pmatrix} -1 \\ 1 \\ 1 \end{pmatrix} + te^{-2t}\begin{pmatrix} 0 \\ -1 \\ 0 \end{pmatrix}$

(d) $\mathbf{x}_1 = e^t\begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix},\ \mathbf{x}_2 = e^{-2t}\begin{pmatrix} -1 \\ 1 \\ 1 \end{pmatrix},\ \mathbf{x}_3 = e^{-2t}\begin{pmatrix} 0 \\ -1 \\ 0 \end{pmatrix} + te^{-2t}\begin{pmatrix} -1 \\ 1 \\ 1 \end{pmatrix}$

(e) None of the above.

8. The eigenvalues of $A = \begin{pmatrix} 7 & -3 & -6 \\ -6 & 10 & 12 \\ 6 & -6 & -8 \end{pmatrix}$ are: $\lambda_1 = \lambda_2 = 4,\ \lambda_3 = 1$. A fundamental set of solutions of $\mathbf{x}' = A\,\mathbf{x}$ is:

(a) $\mathbf{x}_1 = e^t\begin{pmatrix} 1 \\ -2 \\ 2 \end{pmatrix},\ \mathbf{x}_2 = e^{4t}\begin{pmatrix} 2 \\ 0 \\ 1 \end{pmatrix},\ \mathbf{x}_3 = e^{4t}\begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$

(b) $\mathbf{x}_1 = e^t\begin{pmatrix} 1 \\ -2 \\ 2 \end{pmatrix},\ \mathbf{x}_2 = e^{4t}\begin{pmatrix} 2 \\ 0 \\ 1 \end{pmatrix}$

(c) $\mathbf{x}_1 = e^t\begin{pmatrix} -1 \\ 2 \\ -2 \end{pmatrix},\ \mathbf{x}_2 = e^{4t}\begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix},\ \mathbf{x}_3 = te^{4t}\begin{pmatrix} 2 \\ 0 \\ 1 \end{pmatrix}$

(d) $\mathbf{x}_1 = e^{t}\begin{pmatrix} 1 \\ -2 \\ 2 \end{pmatrix}$, $\mathbf{x}_2 = e^{4t}\begin{pmatrix} 2 \\ 0 \\ 1 \end{pmatrix}$, $\mathbf{x}_3 = e^{4t}\left[\begin{pmatrix} 2 \\ 0 \\ 1 \end{pmatrix} + t\begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}\right]$

(e) None of the above.

9. The characteristic polynomial of $A = \begin{pmatrix} -6 & 5 & -4 \\ -5 & 3 & -5 \\ 4 & -5 & 2 \end{pmatrix}$ is: $\lambda^3 + \lambda^2 - 8\lambda - 12$. The general solution of $\mathbf{x}' = A\,\mathbf{x}$ is:

(a) $\mathbf{x} = C_1 e^{3t}\begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix} + C_2 e^{-2t}\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix} + C_3 t e^{-2t}\begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix}$

(b) $\mathbf{x} = C_1 e^{3t}\begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix} + C_2 e^{-2t}\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix} + C_3\left[e^{-2t}\begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix} + t e^{-2t}\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix}\right]$

(c) $\mathbf{x} = C_1 e^{3t}\begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix} + C_2 e^{-2t}\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix} + C_3\left[e^{-2t}\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix} + t e^{-2t}\begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix}\right]$

(d) $\mathbf{x} = C_1 e^{3t}\begin{pmatrix} -1 \\ -1 \\ 1 \end{pmatrix} + C_2 e^{-2t}\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix} + C_3 t e^{-2t}\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix}$

(e) None of the above.

10. A fundamental set of solutions of $\mathbf{x}' = \begin{pmatrix} 1 & -3 & 3 \\ 3 & -5 & 3 \\ 6 & -6 & 4 \end{pmatrix}\mathbf{x}$ is:

(a) $\mathbf{x}_1 = e^{-4t}\begin{pmatrix} 1 \\ 1 \\ 2 \end{pmatrix}$, $\mathbf{x}_2 = e^{2t}\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix}$, $\mathbf{x}_3 = e^{2t}\begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$

(b) $\mathbf{x}_1 = e^{4t}\begin{pmatrix} 1 \\ 1 \\ 2 \end{pmatrix}$, $\mathbf{x}_2 = e^{-2t}\begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix}$, $\mathbf{x}_3 = \left[e^{-2t}\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} + t e^{-2t}\begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix}\right]$

(c) $\mathbf{x}_1 = e^{4t}\begin{pmatrix} 1 \\ 1 \\ 2 \end{pmatrix}$, $\mathbf{x}_2 = e^{-2t}\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix}$, $\mathbf{x}_3 = e^{-2t}\begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$

(d) $\mathbf{x}_1 = e^{4t}\begin{pmatrix} 1 \\ 1 \\ 2 \end{pmatrix}$, $\mathbf{x}_2 = e^{-2t}\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix}$, $\mathbf{x}_3 = t e^{-2t}\begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$

(e) None of the above.