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1. The Wronskian of the vector functions $\mathbf{X}_1 = \begin{pmatrix} 1 \\ -1 \end{pmatrix} e^{-2t}$ and $\mathbf{X}_2 = \begin{pmatrix} 3 \\ 5 \end{pmatrix} e^{6t}$ is

Select the correct answer.

- (a) $8e^{4t}$
- (b) $2e^{4t}$
- (c) $-8e^{4t}$
- (d) $-2e^{4t}$
- (e) $15e^{4t}$

2. The Wronskian of the vector functions $\mathbf{X}_1 = \begin{pmatrix} 2 \\ 1 \\ 0 \end{pmatrix} e^t$, $\mathbf{X}_2 = \begin{pmatrix} 1 \\ 3 \\ 5 \end{pmatrix} e^{2t}$ and $\mathbf{X}_3 =$

$$\begin{pmatrix} -1 \\ 5 \\ 0 \end{pmatrix} e^{3t}$$
 is

Select the correct answer.

- (a) $55e^{6t}$
- (b) $-55e^{6t}$
- (c) $45e^{6t}$
- (d) $-45e^{-6t}$
- (e) $45e^{-6t}$

3. If \mathbf{X}_1 , \mathbf{X}_2 , and \mathbf{X}_3 are solutions of the third order system $\mathbf{X}' = A\mathbf{X}$ and \mathbf{X}_p is a particular solution of $\mathbf{X}' = A\mathbf{X} + \mathbf{f}(t)$, then the general solution of $\mathbf{X}' = A\mathbf{X} + \mathbf{f}(t)$ is

Select the correct answer.

- (a) $c_1\mathbf{X}_1 + c_2\mathbf{X}_2 + c_3\mathbf{X}_3$
- (b) $c_1\mathbf{X}_1 + c_2\mathbf{X}_2 + c_3\mathbf{X}_3 + c_4\mathbf{X}_p$
- (c) $c_1\mathbf{X}_1 + c_2\mathbf{X}_2 + c_3\mathbf{X}_3 + \mathbf{X}_p$
- (d) $\mathbf{X}_1 + \mathbf{X}_2 + \mathbf{X}_3 + \mathbf{X}_p$
- (e) $\mathbf{X}_1 + \mathbf{X}_2 + \mathbf{X}_3 + c_4\mathbf{X}_p$

4. The characteristic equation of $A = \begin{pmatrix} 1 & -3 \\ 2 & -4 \end{pmatrix}$ is

Select the correct answer.

- (a) $\lambda^2 + 3\lambda - 2 = 0$
- (b) $\lambda^2 + 5\lambda + 2 = 0$
- (c) $\lambda^2 - 5\lambda + 2 = 0$
- (d) $\lambda^2 + 3\lambda + 2 = 0$
- (e) $\lambda^2 - 3\lambda + 2 = 0$

5. The solution of the system $\mathbf{X}' = \begin{pmatrix} 1 & -3 \\ 2 & -4 \end{pmatrix} \mathbf{X}$ is

Select the correct answer.

(a) $\mathbf{X} = c_1 \begin{pmatrix} 3 \\ 2 \end{pmatrix} e^{-t} + c_2 \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{-2t}$

(b) $\mathbf{X} = c_1 \begin{pmatrix} 3 \\ 2 \end{pmatrix} e^t + c_2 \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{2t}$

(c) $\mathbf{X} = c_1 \begin{pmatrix} 2 \\ 3 \end{pmatrix} e^{-t} + c_2 \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{-2t}$

(d) $\mathbf{X} = c_1 \begin{pmatrix} 2 \\ 3 \end{pmatrix} e^t + c_2 \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{2t}$

(e) none of the above

6. The characteristic equation of $A = \begin{pmatrix} 2 & 2 \\ 1 & 1 \end{pmatrix}$ is

Select the correct answer.

(a) $\lambda^2 + 3\lambda - 4 = 0$

(b) $\lambda^2 + 3\lambda + 4 = 0$

(c) $\lambda^2 - 3\lambda = 0$

(d) $\lambda^2 + 3\lambda = 0$

(e) $\lambda^2 - 3\lambda - 4 = 0$

7. The eigenvalues of $A = \begin{pmatrix} 2 & 2 \\ 1 & 1 \end{pmatrix}$ are

Select the correct answer.

(a) $1 \pm \sqrt{3}i$

(b) $-1 \pm \sqrt{3}i$

(c) 0, 3

(d) 0, 1

(e) 0, -1

8. The solution of the system $\mathbf{X}' = \begin{pmatrix} 2 & 2 \\ 1 & 1 \end{pmatrix} \mathbf{X}$ is

Select the correct answer.

(a) $\mathbf{X} = c_1 \begin{pmatrix} -1 \\ 1 \end{pmatrix} + c_2 \begin{pmatrix} 2 \\ 1 \end{pmatrix} e^{-3t}$

(b) $\mathbf{X} = c_1 \begin{pmatrix} -1 \\ 1 \end{pmatrix} + c_2 \begin{pmatrix} 2 \\ 1 \end{pmatrix} e^{3t}$

(c) $\mathbf{X} = c_1 \begin{pmatrix} -1 \\ 1 \end{pmatrix} + c_2 \begin{pmatrix} 1 \\ 2 \end{pmatrix} e^{-3t}$

(d) $\mathbf{X} = c_1 \begin{pmatrix} -1 \\ 1 \end{pmatrix} + c_2 \begin{pmatrix} 1 \\ 2 \end{pmatrix} e^{3t}$

(e) none of the above

9. The characteristic equation of $A = \begin{pmatrix} -3 & -1 \\ 1 & -1 \end{pmatrix}$ is

Select the correct answer.

(a) $\lambda^2 + 4\lambda - 4 = 0$

(b) $\lambda^2 + 4\lambda + 4 = 0$

(c) $\lambda^2 - 2\lambda = 0$

(d) $\lambda^2 - 2\lambda = 0$

(e) $\lambda^2 - 2\lambda - 4 = 0$

10. The solution of the system $\mathbf{X}' = \begin{pmatrix} -3 & -1 \\ 1 & -1 \end{pmatrix} \mathbf{X}$ is

Select the correct answer.

(a) $\mathbf{X} = c_1 \begin{pmatrix} -1 \\ 1 \end{pmatrix} e^{-2t} + c_2 \left[\begin{pmatrix} -1 \\ 1 \end{pmatrix} t e^{-2t} + \begin{pmatrix} 1 \\ 0 \end{pmatrix} e^{-2t} \right]$

(b) $\mathbf{X} = c_1 \begin{pmatrix} -1 \\ 1 \end{pmatrix} e^{-2t} + c_2 \begin{pmatrix} -1 \\ 1 \end{pmatrix} t e^{-2t} + c_3 \begin{pmatrix} 1 \\ 0 \end{pmatrix} e^{-2t}$

(c) $\mathbf{X} = c_1 \begin{pmatrix} -1 \\ 1 \end{pmatrix} e^{-2t} + c_2 \begin{pmatrix} 1 \\ -1 \end{pmatrix} e^{-2t}$

(d) $\mathbf{X} = c_1 \begin{pmatrix} -1 \\ 1 \end{pmatrix} e^{-2t} + c_2 \begin{pmatrix} 1 \\ 2 \end{pmatrix} e^{-t}$

(e) none of the above

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11. The characteristic equation for the matrix $A = \begin{pmatrix} 3 & 0 & 0 \\ 0 & 1 & -1 \\ 0 & 1 & 3 \end{pmatrix}$ is

Select the correct answer.

- (a) $-\lambda^3 - 7\lambda^2 - 16\lambda + 12 = 0$
- (b) $-\lambda^3 + 7\lambda^2 + 14\lambda + 6 = 0$
- (c) $-\lambda^3 + 7\lambda^2 - 14\lambda + 6 = 0$
- (d) $-\lambda^3 + 7\lambda^2 + 16\lambda + 12 = 0$
- (e) $-\lambda^3 + 7\lambda^2 - 16\lambda + 12 = 0$

12. The eigenvalues of the matrix A of the previous problem are

Select the correct answer.

- (a) $-2, -2, 3$
- (b) $2, 2, 3$
- (c) $1 \pm i, 3$
- (d) $-1 \pm i, 3$
- (e) $1 \pm \sqrt{3}i, 3$

13. Let A be the matrix of the previous two problems. The solution of $\mathbf{X}' = A\mathbf{X}$ is

Select the correct answer.

- (a) $c_1 \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} e^{3t} + c_2 \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} e^{2t} + c_3 \left[\begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} te^{2t} + \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} e^{2t} \right]$
- (b) $c_1 \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} e^{-3t} + c_2 \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} e^{-2t} + c_3 \left[\begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} te^{-2t} + \begin{pmatrix} 0 \\ -1 \\ 0 \end{pmatrix} e^{-2t} \right]$
- (c) $c_1 \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} e^{3t} + c_2 \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} e^{-2t} + c_3 \left[\begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} te^{-2t} + \begin{pmatrix} 0 \\ -1 \\ 0 \end{pmatrix} e^{-2t} \right]$
- (d) $c_1 \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} e^{-3t} + c_2 \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} e^{2t} + c_3 \left[\begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} te^{2t} + \begin{pmatrix} 0 \\ -1 \\ 0 \end{pmatrix} e^{2t} \right]$
- (e) $c_1 \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} e^{3t} + c_2 \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} e^{2t} + c_3 \left[\begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} te^{2t} + \begin{pmatrix} 0 \\ -1 \\ 0 \end{pmatrix} e^{2t} \right]$

14. The characteristic equation of $A = \begin{pmatrix} 2 & -2 \\ 2 & 2 \end{pmatrix}$ is

Select the correct answer.

- (a) $\lambda^2 - 4\lambda = 0$
- (b) $\lambda^2 + 4\lambda = 0$
- (c) $\lambda^2 + 4\lambda - 8 = 0$
- (d) $\lambda^2 - 4\lambda + 8 = 0$
- (e) $\lambda^2 - 4\lambda - 8 = 0$

15. The eigenvalues of $A = \begin{pmatrix} 2 & -2 \\ 2 & 2 \end{pmatrix}$ are

Select the correct answer.

- (a) 0, 4
- (b) 0, -4
- (c) 2, 2
- (d) $2 \pm 2i$
- (e) $-2 \pm 2i$

16. The solution of the system $\mathbf{X}' = \begin{pmatrix} 2 & -2 \\ 2 & 2 \end{pmatrix} \mathbf{X}$ is

Select the correct answer.

- (a) $\mathbf{X} = c_1 e^{2t} \left[\begin{pmatrix} 0 \\ 1 \end{pmatrix} \cos(2t) - \begin{pmatrix} 1 \\ 0 \end{pmatrix} \sin(2t) \right] + c_2 e^{2t} \left[\begin{pmatrix} 1 \\ 0 \end{pmatrix} \cos(2t) + \begin{pmatrix} 0 \\ 1 \end{pmatrix} \sin(2t) \right]$
- (b) $\mathbf{X} = c_1 e^{-2t} \left[\begin{pmatrix} 0 \\ 1 \end{pmatrix} \cos(2t) - \begin{pmatrix} 1 \\ 0 \end{pmatrix} \sin(2t) \right] + c_2 e^{-2t} \left[\begin{pmatrix} 1 \\ 0 \end{pmatrix} \cos(2t) + \begin{pmatrix} 0 \\ 1 \end{pmatrix} \sin(2t) \right]$
- (c) $\mathbf{X} = c_1 e^{2t} \left[\begin{pmatrix} 0 \\ 1 \end{pmatrix} \cos t + \begin{pmatrix} 1 \\ 0 \end{pmatrix} \sin t \right] + c_2 e^{2t} \left[\begin{pmatrix} 1 \\ 0 \end{pmatrix} \cos t + \begin{pmatrix} 0 \\ 1 \end{pmatrix} \sin t \right]$
- (d) $\mathbf{X} = c_1 e^{-2t} \left[\begin{pmatrix} 0 \\ 1 \end{pmatrix} \cos t - \begin{pmatrix} 1 \\ 0 \end{pmatrix} \sin t \right] + c_2 e^{-2t} \left[\begin{pmatrix} 1 \\ 0 \end{pmatrix} \cos t + \begin{pmatrix} 0 \\ 1 \end{pmatrix} \sin t \right]$
- (e) none of the above