

Review Problems for the MA262 Final Exam

9. Let A_{ij} be the cofactor of the element a_{ij} in the matrix $A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$ with $\det(A) = 5$.

The value of the expression $a_{11}A_{11} + a_{12}A_{12} + a_{21}A_{21} + a_{22}A_{22}$ then is equal to

- A. 0
- B. 5
- C. 10
- D. 15
- E. undetermined by the information given above

10. Let $A = \begin{bmatrix} 1 & k \\ k & 3 \end{bmatrix}$ and $b = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$. The values of k for which the system $Ax = b$ has a unique solution are

- A. $k \neq \sqrt{6}$
- B. $k \neq \{\sqrt{3}, -\sqrt{3}\}$
- C. $k = \{\sqrt{2}, -\sqrt{2}\}$
- D. All real numbers
- E. None of the above

2. A ranger in a national park found at noon the body of a wild boar killed by a poacher. To convict a suspected poacher, one needs to know the time when the boar was killed. To determine this time, the temperature of the body was measured twice: at noon it was 60°F and at 1 p. m. it was 55°F . The air temperature on that day was 50°F and it did not change since 8 a.m. The normal body temperature of the boar when it is alive is 90°F . When was the boar killed?
- A. 6 a.m.
 - B. 10 a.m.
 - C. 10:30 a.m.
 - D. 11 a.m.
 - E. 11:30 a.m.

11. Consider the vectors $\mathbf{v}_1 = \begin{bmatrix} 1 \\ -1 \\ 1 \\ -1 \end{bmatrix}$, $\mathbf{v}_2 = \begin{bmatrix} 3 \\ 1 \\ 7 \\ 3 \end{bmatrix}$, $\mathbf{v}_3 = \begin{bmatrix} 5 \\ -3 \\ 9 \\ 1 \end{bmatrix}$, $\mathbf{v}_4 = \begin{bmatrix} -2 \\ 4 \\ 2 \\ 8 \end{bmatrix}$. The dimension of the space $\text{span}\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3, \mathbf{v}_4\}$ is then equal to

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5.

8. Find an implicit solution of the initial value problem:

$$\begin{cases} (6x^2y^2 + 4e^x - 2y \sin 2x) + (4x^3y + \cos 2x) \frac{dy}{dx} = 0, \\ y(0) = 1 \end{cases}$$

- A. $2x^3y^2 - y \cos 2x + 4e^x = 3$
- B. $x^3y^2 + y \cos 2x + 4ye^x = 0$
- C. $2x^3y^2 + y \cos 2x + 4e^x = 5$
- D. $x^3y^2 + y^2 \cos 2x + 4e^x = 5$
- E. $2x^3y^2 + y \cos 2x - 4ye^x = -3$

3. The general solution of $xy' - y = x^2e^x$ is

- A. $y = xe^x + cx$
- B. $y = x^2e^x - xe^x + cx$
- C. $y = xe^x - cx^2$
- D. $y = x^2e^x + xe^x + cx$
- E. None of the above

6. The solution of

$$y' + \frac{y}{x} = \frac{2}{x^2y}, \quad x \neq 0$$

is given by

A. $x^2y^2 + 4xy = C$

B. $x^2y^2 + 4x = C$

C. $xy^2 - 2x = C$

D. $x^2y^2 - 4x = C$

E. $xy^2 - 4x = C$

3. Find the explicit solution of the initial value problem

$$y' = \frac{xy^2}{x^2 + 1} \quad , \quad y(0) = 3.$$

A. $\frac{1}{2}(6 + \ln(1 + x^2))$

B. $\frac{6}{2 - 3\ln(1 + x^2)}$

C. $\frac{6}{2 + 3\ln(1 + x^2)}$

D. $\frac{1}{2}(6 - 3\ln(1 + x^2))$

E. $\frac{1}{3}(9 - 2\ln(1 + x^2))$

8. Which of the following is the general solution to $y'' + 4y = e^{2t} + 12 \sin(2t)$?

A. $y(t) = c_1 \cos(2t) + c_2 \sin(2t) + \frac{1}{8}e^{2t} - 3t \cos(2t)$

B. $y(t) = c_1 e^{2t} + c_2 e^{-2t} + \frac{1}{4}t e^{2t} - 3t \cos(2t)$

C. $y(t) = c_1 + c_2 e^{-4t} + \frac{1}{12}t e^{2t} - 3t \cos(2t)$

D. $y(t) = c_1 \cos(2t) + c_2 \sin(2t) + \frac{1}{8}e^{2t} + 3 \sin(2t)$

E. None of the above.

10. A particular solution of the equation

$$y^{(4)} - y'' = 2 \sin t - 3e^{-t} + 4t$$

is of the form

- A. $y_p(t) = A \cos t + B \sin t + Cte^{-t} + t^2(Dt + E)$
- B. $y_p(t) = t(A \cos t + B \sin t) + Cte^{-t} + t^2(Dt + E)$
- C. $y_p(t) = A \cos t + B \sin t + Ce^{-t} + t^2(Dt + E)$
- D. $y_p(t) = t(A \cos t + B \sin t) + Ce^{-t} + t^2(Dt + E)$
- E. $y_p(t) = t(A \cos t + B \sin t) + Cte^{-t} + t(Dt + E)$

9. According to the method of undetermined coefficients, what is the proper form of a particular solution Y to the following differential equation?

$$y^{(4)} - 4y'' = 24t^2 - 4 - 3te^t.$$

- A. $Y(t) = At^2 + Bte^t$.
- B. $Y(t) = At^2 + Bt + C + Dte^t + Ee^t$.
- C. $Y(t) = At^3 + Bt^2 + Ct + D + Ete^t + Fe^t$.
- D. $Y(t) = At^4 + Bt^3 + Ct^2 + Dte^t + Ee^t$.
- E. None of the above.

5. How many asymptotically unstable equilibrium solution(s) does the following differential equation have?

$$y' = (y^2 + 1)(y^2 - 1)(y + 2).$$

- A. 0,
- B. 1,
- C. 2,
- D. 3,
- E. None of the above.

3. Find the solution $y(x)$ to

$$\frac{dy}{dx} = e^{-\frac{y}{x}} + \frac{y}{x},$$
$$y(e) = 0.$$

A. $y(x) = \ln(\ln(x))$

B. $y(x) = x \ln(\ln(x))$

C. $y(x) = \ln(\ln(x) + 1) - \ln(2)$

D. $y(x) = x \ln(x) - e$

E. $y(x) = x \ln(x) - x$

14. Using the method of Undetermined Coefficients, which of the following is the correct form of a particular solution y_p to the nonhomogeneous differential equation

$$y^{(4)} - y = xe^x + 3 \cos x - 4x ?$$

- A. $y_p = x(A + Bx)e^x + (C \cos x + D \sin x) + Ex$
- B. $y_p = (A + Bx)e^x + (C \cos x + D \sin x) + E + Fx$
- C. $y_p = (A + Bx)e^x + x(C \cos x + D \sin x) + x(E + Fx)$
- D. $y_p = x(A + Bx)e^x + x(C \cos x) - Dx$
- E. $y_p = x(A + Bx)e^x + x(C \cos x + D \sin x) + E + Fx$
-

9. Find the general solutions to $y'' + 6y' + 10y = 0$

- A. $c_1 e^{-2t} \cos(t) + c_2 e^{-2t} \sin(t)$
- B. $c_1 e^{-3t} \cos(t) + c_2 e^{-3t} \sin(t)$
- C. $c_1 e^{-3t} \cos(2t) + c_2 e^{-3t} \sin(2t)$
- D. $c_1 e^{2t} \cos(t) + c_2 e^{2t} \sin(t)$
- E. $c_1 e^{3t} \cos(t) + c_2 e^{3t} \sin(t)$

7. Find the general solution of the system

$$\mathbf{x}' = \begin{pmatrix} -3 & -4 \\ 1 & 1 \end{pmatrix} \mathbf{x}.$$

A. $c_1 \begin{pmatrix} 2 \\ 1 \end{pmatrix} e^t + c_2 \left[\begin{pmatrix} 2 \\ 1 \end{pmatrix} t e^t + \begin{pmatrix} 1 \\ 0 \end{pmatrix} e^t \right],$

B. $c_1 \begin{pmatrix} -2 \\ 1 \end{pmatrix} e^{-t} + c_2 \left[\begin{pmatrix} -2 \\ 1 \end{pmatrix} t e^{-t} + \begin{pmatrix} -1 \\ 0 \end{pmatrix} e^{-t} \right],$

C. $c_1 \begin{pmatrix} 2 \\ 1 \end{pmatrix} e^{-t} + c_2 \left[\begin{pmatrix} 2 \\ 1 \end{pmatrix} t e^{-t} + \begin{pmatrix} 1 \\ 0 \end{pmatrix} e^{-t} \right],$

D. $c_1 \begin{pmatrix} -2 \\ 1 \end{pmatrix} e^{-t} + c_2 \left[\begin{pmatrix} -2 \\ 1 \end{pmatrix} t e^{-t} + \begin{pmatrix} 1 \\ 0 \end{pmatrix} e^{-t} \right],$

E. $c_1 \begin{pmatrix} -2 \\ 1 \end{pmatrix} e^t + c_2 \left[\begin{pmatrix} -2 \\ 1 \end{pmatrix} t e^t + \begin{pmatrix} 1 \\ 0 \end{pmatrix} e^t \right].$

2. Find the number of **stable** critical points for the autonomous equation

$$\frac{dx}{dt} = x(x - 1)^2(x + 3)(x^2 - 4).$$

- A. 1
- B. 2
- C. 3
- D. 4
- E. 0

16. One eigenvalue of $\begin{bmatrix} 1 & 2 & 2 \\ -1 & 4 & 1 \\ 0 & 0 & 3 \end{bmatrix}$ is $\lambda = 3$. A basis for the corresponding eigenspace is

A. $\left\{ \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ 1 \\ 0 \end{bmatrix} \right\}$

B. $\left\{ \begin{bmatrix} -1 \\ 2 \\ 1 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \right\}$

C. $\left\{ \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix} \right\}$

D. $\left\{ \begin{bmatrix} 2 \\ 1 \\ 0 \end{bmatrix} \right\}$

E. $\left\{ \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} \right\}$

17. If $y(x)$ is a solution of $y'' - 2y' + y = 0$ satisfying $y(0) = 1$ and $y'(0) = -1$, then $y(\frac{1}{2}) =$

- A. 0
- B. $-e^{\frac{1}{2}}$
- C. $e^{\frac{1}{2}}$
- D. $2e^{\frac{1}{2}}$
- E. $-3e^{\frac{1}{2}}$

24. The general solution of $\mathbf{x}' = \begin{bmatrix} 3 & 5 \\ -1 & -1 \end{bmatrix} \mathbf{x}$ has the form

A. $c_1 e^t \begin{bmatrix} 2 \cos t - \sin t \\ -\cos t \end{bmatrix} + c_2 e^t \begin{bmatrix} \cos t + 2 \sin t \\ -\sin t \end{bmatrix}$

B. $c_1 e^t \begin{bmatrix} \cos t \\ 2 \cos t - \sin t \end{bmatrix} + c_2 e^t \begin{bmatrix} -\sin t \\ \cos t - 2 \sin t \end{bmatrix}$

C. $c_1 e^t \begin{bmatrix} 2 \cos t + \sin t \\ -\cos t \end{bmatrix} + c_2 e^t \begin{bmatrix} \cos t + 2 \sin t \\ \sin t \end{bmatrix}$

D. $c_1 e^t \begin{bmatrix} \cos t - 2 \sin t \\ \sin t \end{bmatrix} + c_2 e^t \begin{bmatrix} 2 \cos t + \sin t \\ -\cos t \end{bmatrix}$

E. None of the above.

7. If $y = u_1 y_1 + u_2 y_2$ where $y_1 = e^{2x}$ and $y_2 = e^{-2x}$ is a particular solution of

$$y'' - 4y = 4 \tan x$$

then u_1 and u_2 are determined by

A. $u'_1 = e^{-2x} \tan x \quad u'_2 = -e^{2x} \tan x$

B. $u'_1 = -e^{-2x} \sec^2 x \quad u'_2 = e^{2x} \sec^2 x$

C. $u'_1 = -2 \sin 2x \tan x \quad u'_2 = 2 \cos 2x \tan x$

D. $u'_1 = 2 \sin 2x \tan x \quad u'_2 = -2 \cos 2x \tan x$

E. $u'_1 = \tan x \quad u'_2 = 0$

10. Find all values of a such that the following system of equations has exactly one solution.

$$\begin{cases} x + y - z = 2 \\ x + 2y + z = 3 \\ x + y + (a^2 - 5)z = a \end{cases}$$

A. $a \neq 2$ and $a \neq -2$

B. $a = 2$ or $a = -2$

C. $a = -2$

D. $a = \pm\sqrt{5}$

E. $a \neq 0$

17. Determine all values of k such that the vectors $(1, -1, 0)$, $(1, 2, 2)$, $(0, 3, k)$ are a basis for $\mathbb{R}^3$.

A. $k = 1$

B. $k = 2$

C. $k \neq 2$

D. $k \neq 1$

E. $k \neq 3$

11. Let $y(x)$ be the solution of the initial value problem

$$\begin{aligned}y'' + y &= x, \\ y(0) &= 1, \quad y'(0) = 2.\end{aligned}$$

Then $y(\pi)$ is equal to

- A. $y(\pi) = \pi$
- B. $y(\pi) = 2\pi$
- C. $y(\pi) = \pi - 1$
- D. $y(\pi) = 2\pi + 1$
- E. $y(\pi) = \pi + 1$



12. Let $y(x)$ satisfy

$$\begin{aligned}y'' - y' &= 2 \sin(x), \\ y(0) &= 3, \quad y'(0) = 0.\end{aligned}$$

Then $y(\pi)$ is equal to:

A. $e^\pi + 10$

B. $e^\pi + 1$

C. $e^\pi + 2$

D. $e^\pi + 3$

E. e^π

12. For the system $\mathbf{x}' = \begin{bmatrix} 5 & 5 \\ -8 & -7 \end{bmatrix} \mathbf{x}$, the origin is

- A. a saddle point
- B. a proper node source
- C. a center point
- D. a spiral sink
- E. a spiral source

15. The solution curves of the system

$$X'(t) = \begin{bmatrix} 1 & 1 \\ 1 & -2 \end{bmatrix} X(t),$$

where $X(t) = \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$, have the following structure near the origin $x_1 = x_2 = 0$:

- A. A saddle point
- B. A nodal sink
- C. A nodal source
- D. A center
- E. parallel lines.

16. Let $X(t) = \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$. Find all the values of a so that the origin $x_1 = x_2 = 0$

$$X'(t) = \begin{bmatrix} a & -27 \\ 3 & 0 \end{bmatrix} X(t)$$

is a spiral source of the system, that is, the solution curves are spirals approaching infinity as $t \rightarrow \infty$?

- A. $0 < a < 27$
- B. $0 < a < 18$
- C. $-18 < a < 18$
- D. $0 > a > -18$.
- E. $0 > a > -27$.

17. Let $X(t) = \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$ satisfy

$$X'(t) = \begin{bmatrix} 1 & 6 \\ 1 & 2 \end{bmatrix} X(t), \quad X(0) = \begin{bmatrix} -1 \\ 2 \end{bmatrix}$$

The limit $S = \lim_{t \rightarrow \infty} \frac{x_2'(t)}{x_1'(t)}$, which is the slope of the curve $X(t)$ as $t \rightarrow \infty$, is equal to

A. $S = -3$

B. $S = \frac{1}{2}$

C. $S = -\frac{1}{3}$

D. $S = -\frac{1}{2}$

E. $S = 3$

15. Which of the following matrices are nondefective:

$$A = \begin{bmatrix} 1 & 2 \\ 0 & 3 \end{bmatrix}, \quad B = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}, \quad C = \begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}?$$

- A. A, B
- B. A, C
- C. B only
- D. C only
- E. A only

22. The eigenvalues of the matrix $A = \begin{bmatrix} 3 & 0 & 0 \\ -2 & 3 & -2 \\ 2 & 0 & 5 \end{bmatrix}$ are 3 and 5. One of the associated eigenspaces has dimension one. This eigenspace has basis:

- A. $\begin{bmatrix} 0 \\ 1 \\ -1 \end{bmatrix}$
- B. $\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$
- C. $\begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$
- D. $\begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}$
- E. $\begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$

8. Let $A = \begin{bmatrix} -1 & 0 & 0 \\ 1 & 5 & -1 \\ 1 & 6 & -2 \end{bmatrix}$. Let λ_1 , λ_2 and λ_3 denote the eigenvalues of A and let E_1 , E_2 and E_3 denote the corresponding eigenspaces. Which of the following is correct?
- A. $\lambda_1 = 2$, $\lambda_2 = 3$ and $\lambda_3 = -1$, $\dim E_1 = \dim E_2 = \dim E_3 = 1$
- B. $\lambda_1 = \lambda_2 = -1$, $\lambda_3 = 4$, $\dim E_1 = \dim E_2 = 2$, $\dim E_3 = 1$
- C. $\lambda_1 = \lambda_2 = -1$, $\lambda_3 = 4$, $\dim E_1 = \dim E_2 = 1$, $\dim E_3 = 1$
- D. $\lambda_1 = 1$, $\lambda_2 = \lambda_3 = 4$, $\dim E_1 = 1$, $\dim E_2 = \dim E_3 = 2$
- E. $\lambda_1 = \lambda_2 = -1$, $\lambda_3 = 3$, $\dim E_1 = \dim E_2 = 2$, $\dim E_3 = 1$

15. Let A be a 2×2 matrix whose entries are real numbers. If $\lambda = 2 + 3i$ is a complex eigenvalue of A with corresponding complex eigenvector $\mathbf{w} = \begin{bmatrix} 1 - i \\ 4 \end{bmatrix}$, then the general solution to $\mathbf{x}' = A\mathbf{x}$ is:

A. $\mathbf{x} = C_1 e^{2t} \begin{bmatrix} \cos 3t + \sin 3t \\ 4 \cos 3t \end{bmatrix} + C_2 e^{2t} \begin{bmatrix} \sin 3t - \cos 3t \\ 4 \sin 3t \end{bmatrix}$

B. $\mathbf{x} = C_1 e^{2t} \begin{bmatrix} \cos 3t - \sin 3t \\ 4 \cos 3t \end{bmatrix} + C_2 e^{2t} \begin{bmatrix} \sin 3t - \cos 3t \\ 4 \sin 3t \end{bmatrix}$

C. $\mathbf{x} = C_1 e^{3t} \begin{bmatrix} \cos 2t + \sin 2t \\ 4 \cos 2t \end{bmatrix} + C_2 e^{3t} \begin{bmatrix} \sin 2t - \cos 2t \\ 4 \sin 2t \end{bmatrix}$

D. $\mathbf{x} = C_1 e^{2t} \begin{bmatrix} \cos 3t + \sin 3t \\ 4 \cos 3t \end{bmatrix} + C_2 e^{2t} \begin{bmatrix} \sin 3t + \cos 3t \\ 4 \sin 3t \end{bmatrix}$

E. $\mathbf{x} = C_1 e^{2t} \begin{bmatrix} \cos 3t + \sin 3t \\ 4 \cos 3t \end{bmatrix} + C_2 e^{2t} \begin{bmatrix} \sin 3t - \cos 3t \\ -4 \sin 3t \end{bmatrix}$

17. Let $\mathbf{x}(t) = \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$ be the solution of the system of differential equations

$$\mathbf{x}' = A\mathbf{x}, \quad A = \begin{bmatrix} 4 & -3 \\ 6 & -7 \end{bmatrix}.$$

with the initial data $\mathbf{x}(0) = \begin{bmatrix} 1 \\ 3 \end{bmatrix}$. Given that the eigenvalues of A and their corresponding eigenvectors of A are $\lambda_1 = -5$, $V_1 = \begin{bmatrix} 1 \\ 3 \end{bmatrix}$ and $\lambda_2 = 2$, $V_2 = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$, find $x_1(1)$.

- A. $3e^2$
- B. $-2e^{-5}$
- C. e^{-5}
- D. $-3e^{-5}$
- E. $e^{-5} + 3e^2$

19. Find all constants b such that the origin is a spiral source of the system

$$X'(t) = \begin{bmatrix} 3 & b \\ 1 & 4 \end{bmatrix} X(t), \quad b \text{ in } \mathbb{R}$$

are

A. $b < -\frac{1}{3}$

B. $b > -\frac{1}{3}$

C. $-\frac{1}{4} < b < -\frac{1}{4}$

D. $b > -\frac{1}{4}$

E. $b < -\frac{1}{4}$

- 16.** Given that $\lambda = 1$ is a defective eigenvalue of the matrix $\begin{bmatrix} 2 & -1 \\ 1 & 0 \end{bmatrix}$, which of the following is the solution of the initial value problem:

$$\mathbf{x}' = \begin{bmatrix} 2 & -1 \\ 1 & 0 \end{bmatrix} \mathbf{x} \quad \mathbf{x}(0) = \begin{bmatrix} 4 \\ 2 \end{bmatrix}?$$

- A. $\mathbf{x}(t) = 2e^t \begin{bmatrix} 1 \\ 1 \end{bmatrix} + e^t \left\{ t \begin{bmatrix} 1 \\ 1 \end{bmatrix} + \begin{bmatrix} 2 \\ 0 \end{bmatrix} \right\}$
- B. $\mathbf{x}(t) = 2e^t \begin{bmatrix} 1 \\ 1 \end{bmatrix} + 2te^t \begin{bmatrix} 1 \\ 0 \end{bmatrix}$
- C. $\mathbf{x}(t) = 2e^t \begin{bmatrix} 1 \\ -1 \end{bmatrix} + 2e^t \left\{ t \begin{bmatrix} 1 \\ -1 \end{bmatrix} + \begin{bmatrix} 1 \\ 2 \end{bmatrix} \right\}$
- D. $\mathbf{x}(t) = 2e^t \begin{bmatrix} 1 \\ 1 \end{bmatrix} + 2e^t \left\{ t \begin{bmatrix} 1 \\ 1 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} \right\}$
- E. $\mathbf{x}(t) = e^t \begin{bmatrix} 1 \\ 1 \end{bmatrix} + e^t \left\{ t \begin{bmatrix} 1 \\ 1 \end{bmatrix} + \begin{bmatrix} 3 \\ 1 \end{bmatrix} \right\}$

20. The general solution of the system

$$\mathbf{x}' = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & 2 \end{bmatrix} \mathbf{x}$$

is given by

A. $\mathbf{x}(t) = ae^t \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} + be^t \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} + ce^{2t} \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}$

B. $\mathbf{x}(t) = ae^t \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} + be^{-t} \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} + ce^{2t} \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}$

C. $\mathbf{x}(t) = ae^t \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} + be^t \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} + ce^{2t} \begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix}$

D. $\mathbf{x}(t) = ae^t \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} + be^t \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} + ce^{2t} \begin{bmatrix} 0 \\ 2 \\ 1 \end{bmatrix}$

E. $\mathbf{x}(t) = ae^{2t} \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} + be^{2t} \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} + ce^t \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}$