Do not open this exam until you are told to begin. You will have 25 minutes for the exam.

Check that you have a complete exam. There are 3 questions for a total of 26 points.

You are allowed to have one single sided, handwritten note sheet. Calculators are not allowed.

Cheating will result in a zero and be reported to the Dean’s Academic Conduct Committee.

Show all your work. With the exception of True/False questions, if there is no work supporting your answer, you will not receive credit for the problem. If you need more space to answer a question, continue on the back of the page, and indicate that you have done so.

<table>
<thead>
<tr>
<th>Question</th>
<th>Points</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>
1. (8 points) True/False and short answer. For these questions, you are not required to show any work.

(a) If $A$ is a matrix in reduced echelon form, then every column of $A$ must have a leading one.

- True  - False

(b) If $\{u_1, u_2, u_3\}$ is a linearly independent set of vectors, and $c_1, c_2, c_3$ are nonzero constants, then $\{c_1 u_1, c_2 u_2, c_3 u_3\}$ is also linearly independent.

- True  - False

(c) If $\text{span}\{u_1, u_2, u_3, u_4\} = \text{span}\{v_1, v_2, v_3\}$, then $u_1$ must be a linear combination of $\{v_1, v_2, v_3\}$.

- True  - False

(d) Give an example of two vectors $u_1$ and $u_2$ in $\mathbb{R}^3$ such that $\text{span}\{u_1, u_2\}$ is the plane $x + y + z = 0$.
2. Consider the vectors

\[ u_1 = \begin{bmatrix} 1 \\ -3 \\ -1 \end{bmatrix}, \quad u_2 = \begin{bmatrix} -2 \\ 3 \\ 3 \end{bmatrix}, \quad u_3 = \begin{bmatrix} -3 \\ -3 \\ 7 \end{bmatrix} \]

(a) (6 points) Show that the set \{u_1, u_2, u_3\} is linearly dependent and write one vector in the set as a linear combination of the other vectors.

(b) (4 points) If \( v \) is any vector that is NOT a linear combination of \( u_1 \) and \( u_2 \), and \( A \) is the matrix \( A = [u_1 \quad u_2 \quad u_3 \quad v] \), is the equation \( Ax = b \) guaranteed to have a solution for every \( b \) in \( \mathbb{R}^3 \)? Is that solution unique? Justify your answer.
3. (8 points) Do the points $(1, 2), (-1, 6), (2, 9)$ and $(0, 0)$ lie on a parabola $y = ax^2 + bx + c$? If so, find its equation. If not, explain why not.