INSTRUCTIONS: Write neatly and show all work on the exam. Books, notes, and electronic devices are not permitted. The exam is worth 100 points. Box your answers. A correct answer with incorrect or no supporting work may receive no credit.

Name: ________________________________

1. Sketch the graph of: (24 pts)

(a) \( y = (x - 3)^2 \)

(b) \( y = \sqrt{x} - 2 \)

(c) \( y = x^{1/3} \)

(d) \( y = x^3 \)

(e) \( y = |x| \)

(f) \( y = -2x^4 \)

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<tr>
<th>Question</th>
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2. For \( f(x) = x^2 - 4 \) and \( g(x) = \frac{1}{x} \) determine the following functions and their respective domains. Give all domains in interval notation. (12 pts)

(a) \((fg)(x)\)

(b) \(\left(\frac{f}{g}\right)(x)\)

(c) \((g \circ f)(x)\)

3. Answer the following for the polynomial: \( f(x) = x^4 - 2x^2 + 1 \). (12 pts)

(a) Use arrow notation or indicate on a graph the end behavior of \( f(x) \).

(b) Find all \( x \) and \( y \) intercepts.

(c) For each \( x \) intercept you found in part (b), does the graph cross or touch the \( x \)-axis at the intercept?
4. Consider the polynomial $P(x) = x^4 - 2x^3 + 5x^2 - 8x + 4$. (10 pts)

(a) Use the rational roots theorem to list all possible rational zeros of the polynomial.

(b) Now find all zeros of the polynomial over the complex numbers. In other words, zeros may be real or imaginary numbers.

5. The graph of a parabola is shown below that crosses through $(0, -1)$ and has vertex $(2, 1)$. Write down the equation of the parabola in form $y = a(x - h)^2 + k$. (5 pts)
6. For each part you are given either the graph of a function or the equation of a function. Determine whether the given graph or function is odd, even, or neither. (9 pts)

(a) You do not need to show work for this part.

(b) You do not need to show work for this part.

(c) \( f(x) = 8x^4 - 3x^2 \). Show work to justify your answer for this part.
7. Find the slant asymptote for \( R(x) = \frac{x^3 - 4x^2 + 2x - 2}{x^2 + 2x - 1} \) (5 pts).

8. A piece of wire 14 inches long is bent into the shape of a rectangle having width \( x \) and length \( y \). **Setup but do not solve** an equation to find the maximum area of the rectangle as a function of either the width or the length. (5 pts)
9. Consider the following rational function: \( r(x) = \frac{2x^2 + 4x - 16}{x^2 - x - 2} \) (18 pts)

(a) Find all holes and/or intercepts of \( r(x) \).

(b) Find all vertical asymptotes of \( r(x) \). If there are none write NONE.

(c) Find any horizontal and/or slant asymptotes of \( r(x) \). If there are none write NONE.

(d) Sketch the graph of \( r(x) \). Plot any extra points as needed to confirm the graph. Label all intercepts, holes, and asymptotes as relevant.