Mu Alpha Theta National Convention 2002
Mississippi State University
Matrices Topic Test
Theta Division

1. Solve for x, y, z, and w: $\begin{bmatrix} 2 & -8 \\ 6 & -7 \end{bmatrix} = \begin{bmatrix} 2x-3 & 3y+1 \\ -5z+1 & -2w-5 \end{bmatrix}$

(a) $\begin{matrix} x=-2.5 \\ y=-3 \\ z=-1 \\ w=1 \end{matrix}$ (b) $\begin{matrix} x=2.5 \\ y=-3 \\ z=-1 \\ w=1 \end{matrix}$ (c) $\begin{matrix} x=-2.5 \\ y=-3 \\ z=-1 \\ w=-1 \end{matrix}$ (d) $\begin{matrix} x=-2.5 \\ y=-3 \\ z=1 \\ w=1 \end{matrix}$ (e) NOTA

2. Evaluate: $\begin{bmatrix} 6 & -1 \\ -8 & 3 \\ 13 & 7 \end{bmatrix} + \begin{bmatrix} -16 & 5 \\ 4 & -4 \\ 9 & 8 \end{bmatrix}$

(a) $\begin{bmatrix} 10 & 4 \\ -4 & -1 \\ 22 & 15 \end{bmatrix}$ (b) $\begin{bmatrix} -10 & 4 \\ -4 & 1 \\ 22 & 15 \end{bmatrix}$ (c) $\begin{bmatrix} -10 & 4 \\ -4 & -1 \\ 22 & 15 \end{bmatrix}$ (d) $\begin{bmatrix} -10 & 4 \\ -4 & 1 \\ 22 & 15 \end{bmatrix}$ (e) NOTA

3. Evaluate: $\begin{bmatrix} 10 & 7 & 3 \\ -5 & 2 & -11 \\ 6 & -5 & 8 \\ 4 & 1 & 15 \end{bmatrix} - \begin{bmatrix} 5 & 4 & -7 \\ -6 & -9 & 4 \\ 7 & 0 & 2 \\ -3 & 2 & -11 \end{bmatrix}$

(a) $\begin{bmatrix} 5 & 3 & 10 \\ 1 & 11 & -15 \\ -1 & -5 & 6 \\ 7 & -1 & 26 \end{bmatrix}$ (b) $\begin{bmatrix} 5 & 3 & 10 \\ 1 & 11 & -15 \\ 1 & -5 & 6 \\ 7 & -1 & 26 \end{bmatrix}$ (c) $\begin{bmatrix} 5 & 3 & 10 \\ 1 & 11 & 15 \\ -1 & -5 & 6 \\ 7 & -1 & 26 \end{bmatrix}$ (d) $\begin{bmatrix} 5 & 3 & 10 \\ 1 & 11 & -15 \\ -1 & -5 & 6 \\ 7 & 1 & 26 \end{bmatrix}$

(e) NOTA

4. Evaluate: $\begin{bmatrix} 3x+y & x-2y & 2x \\ 2x-5y & 3x-2y & x+y \end{bmatrix} + \begin{bmatrix} 2x & -3y & 5x+y \\ 3x+2y & x-4y & 2x \end{bmatrix}$

(a) $\begin{bmatrix} 5x+y & x+y & 7x+y \\ 5x-3y & 4x-6y & 3x+y \end{bmatrix}$ (b) $\begin{bmatrix} 5x+y & x-5y & 7x+y \\ 5x+3y & 4x-6y & 3x+y \end{bmatrix}$

(c) $\begin{bmatrix} 5x+y & x-5y & 7x+y \\ 5x-3y & 4x+6y & 3x+y \end{bmatrix}$ (d) $\begin{bmatrix} 5x+y & x-5y & 7x+y \\ 5x-3y & 4x-6y & 3x+y \end{bmatrix}$

(e) NOTA

5. Given: $A = \begin{bmatrix} 3 & -11 & -1 \\ -6 & 4 & 9 \end{bmatrix}$ and $B = \begin{bmatrix} 7 & -2 & 8 \\ 2 & -4 & -5 \end{bmatrix}$. Find $2A - 3B$.

(a) $\begin{bmatrix} -15 & -16 & -26 \\ -18 & 20 & 33 \end{bmatrix}$ (b) $\begin{bmatrix} -15 & -16 & -26 \\ 18 & 20 & 33 \end{bmatrix}$ (c) $\begin{bmatrix} -15 & -16 & 26 \\ -18 & 20 & 33 \end{bmatrix}$

(d) $\begin{bmatrix} -15 & 16 & -26 \\ -18 & 20 & 33 \end{bmatrix}$ (e) NOTA

6. Solve for A: $3A + \begin{bmatrix} 3 & -2 \\ 4 & -7 \\ -2 & 5 \end{bmatrix} = \begin{bmatrix} 6 & 13 \\ -8 & 2 \\ 1 & -1 \end{bmatrix}$.

(a) $\begin{bmatrix} 1 & 5 \\ -4 & 3 \\ 1 & 2 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 5 \\ 4 & 3 \\ 1 & -2 \end{bmatrix}$ (c) $\begin{bmatrix} 1 & 5 \\ 4 & 3 \\ 1 & 2 \end{bmatrix}$ (d) $\begin{bmatrix} 3 & 15 \\ -12 & 9 \\ 3 & -6 \end{bmatrix}$ (e) NOTA

7. Solve for x, y, and z in the matrix equation $4\begin{bmatrix} x & y \\ z & -1 \end{bmatrix} = 2\begin{bmatrix} y & z \\ -x & 1 \end{bmatrix} + 2\begin{bmatrix} 4 & x \\ 5 & -x \end{bmatrix}$.

(a) $x = -3$, $y = 2$, $z = 1$ (b) $x = 3$, $y = 2$, $z = -1$ (c) $x = 3$, $y = 2$, $z = 1$ (d) $x = -3$, $y = 2$, $z = -1$ (e) NOTA

8. Evaluate: $\begin{bmatrix} 1 & -1 & 7 \\ 2 & -1 & 8 \\ 3 & 1 & -1 \end{bmatrix}\begin{bmatrix} 1 & 1 & 2 \\ 2 & 1 & 1 \\ 1 & -3 & 2 \end{bmatrix}$

(a) $\begin{bmatrix} 6 & -21 & 15 \\ 8 & -23 & 19 \\ 4 & 7 & -5 \end{bmatrix}$ (b) $\begin{bmatrix} 6 & -21 & 15 \\ 8 & -23 & 19 \\ 4 & 7 & 5 \end{bmatrix}$ (c) $\begin{bmatrix} 6 & -21 & 15 \\ 8 & -23 & 19 \\ 4 & 7 & 9 \end{bmatrix}$ (d) $\begin{bmatrix} 6 & -21 & 15 \\ 8 & -23 & 19 \\ 4 & 1 & -5 \end{bmatrix}$

(e) NOTA

9. Evaluate: $\begin{bmatrix} 2 & x & 3 \\ -1 & 2 & 7 \\ z & 5 & -2 \end{bmatrix}\begin{bmatrix} 3 & 1 & 5 \\ 3 & -3 & -1 \\ 2 & 0 & y \end{bmatrix}$

(a) $\begin{bmatrix} 3x+12 & 3x+2 & -x+3y+10 \\ 17 & -7 & 7y-7 \\ 3z+11 & z-15 & -2y+5z-5 \end{bmatrix}$ (b) $\begin{bmatrix} 3x+12 & -3x+2 & -x+3y+10 \\ 17 & 7 & 7y-7 \\ 3z+11 & z-15 & -2y+5z-5 \end{bmatrix}$

(c) $\begin{bmatrix} 3x+12 & -3x+2 & -x+3y+10 \\ 17 & -7 & 7y-7 \\ 3z+11 & z-15 & -2y+5z+5 \end{bmatrix}$ (d) $\begin{bmatrix} 3x+12 & -3x+2 & -x+3y+10 \\ 17 & -7 & 7y-7 \\ 3z+11 & z-15 & -2y+5z-5 \end{bmatrix}$

(e) NOTA

10. Find the trace of $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & -2 & 4 \\ 3 & 1 & 3 \end{bmatrix}$.

(a) 15 (b) 4 (c) 3 (d) 2 (e) NOTA

11. If $A = \begin{bmatrix} 1 & 2 \\ x & -1 \end{bmatrix}$, then calculate A^3.

(a) $\begin{bmatrix} 1 & 8 \\ x^3 & -1 \end{bmatrix}$ (b) $\begin{bmatrix} 2x+1 & 4x+2 \\ 2x^2+x & -2x+1 \end{bmatrix}$ (c) $\begin{bmatrix} 2x+1 & 4x+2 \\ 2x^2+x & 2x+1 \end{bmatrix}$ (d) $\begin{bmatrix} 2x+1 & 4x+2 \\ 2x^2+x & 2x-1 \end{bmatrix}$

(e) NOTA

12. If $A = \begin{bmatrix} -7 & 11 & 12 \\ 4 & -3 & 1 \\ 6 & -1 & 3 \end{bmatrix}$, then calculate A^T.

(a) $\begin{bmatrix} 7 & -11 & -12 \\ -4 & 3 & -1 \\ -6 & 1 & -3 \end{bmatrix}$ (b) $\begin{bmatrix} 7 & 11 & 12 \\ 4 & 3 & 1 \\ 6 & 1 & 3 \end{bmatrix}$ (c) $\begin{bmatrix} -7 & 4 & 6 \\ 11 & -3 & -1 \\ 12 & 1 & 3 \end{bmatrix}$ (d) $\begin{bmatrix} 7 & 4 & 6 \\ 11 & 3 & 1 \\ 12 & 1 & 3 \end{bmatrix}$

(e) NOTA

13. If $X = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$, $Y = \begin{bmatrix} 1 \\ 0 \\ 2 \end{bmatrix}$, and $Z = \begin{bmatrix} 1 \\ 4 \\ 4 \end{bmatrix}$, then find scalars *a* and *b* such that $Z = aX + bY$.

(a) $\begin{matrix} a = 2 \\ b = 1 \end{matrix}$ (b) $\begin{matrix} a = -2 \\ b = -1 \end{matrix}$ (c) $\begin{matrix} a = -2 \\ b = 1 \end{matrix}$ (d) $\begin{matrix} a = 2 \\ b = -1 \end{matrix}$ (e) NOTA

14. If $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$, then calculate A^{101}.

(a) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (c) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (e) NOTA

15. Find the inverse of $\begin{bmatrix} 1 & 1 & 1 \\ 3 & 5 & 4 \\ 3 & 6 & 5 \end{bmatrix}$.

(a) $\begin{bmatrix} 1 & 1 & 1 \\ \frac{1}{3} & \frac{1}{5} & \frac{1}{4} \\ \frac{1}{3} & \frac{1}{6} & \frac{1}{5} \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 1 & -1 \\ 3 & 2 & -1 \\ 3 & -3 & 2 \end{bmatrix}$ (c) $\begin{bmatrix} 1 & 1 & -1 \\ -3 & 2 & 1 \\ 3 & -3 & 2 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 1 & -1 \\ -3 & 2 & -1 \\ 3 & 3 & 2 \end{bmatrix}$

(e) NOTA

16. For $x \neq \frac{-2}{3}$, find the inverse of $\begin{bmatrix} 2 & -3 \\ x & 1 \end{bmatrix}$.

(a) $\frac{1}{2-3x}\begin{bmatrix} 1 & 3 \\ -x & 2 \end{bmatrix}$ (b) $\frac{1}{2+3x}\begin{bmatrix} 1 & 3 \\ -x & 2 \end{bmatrix}$ (c) $\frac{1}{2-3x}\begin{bmatrix} 2 & x \\ -3 & 1 \end{bmatrix}$ (d) $\frac{1}{2+3x}\begin{bmatrix} 2 & x \\ -3 & 1 \end{bmatrix}$

(e) NOTA

17. Find x such that the matrix $\begin{bmatrix} 3 & x \\ -2 & -3 \end{bmatrix}$ is equal to its own inverse.

(a) - 4 (b) 2 (c) 4 (d) 5 (e) NOTA

18. Find A given that $(2A)^{-1} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$.

(a) $\begin{bmatrix} \frac{1}{2} & 1 \\ \frac{3}{2} & 2 \end{bmatrix}$ (b) $\begin{bmatrix} 2 & 4 \\ 6 & 8 \end{bmatrix}$ (c) $\begin{bmatrix} 8 & -4 \\ -6 & 2 \end{bmatrix}$ (d) $\begin{bmatrix} -1 & \frac{1}{2} \\ \frac{3}{4} & -\frac{1}{4} \end{bmatrix}$ (e) NOTA

19. If $\begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ 10 \end{bmatrix}$, then calculate x - y.

(a) 1 (b) 5 (c) –1 (d) – 5 (e) NOTA

20. Solve for A: $\begin{bmatrix} 1 & -2 \\ 3 & -2 \end{bmatrix}A = \begin{bmatrix} 1 & 3 \\ -2 & 1 \end{bmatrix}$

(a) $\begin{bmatrix} -\frac{3}{2} & -1 \\ -\frac{5}{4} & -2 \end{bmatrix}$ (b) $\begin{bmatrix} -\frac{11}{4} & \frac{5}{4} \\ \frac{1}{4} & -\frac{3}{4} \end{bmatrix}$ (c) $\begin{bmatrix} 1 & -\frac{3}{2} \\ -\frac{2}{3} & -\frac{1}{2} \end{bmatrix}$ (d) $\begin{bmatrix} \frac{3}{2} & 1 \\ \frac{5}{4} & 2 \end{bmatrix}$ (e) NOTA

21. Find all x such that the matrix $\begin{bmatrix} x & 3x \\ -2 & x \end{bmatrix}$ is singular.

(a) – 6 (b) – 6 or 0 (c) 0 (d) 0 or 6 (e) NOTA

22. Evaluate: $\begin{vmatrix} x-3 & 2 \\ 4 & x-1 \end{vmatrix}$

(a) $x^2-4x+11$ (b) x^2-4x-5 (c) $x^2-4x-11$ (d) x^2-4x+5 (e) NOTA

23. Evaluate: $\begin{vmatrix} -3 & 2 & 1 \\ 4 & 5 & 6 \\ 2 & -3 & 1 \end{vmatrix}$

(a) – 107 (b) – 75 (c) – 31 (d) 107 (e) NOTA

24. Evaluate: $\begin{vmatrix} x & y & 1 \\ 2 & 3 & -1 \\ -2 & -1 & 3 \end{vmatrix}$

(a) $8x-4y+4$ (b) $8x+4y+4$ (c) $10x-4y+4$ (d) $8x-4y-8$ (e) NOTA

25. Find the value(s) of x for which $\begin{vmatrix} x-1 & -4 \\ -2 & x+1 \end{vmatrix} = 0$.

(a) – 3 (b) 0 (c) 3 (d) – 3 or 3 (e) NOTA

26. If $\begin{vmatrix} 2 & -3 \\ x & 4 \end{vmatrix} = \begin{vmatrix} 5 & 4 \\ -1 & 3 \end{vmatrix}$, then calculate the value of x.

(a) $\frac{11}{3}$ (b) $-\frac{11}{3}$ (c) 1 (d) -1 (e) NOTA

27. If A is a 4×4 matrix such that $|A| = -3$, then calculate the value of $|2A|$.

(a) – 6 (b) – 48 (c) 6 (d) 48 (e) NOTA

28. After applying Cramer's Rule to solve a linear system of equations, it was calculated

that $x = \dfrac{\begin{vmatrix} 1 & 2 & -3 \\ 0 & 0 & 1 \\ 2 & -4 & 4 \end{vmatrix}}{\begin{vmatrix} -1 & 2 & -3 \\ 2 & 0 & 1 \\ 3 & -4 & 4 \end{vmatrix}}$ and $y = \dfrac{\begin{vmatrix} -1 & 1 & -3 \\ 2 & 0 & 1 \\ 3 & 2 & 4 \end{vmatrix}}{\begin{vmatrix} -1 & 2 & -3 \\ 2 & 0 & 1 \\ 3 & -4 & 4 \end{vmatrix}}$. Calculate the value of z.

(a) $\frac{4}{5}$ (b) $-\frac{3}{2}$ (c) $\frac{8}{5}$ (d) $-\frac{8}{5}$ (e) NOTA

29. For $x \neq \frac{-3}{2}$ and $A = \begin{bmatrix} 3 & -x \\ 2 & 1 \end{bmatrix}$, find $\left|A^{-1}\right|$.

(a) $\frac{1}{3-2x}$ (b) $\frac{1}{3+2x}$ (c) $3-2x$ (d) $3+2x$ (e) NOTA

30. If $A^{-1} = \begin{bmatrix} 2 & 5 \\ -7 & 6 \end{bmatrix}$ and $B^{-1} = \begin{bmatrix} 7 & -3 \\ 2 & 0 \end{bmatrix}$, then calculate $(AB)^{-1}$.

(a) $\begin{bmatrix} 35 & 17 \\ 4 & 10 \end{bmatrix}$ (b) $\begin{bmatrix} 24 & -6 \\ -37 & 21 \end{bmatrix}$ (c) $\begin{bmatrix} -35 & 17 \\ 4 & 10 \end{bmatrix}$ (d) $\begin{bmatrix} -24 & -6 \\ -37 & 21 \end{bmatrix}$ (e) NOTA

Work the following tiebreaker in the white space on the back on the scantron sheet and circle your answer.

Bonus: Find the adjoint of $A = \begin{bmatrix} -1 & 3 & 2 \\ 0 & -2 & 1 \\ 1 & 0 & -2 \end{bmatrix}$.

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1. b
2. c
3. a
4. d
5. a
6. e
7. c
8. b
9. d
10. d
11. e
12. c
13. d
14. a
15. e
16. b
17. c
18. d
19. d
20. a
21. b
22. b
23. b
24. a
25. d
26. a
27. b
28. d
29. b
30. a

Bonus: $\begin{bmatrix} 4 & 6 & 7 \\ 1 & 0 & 1 \\ 2 & 3 & 2 \end{bmatrix}$