MATHEMATICS 1110A 2003 FALL TEST 1

SECTION ____________ NAME (PRINTED) ______________________________

Student Number ________________ SIGNATURE ______________________________

Calculators with memory cleared are allowed. Each multiple choice question is worth 1 mark. All work is to be shown on this question paper in the space provided and *the answer selected must be entered on the attached answer sheet.* Both the question paper and the answer sheet, *both* with completed identification sections, must be handed in.

Let $\mathbf{A} = [a_{ij}] = \begin{bmatrix} 7 & -2 & 14 & 6 \\ 6 & 2 & 3 & -2 \\ 5 & 4 & 1 & 0 \\ 8 & 0 & 2 & 0 \end{bmatrix}$

1. Then entry $a_{32} =$

   (A) 3 (B) 4 (C) 32 (D) 14 (E) none of these

2. The size of matrix $\mathbf{A}$ is:

   (A) 3×3 (B) 3 (C) 4×1 (D) 4×4 (E) undefined

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3. The matrix $\begin{bmatrix} 2 & -1 & 0 \\ -1 & 5 & 1 \\ 0 & 1 & 3 \end{bmatrix}$ is

   (A) upper triangular (B) diagonal (C) lower triangular (D) symmetric (E) reduced

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4. $\begin{bmatrix} 2 & -1 \\ 7 & 4 \end{bmatrix} + 3\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} =$

   (A) $\begin{bmatrix} 2 & -1 \\ 7 & 4 \end{bmatrix}$ (B) $\begin{bmatrix} 5 & 2 \\ 10 & 7 \end{bmatrix}$ (C) undefined (D) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ (E) none of these

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If $\mathbf{A} = \begin{bmatrix} 2 & 1 \\ 3 & -3 \end{bmatrix}$, $\mathbf{B} = \begin{bmatrix} -6 & -5 \\ 2 & -3 \end{bmatrix}$ and $\mathbf{C} = \begin{bmatrix} -2 & -1 \\ -3 & 3 \end{bmatrix}$ then

5. $2\mathbf{A} - \frac{1}{2}(\mathbf{B} - \mathbf{C}) =$

   (A) $\begin{bmatrix} 6 & 4 \\ \frac{7}{2} & -3 \end{bmatrix}$ (B) $\begin{bmatrix} 4 & 2 \\ 6 & -6 \end{bmatrix}$ (C) $\begin{bmatrix} -2 & -2 \\ \frac{5}{2} & -3 \end{bmatrix}$ (D) $\begin{bmatrix} 6 & \frac{7}{2} \\ 4 & -3 \end{bmatrix}$ (E) undefined

6. $2\mathbf{A} + 3\mathbf{A} =$

   (A) undefined (B) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ (C) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (D) $\begin{bmatrix} -10 & -5 \\ -15 & 15 \end{bmatrix}$ (E) $\begin{bmatrix} 10 & 5 \\ 15 & -15 \end{bmatrix}$

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7. If $\mathbf{A} = \begin{bmatrix} 1 & 2 \\ 0 & -1 \\ 7 & 0 \end{bmatrix}$ and $\mathbf{D} = \begin{bmatrix} 1 & 2 & -1 \\ 1 & 0 & 2 \end{bmatrix}$ then $(\mathbf{D} - 2\mathbf{A}^T)^T =$

(A) $\begin{bmatrix} -1 & 2 & -15 \\ -3 & 2 & 2 \end{bmatrix}$ (B) $\begin{bmatrix} -1 & -3 \\ 2 & -2 \\ -15 & -2 \end{bmatrix}$ (C) $\begin{bmatrix} -1 & -3 \\ 2 & 2 \\ -15 & 2 \end{bmatrix}$

(D) $\begin{bmatrix} -1 & 2 & -15 \\ -3 & -2 & 2 \end{bmatrix}$ (E) none of these

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8. If $\mathbf{B}$ is 3×1 and $\mathbf{D}$ is 4×3 then $\mathbf{DB}$ is:

(A) 4×1 (B) undefined (C) 3×4 (D) 4×3 (E) 3×1

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9. $\begin{bmatrix} -1 & 1 \\ 0 & 4 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} 1 & -2 \\ 3 & 4 \end{bmatrix} =$

(A) undefined (B) $\begin{bmatrix} 4 & 6 \\ 13 & 16 \\ 5 & 0 \end{bmatrix}$ (C) $\begin{bmatrix} 6 & 2 \\ 16 & 12 \\ 0 & 5 \end{bmatrix}$ (D) $\begin{bmatrix} 2 & 6 \\ 12 & 16 \\ 5 & 0 \end{bmatrix}$ (E) none of these

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10. If $\mathbf{A} = \begin{bmatrix} 1 & -1 & 0 \\ 0 & 1 & 1 \end{bmatrix}$ and $\mathbf{C} = \begin{bmatrix} 1 & 0 \\ 2 & -1 \\ 0 & 1 \end{bmatrix}$ then $\mathbf{A}^T(2\mathbf{C}^T) =$

(A) none of these (B) undefined (C) $\begin{bmatrix} 2 & -2 & 0 \\ 4 & -6 & -2 \\ 0 & 2 & 2 \end{bmatrix}$ (D) $\begin{bmatrix} 2 & 4 & 0 \\ -2 & -6 & 2 \\ 0 & -2 & 2 \end{bmatrix}$ (E) $\begin{bmatrix} -2 & 4 \\ 2 & 0 \end{bmatrix}$

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11. The matrix $\begin{bmatrix} 0 & 0 & 5 \\ 1 & 0 & 4 \\ 0 & 1 & 2 \\ 0 & 0 & 0 \end{bmatrix}$ is:

(A) not reduced (B) diagonal (C) square (D) upper triangular (E) lower triangular

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12. The matrix $\begin{bmatrix} 2 & 3 \\ 1 & -6 \\ 4 & 8 \\ 1 & 7 \end{bmatrix}$ reduces to:

(A) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$ (C) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$ (D) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$

(E) none of these

For the system of equations:

$$\begin{aligned} x - 3y &= -11 \\ 4x + 3y &= 9 \end{aligned}$$

13. The augmented matrix is:

(A) none of these (B) $\left[\begin{array}{cc} 1 & 4 \\ -3 & 3 \\ \hline -11 & 9 \end{array}\right]$ (C) $\left[\begin{array}{cc} 1 & -3 \\ 4 & 3 \\ \hline -11 & 9 \end{array}\right]$

(D) $\left[\begin{array}{cc|cc} 1 & -3 & 1 & 0 \\ 4 & 3 & 0 & 1 \end{array}\right]$ (E) $\left[\begin{array}{cc|c} 1 & -3 & -11 \\ 4 & 3 & 9 \end{array}\right]$

14. The correct matrix in Question 13. reduces to:

(A) none of these (B) all of these (C) $\left[\begin{array}{cc|c} 1 & 0 & -\frac{2}{5} \\ 0 & 0 & \frac{53}{15} \end{array}\right]$ (D) $\left[\begin{array}{cc|c} 1 & 0 & -\frac{2}{5} \\ 0 & 0 & 0 \end{array}\right]$ (E) $\left[\begin{array}{cc|c} 1 & 0 & -\frac{2}{5} \\ 0 & 1 & \frac{53}{15} \end{array}\right]$

15. The solution(s) for the system of equations is/are:

(A) none of these (B) no solution, system is inconsistent (C) $x = -\frac{2}{5}$, $y = y$
(D) infinitely many in number (E) $x = -\frac{2}{5}$, $y = \frac{53}{15}$

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16. The system

$$\begin{aligned} 3w + 5x - 4y + 2z &= 0 \\ 7w - 2x + 9y + 3z &= 0 \end{aligned}$$

has

(A) a unique solution (B) no solutions (C) infinitely many solutions
(D) only the trivial solution (E) two non-trivial solutions

For the system of equations:

$$\begin{aligned} x + y + 7z &= 0 \\ x - y - z &= 0 \\ 2x - 3y - 6z &= 0 \\ 3x + y + 13z &= 0 \end{aligned}$$

17. The coefficient matrix reduces to:

(A) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ (C) $\begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$ (E) $\begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & 4 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$

18. The solution(s) to the system are:

(A) none, system is inconsistent (B) $x = -3z,\ y = -4z,\ z = z$ (C) $x = 0,\ y = 0,\ z = 0$
(D) $x = -z,\ y = -z,\ z = z$ (E) $x = -z,\ y = y,\ z = z$

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19. If the procedure to find the inverse of a matrix is applied to $\mathbf{A} = \begin{bmatrix} 7 & -8 & 5 \\ -4 & 5 & -3 \\ 1 & -1 & 1 \end{bmatrix}$ the result is $\left[\begin{array}{ccc|ccc} 1 & 0 & 0 & 2 & 3 & -1 \\ 0 & 1 & 0 & 1 & 2 & 1 \\ 0 & 0 & 1 & -1 & -1 & 3 \end{array}\right]$ We conclude that $\mathbf{A}^{-1}$

(A) does not exist (B) $= \begin{bmatrix} 2 & 3 & -1 \\ 1 & 2 & 1 \\ -1 & -1 & 3 \end{bmatrix}$ (C) $= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (D) cannot be found

(E) is not a square matrix

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20. $\begin{bmatrix} 2 & 0 & 8 \\ -1 & 4 & 0 \\ 2 & 1 & 0 \end{bmatrix}^{-1} =$

(A) does not exist (B) $\begin{bmatrix} 0 & -\frac{1}{9} & \frac{4}{9} \\ 0 & \frac{2}{9} & \frac{1}{9} \\ \frac{1}{8} & \frac{1}{36} & -\frac{1}{9} \end{bmatrix}$ (C) $\begin{bmatrix} \frac{1}{2} & 0 & \frac{1}{8} \\ -1 & \frac{1}{4} & 0 \\ \frac{1}{2} & 1 & 0 \end{bmatrix}$ (D) $\begin{bmatrix} -2 & 0 & -8 \\ 1 & -4 & 0 \\ -2 & -1 & 0 \end{bmatrix}$

(E) none of these

The education E and government G sectors of an economy are related in the following way. One unit of output from the education sector requires 1/5 of a unit output from the education sector and 3/5 of a unit output from the government sector. One unit of output from the government sector requires 2/5 of a unit output from the education sector and 3/10 of a unit output from the government sector.

21. The coefficient matrix for this economy is:

(A) $\begin{matrix} & E & G \\ E & 1/5 & 3/5 \\ G & 2/5 & 3/10 \end{matrix}$ (B) $\begin{matrix} & E & G \\ E & 1 & 2/5 \\ G & 3/5 & 1 \end{matrix}$ (C) $\begin{matrix} & E & G \\ E & 4/5 & -2/5 \\ G & -3/5 & 7/10 \end{matrix}$ (D) $\begin{matrix} & E & G \\ E & 1/5 & 2/5 \\ G & 3/5 & 3/10 \end{matrix}$

(E) none of these

22. There is an (external) demand for 200 units of education output and 300 units of government output. The production required to satisfy the external demand is found by solving:

(A) $\begin{array}{rrl} 4/5x & -2/5y & = 200 \\ -3/5x & +7/10y & = 300 \end{array}$ (B) $\begin{array}{rrl} 1/5x & -3/5y & = 200 \\ -2/5x & +7/10y & = 300 \end{array}$ (C) $\begin{array}{rrl} 1/5x & -2/5y & = 200 \\ -3/5x & +3/10y & = 300 \end{array}$

(D) $\begin{array}{rrl} 1/5x & +3/5y & = 200 \\ 2/5x & +7/10y & = 300 \end{array}$ (E) none of these

23. If (external) demand changes frequently then it would) make sense to compute:

(A) $\begin{bmatrix} 1/5 & 2/5 \\ 3/5 & 3/10 \end{bmatrix}^{-1}$ (B) $\begin{bmatrix} 1/5 & 3/5 \\ 2/5 & 3/10 \end{bmatrix}^{-1}$ (C) $\begin{bmatrix} 4/5 & -2/5 \\ -3/5 & 7/10 \end{bmatrix}^{-1}$ (D) $\begin{bmatrix} 4/5 & 2/5 \\ 3/5 & 7/10 \end{bmatrix}^{-1}$

(E) none of these

Consider the following system of linear inequalities:

$$\begin{aligned} 4x + 3y &> 12 \\ y &> x \\ 2y &< 3x + 6 \end{aligned}$$

24. The region they describe consists of all points:

(A) right of $4x + 3y = 12$ and left of $3x - 2y = -6$ and left of $x - y = 0$
(B) right of $4x + 3y = 12$ and right of $3x - 2y = -6$ and left of $x - y = 0$
(C) right of $4x + 3y = 12$ and right of $3x - 2y = -6$ and right of $x - y = 0$
(D) left of $4x + 3y = 12$ and right of $3x - 2y = -6$ and left of $x - y = 0$
(E) left of $4x + 3y = 12$ and left of $3x - 2y = -6$ and left of $x - y = 0$

25. The number of corner points of the region in Question 24. is

(A) 5 (B) 4 (C) 2 (D) 3 (E) 1

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