• On the front of your blue book print (1) your name, (2) your student ID number, (3) your discussion section number, and (4) a grading table.

• Show all work in your blue book and BOX IN YOUR FINAL ANSWERS where appropriate.

• Please start each problem on a new page. There are a total of three problems on both sides of this paper and a total of 100 points.

• NO books, notes, crib sheets, calculators or any other electronic devices are allowed.

Show your reasoning clearly for problems 2–7. A correct answer with no supporting work may receive no credit while an incorrect answer with some correct work may receive partial credit.

1. (30 points: 15 points each) Find the derivatives of the following functions with respect to $x$.
   \( (a) \ y = (x^2 - \sqrt{x})(x^2 + \sqrt{x}) \)
   \( (b) \ g(x) = \frac{e^x}{\sin(2x)} \)

2. (20 points) Find \( \frac{dy}{dx} \) given that \( \ln(xy) = 2x \).

3. The function \( f \) and its first and second derivatives, \( f' \) and \( f'' \), are given below:
   \( f(x) = x^3 - 3x + 2, \quad f'(x) = 3(x - 1)(x + 1), \quad f''(x) = 6x. \)

   Use these information to answer the following unrelated questions.
   \( (a) \ (15 \text{ point}) \) Find the tangent line approximation to \( f(x) \) near \( x = 2 \). Use this approximation to estimate \( f(2.01) \).
   \( (b) \ (25 \text{ point}) \) Find and classify all critical points of \( f \). On what interval(s) is \( f \) increasing? decreasing?
   \( (c) \ (10 \text{ points}) \) On what intervals(s) is \( f \) concave up? concave down?