"On my honor, as an Aggie, I have neither given nor received unauthorized aid on this academic work."

________________________________________
Signature of student

Academic Integrity Task Force, 2004

My signature in this blank allows my instructor to pass back my graded exam in class or allows me to pick up my graded exam in class on the day the exams are returned. If I do not sign the blank or if I am absent from class on the day the exams are returned, I know I must show my Texas A&M student ID during my instructor’s office hours to pick up my exam.

Signature of student ________________________________

**Multiple Choice:** Clearly circle your answer choices. There is NO partial credit on the multiple choice questions.

**Work Out:** Write all solutions in the space provided, as full credit will not be given without complete, correct accompanying work, even if the final answer is correct. Fully simplify all your answers, and give exact answers unless otherwise stated. State any special features or programs you use on your calculator. Remember your units! Make sure that you indicate your answer clearly by circling your response.

Clear your calculator **BEFORE** and **AFTER** your exam. **MEM (2nd +)**, **Reset**, **ALL**, **Reset**

To turn on the correlation coefficient: **Catalog (2nd 0)**, **DiagnosticOn**, **Enter**, **Enter**

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*Once a mathematician named Dix
Gardened his lot, just for kicks.
And, as everything grows
In columns and rows,
He cheerfully weeded matrix.*

- Jan Gullberg
1. (5 pts) Line $L_1$ passes through points $(a, 3)$ and $(-1, 4)$, and Line $L_2$ passes through points $(-5, a - 3)$ and $(-2, 1)$. If $L_1$ and $L_2$ are perpendicular, what is the slope of $L_1$? Circle the correct answer.

   a. $m_{L_1} = \frac{-5}{4}$
   b. $m_{L_1} = \frac{5}{4}$
   c. $m_{L_1} = 4$
   d. $m_{L_1} = \frac{4}{5}$
   e. $m_{L_1} = \frac{-4}{5}$

2. (7 pts) Solve for $X$ in the following matrix equation. Assume all dimensions are compatible and all matrix algebra is defined.

   $$8X + P = XM + 2T$$

3. (5 pts) Consumers demand 3125 pairs of Foot Glove shoes when the price is $50. When 2300 pairs of shoes are produced and sold at a price of $63.20, both producers and consumers are satisfied. Foot Gloves will supply 2400 pairs of shoes if they can be sold for $64 per pair. Foot Gloves is not willing to supply any shoes unless it can get more than how much per pair of shoes? Circle the correct answer.

   a. $110.34$
   b. $42.37$
   c. $39.23$
   d. $44.80$
   e. $38.78$

4. (5 pts) Fully simplify the product

   $$\begin{bmatrix} 1 & 2 \\ n & -3 \end{bmatrix} \begin{bmatrix} -2 & 0 \\ 1 & 3 \end{bmatrix}.$$
5. (5 pts) For what value of \( k \) would the augmented matrix below be in reduced row echelon form? Circle the correct answer.

\[
\begin{bmatrix}
1 & 0 & 9 & 0 & 8 \\
0 & 1 & 4 & 8 & -4 \\
0 & k & 0 & 0 & 2
\end{bmatrix}
\]

a. \( k = 1 \)  
   b. \( k = 0 \)  
   c. \( k = -1 \)  
   d. Any value for \( k \) is acceptable  
   e. No value for \( k \) is acceptable

6. (5 pts) This table gives the dimensions and characteristics of five matrices.

<table>
<thead>
<tr>
<th>Matrix</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>( M ), non-singular</td>
<td>4 x 4</td>
</tr>
<tr>
<td>( N ), singular</td>
<td>8 x 8</td>
</tr>
<tr>
<td>( P )</td>
<td>1 x 4</td>
</tr>
<tr>
<td>( Q )</td>
<td>8 x 4</td>
</tr>
<tr>
<td>( R )</td>
<td>4 x 8</td>
</tr>
</tbody>
</table>

Which one of the following matrix operations is NOT defined? Circle the correct answer.

a. \( 2N^T - 4I_8 \)
   b. \( M^{-1}P^T \)
   c. \( RQM^T \)
   d. \( N^{-1}Q \)
   e. \( 3Q + 2R^T \)

7. The table shows the average cost (in dollars) of a basic cell phone in certain years.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average $ cost</td>
<td>150</td>
<td>110</td>
<td>85</td>
<td>48</td>
</tr>
</tbody>
</table>

a. (5 pts) Determine the equation of the best-fitting line for this data, where \( x \) is the number of years after 1985. If necessary, round your coefficients to two decimal places.

b. (3 pts) Use the unrounded model to predict the price of a basic cell phone in 1988.

c. (3 pts) Use the unrounded model to predict the year in which you would expect a basic cell phone to cost $28.
8. (5 pts) Matrix $L$ shows the number of children (C), the number of students (S), and the number of adults (A) that attended each of the three types of movies in one evening. The admission price for one movie is $4 for children, $6 for students, and $10 for adults. Find a matrix $M$ such that the product of $M$ and $L$ will give matrix $R$, showing the gross revenue for each type of movie. Circle the correct answer.

\[
L = \begin{bmatrix}
20 & 80 & 30 \\
30 & 50 & 90 \\
40 & 60 & 40
\end{bmatrix}
\]

a. $R = ML$ with $M = \begin{bmatrix} 4 & 6 & 10 \end{bmatrix}$

b. $R = LM$ with $M = \begin{bmatrix} 4 \\ 6 \\ 10 \end{bmatrix}$

c. None of these

d. $R = LM$ with $M = \begin{bmatrix} 4 & 6 & 10 \end{bmatrix}$

e. $R = ML$ with $M = \begin{bmatrix} 4 \\ 6 \\ 10 \end{bmatrix}$

9. (5 pts) Solve the following system of equations. If the system has an infinite number of solutions, then write the solution set in parametric form. Find the sum of the coordinates of the solution point(s); that is, if $(p, q)$, what is the value of $p + q$? Circle the correct answer.

\[
\begin{align*}
2y &= x - 14 \\
2x &= y + 13 \\
12x + 3y &= 33
\end{align*}
\]

a. 1

b. 0

c. No solution

d. $-1$

e. $3t - 13$, where $t$ is any real number

10. (8 pts) Solve for $a$, $b$, $c$ and $d$ in the matrix equation, \[
\begin{bmatrix} a & 4 \\ 8 & d \end{bmatrix}^T - 2\begin{bmatrix} -6 & c \\ 2 & -4 \end{bmatrix} = \begin{bmatrix} 7 & -3 \\ b & 1 \end{bmatrix}.
\]

$a = \quad b = \quad c = \quad d =$

11. (4 pts) Indicate the two next best row operations in the elimination process.
Immediate next row operation to be performed: __________________________

Then the next row operation after that (Hint: Perform the first row operation): __________________________

12. (4 pts) Solve the following system of equations. If the system has an infinite number of solutions, then write the solution set in parametric form.

\[ 0.16x - 2y = 0.5 \]
\[ 20y = 1.6x + 4 \]

13. (6 pts) If the monthly cost is \( C(x) = 1000x + 90000 \) Euros for \( x \) thousand leather couches that each sell for 2500 Euros, find the break-even revenue.

14. (5 pts) The solution to a system of equations is \( (r + 5, t, r, t + 2) \) where \( r \) and \( t \) are any real numbers. Which of the following is a particular solution to the system of equations? Circle the correct answer.

a. (10, 5, 0, 2)

b. (0, 0, 0, 0)

c. (6, 0, 1, 3)

d. (0, 2, 0, 5)

e. (10, 2, 5, 4)

15. (8 pts) A simple economy consists of bison ranchers and vegetable farmers. To produce one unit of bison, \( B \), requires 0.4 units of bison and 0.2 units of vegetables. To harvest one unit of vegetables, \( V \), requires the
consumption of 0.3 units of bison and 0.5 units of vegetables. Find the gross output of bison and vegetables to satisfy an external consumer demand for 972 units of bison and 1332 units of vegetables.

____________ units of bison  ____________ units of vegetables

5-pointBonus: How many units of bison and vegetables are consumed in the internal process of production in order to meet the external demand?

____________ units of bison  ____________ units of vegetables

16. (12 pts) Set up, but DO NOT SOLVE, a system of equations that can be used to solve the following problem. Be sure to clearly define your variables.

The Canine Company produces three types of dog biscuits. The puppy biscuit contains 20% wheat, 20% meat, and 30% fat. The adult biscuit contains 30% wheat, 20% meat and 20% fat. The senior biscuit contains 10% wheat, 40% meat, and 10% fat. Due to consumer demand, the number of pounds of puppy and senior biscuits is to be 1.5 times the pounds of adult biscuits. How many pounds of each type of dog biscuit should Canine Company produce if 102 pounds of wheat, 136 pounds of meat, and 94 pounds of fat are available and all the ingredients are completely used?