- 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) $g(x) = \dfrac{e^x}{\sin(2x)}$

2. (20 points) Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ given that $\ln(xy) = 2x$.

3. The function f and its first and second derivatives, f' and f'', are given below:

   $$f(x) = x^3 - 3x + 2, \qquad f'(x) = 3(x-1)(x+1), \qquad f''(x) = 6x.$$

   Use these information to answer the following *unrelated* questions.

   (a) (15 point) Find the tangent line approximation to $f(x)$ near $x = 2$. Use this approximation to estimate $f(2.01)$.

   (b) (25 point) Find and classify all critical points of f. On what interval(s) is f increasing? decreasing?

   (c) (10 points) On what intervals(s) is f concave up? concave down?