On the front of your bluebook, please write: a grading key, your name, student ID, your lecture number, and instructor. This exam is worth 100 points and has 5 questions on both sides of this paper.

- Submit this exam sheet with your bluebook. However, nothing on this exam sheet will be graded. Make sure all of your work is in your bluebook.

- **Show all work and simplify your answers!** Answers with no justification will receive no points.

- Please begin each problem on a new page.

- No notes or papers, calculators, cell phones, or electronic devices are permitted.

1. (24 points) Let $f(x) = -2\sqrt{x-2}$ and $g(x) = x^2 - 4$

   a.) (4 points) State the domain and range of $f(x)$ using interval notation.

   b.) (4 points) State the domain and range of $g(x)$ using interval notation.

   c.) (8 points) Calculate $(g \circ f)(x)$ and simplify your answer. State its domain and range using interval notation.

   d.) (8 points) Calculate $(f \circ g)(x)$ and simplify your answer. State its domain using interval notation.

2. (24 points, 6 points each) Calculate the following limits:

   a.) $\displaystyle\lim_{x \to 1} \frac{|2x - 2|}{x - 1}$

   b.) $\displaystyle\lim_{x \to 2} \frac{\cos(\pi x)}{x(x + 2)}$

   c.) $\displaystyle\lim_{x \to 0} x \sin(1/x)$

   d.) $\displaystyle\lim_{x \to \infty} \frac{\sqrt[3]{x^5 + 4x - 2}}{2x^2 - 9}$

3. (22 points) The following are unrelated:

   a.) (8 points) If $f(x)$ is odd and $g(x)$ is even, is $(f \circ g)(x)$ even, odd, or neither? What about $(g \circ f)(x)$?

   b.) (6 points) For what values of x is the function $f(x) = \csc(x)$ continuous?

   c.) (8 points) Prove that the function $h(x) = \sin(x) - \pi x + \frac{2}{3}x^2$ has at least one zero that is greater than 0.

4. (20 points) Consider $f(x) = \sqrt{2x + 4}$

   a.) (3 points) What is the average rate of change of $f(x)$ between $x = 2.5$ and $x = 6$?

   b.) (10 points) Use the limit definition of the derivative to calculate $f'(x)$.

   c.) (7 points) Find an equation for tangent line to $f(x)$ at $x = 2.5$.

5. (10 points) If $f(x) = \frac{1}{x^2}$, sketch $y = 3f(x - 2) - 3$. Clearly label and identify all vertical asymptotes, horizontal asymptotes, and zeros.