This exam contains 4 pages (including this cover page) and 25 problems. Check to see if any pages are missing. Enter all requested information on the top of this page, and put your initials on the top of every page, in case the pages become separated.

You may not use your books, notes, or any calculator on this exam.

You are required to show your work on each problem on this exam. The following rules apply:

- **Organize your work**, in a reasonably neat and coherent way, in the space provided. Work scattered all over the page without a clear ordering will receive very little credit.

- **Mysterious or unsupported answers will not receive full credit**. A correct answer, unsupported by calculations, explanation, or algebraic work will receive no credit; an incorrect answer supported by substantially correct calculations and explanations might still receive partial credit.

- If you need more space, use the back of the pages; clearly indicate when you have done this.

- This practice exam is much much longer than the real midterm exam. It is provided to make you more familiar with the types of questions that may appear on the real midterm exam.
1. Find all \( x \) satisfying \( |3x - 1| = 5 \).

2. Find all \( x \) satisfying \( |x| + |x - 1| = 2 \).

3. Find all \( x \) satisfying
\[
\frac{x - 1}{2x + 3} < 5.
\]
Write your solution using interval notation.

4. Find all \( x \) satisfying
\[
\frac{|3x + 2|}{x + 3} < 1.
\]
Write your solution using interval notation.

5. Write the standard domain for the function
\[
f(x) = \frac{\sqrt{x - 5}}{x - 8}.
\]

6. For each curve below, state whether or not it is the graph of a function. If so, is the function invertible?

7. (a) Given the graph of \( f(x) \) below, sketch the graph of \( g(x) = 3f(x + 1) + 2 \).

(b) Given the graph of \( f(x) \) below, sketch the graph of \( g(x) = f(2x - 1) \).

8. Suppose \( f(x) \) is a function with domain \([-3, 2]\) and range \([0, 5]\). What are the domain and range of \( f(-x + 3) \) and \(-3f(x) + 1\)?
9. Label each of the following functions as being even, odd, neither, or both.

10. Label each of the following functions as being even, odd, neither, or both.

   (a) \[ f(x) = |x| \]

   (b) \[ g(x) = \begin{cases} x^2, & x > 0 \\ -x^2, & x < 0 \end{cases} \]

   (c) \[ h(x) = x^N, \text{ } N \text{ even} \]

11. Let \( f(x) = x + 2 \) and let \( g(x) = \frac{1}{x^2} \). Compute \( (fg)(x) \), \( \left( \frac{f}{g} \right)(x) \), \( (f \circ g)(x) \), and \( (g \circ f)(x) \). For each, write the standard domain.

12. Write the following function as a composition of two simpler functions:

   \[ f(x) = \frac{x^2 + 1}{x^2 - 3} \]

13. Write \( g(x) = 3f(2x - 1) + 2 \) as a composition of two linear functions and \( f(x) \).

14. Which of the tables below define a function? For the ones that are functions, give the domain and range and say if an inverse function exists.

<table>
<thead>
<tr>
<th>x</th>
<th>f(x)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
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<tr>
<td>3</td>
<td>2</td>
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<tr>
<td>\pi</td>
<td>3</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>x</th>
<th>g(x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
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<tr>
<td>6</td>
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</table>

<table>
<thead>
<tr>
<th>x</th>
<th>h(x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
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<tr>
<td>4</td>
<td>11</td>
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<tr>
<td>8</td>
<td>9.5</td>
</tr>
<tr>
<td>9</td>
<td>8.5</td>
</tr>
</tbody>
</table>
15. On which of the following domains does \( f(x) \) have an inverse: \((-\infty, \infty)\), \((-\infty, 2)\), \((-\infty, 0)\), \((0, 2)\), \((0, \infty)\), \((2, \infty)\)?

16. Find \( f^{-1}(y) \) for 
\[
f(x) = \frac{x - 1}{x - 2}
\]

17. Let \( f(x) \) have domain \([1, 3]\) and range \([2, 4]\). Assume \( f(x) \) is invertible. What are the domain and range for \( f^{-1}(y) \)?

18. Compute \( (g \circ f)(x) \) and \( (f \circ g)(x) \) for \( f(x) = 4x + 5 \) and \( g(x) = \frac{1}{4}(x - 5) \). Is \( g(x) = f^{-1}(x) \)?

19. Given the graph of \( f(x) \) below, sketch the graph of \( f^{-1}(y) \).

20. Find the equation of the line through the points \((2, 3)\) and \((-1, -1)\).

21. (a) Find the equation of the line parallel to \( y = \frac{2}{3}x + 1 \) passing through the point \((1, 5)\).
   (b) Find the equation of the line perpendicular to \( y = \frac{2}{3}x + 1 \) passing through the point \((1, 5)\).

22. Find two numbers that add to 6 and multiply to 7.

23. (a) Find the vertex of the parabola \( y = x^2 - 4x + 5 \).
   (b) Find the center and radius of the circle \( x^2 - 4x + y^2 + 6y = 13 \).

24. Do the following three points lie on a line? If so, give the equation for the line.
   \((0, 1), (2, 3), (3, 4)\).

25. Find the point on the line \( y = 2x - 1 \) closest to the point \((0, 0)\).