Instructions:

- Turn off and put away all mobile phones, computers, iPods, etc.
- Show answers and arguments in the space provided. You may use the back of the pages also, but indicate clearly any such material that you want marked.
- Answers given without justification may receive zero credit.
- This is a closed book exam. No calculators. No formula sheets. No questions.
- Use blue or black ballpoint pens please. Answers written in pencil will be disregarded.
- Incorrect statements will be penalized. If you do not want something graded, please cross it out.
- Write neatly.

NOTE: QUESTIONS THAT ARE NOT ON THIS PRACTICE MIDTERM MAY BE ON THE ACTUAL MIDTERM. MOST IMPORTANTLY, TOPICS THAT ARE NOT COVERED IN THIS PRACTICE MIDTERM, BUT ARE PART OF THE SYLLABUS, MAY BE ON THE ACTUAL MIDTERM.

All in all, the content of the problems on the actual midterm may be completely different than the one in this practice midterm.
1. Compute the following:

(a) \( \int (7t^4 - t^{-2}) \, dt \)

(b) \( \int \left( \frac{2}{3} \sin x - 10 \cos x \right) \, dx \)
1. (continued) Compute the following:

(c) \( \int (\sec(2x + 3) \tan(2x + 3)) \, dx \)
1. (continued) Compute the following:

(d) \( (x^{e^x^2} + \cos x)' \)

(e) \( \frac{d}{dx} \log_{11}(\sin x) \)
1. (continued) Compute the following:

\( \frac{d}{dx} \sec^{-1}(2e^x + 3) \bigg|_{x=0} \)
2. Consider the function \( f(x) = xe^{-2x} \).

(a) Find the intervals on which the function \( f \) is increasing or decreasing.

(b) Determine the intervals on which the function \( f \) is concave up or down and find the points of inflection.
2. (continued) Consider the function \( f(x) = xe^{-2x} \).

(c) Does \( f \) have a minimum on the interval \([0, 2]\)? If yes, explain why and find it. If not, explain why.

(d) Does \( f \) have a maximum on the interval \([0, 2]\)? If yes, explain why and find it. If not, explain why.
2. (continued) Consider the function $f(x) = xe^{-2x}$.

(e) Find all vertical and horizontal asymptotes of $f$.

(f) Sketch the graph of $f$. 
3. Determine whether the following limit exists. If it exists, compute it. If it does not exist, say so and explain why.

(a) \[ \lim_{{x \to 0}} \frac{\sin^{-1}x}{\tan^{-1}x} \]

*Note: \( \sin^{-1} = \arcsin \), \( \tan^{-1} = \arctan \).*
3. (continued) Determine whether the following limit exists. If it exists, compute it. If it does not exist, say so and explain why.

(b) \( \lim_{x \to 0} \left( \frac{1}{x^2} - \cot^2 x \right) \).
4. Find an equation of the tangent line to the curve \( \sin(x - y) = x \cos(y + \frac{\pi}{4}) \) at the point \( \left(\frac{\pi}{4}, \frac{\pi}{4}\right) \).
5. (a) At a given moment, a plane passes directly above a radar station at an altitude of 6\text{ km}. The plane’s speed is 800\text{ km/h}. Let $\theta$ be the angle that the line through the radar station and the plane makes with the horizontal. How fast is $\theta$ changing 12 min after the plane passes over the radar station?

Note: You do NOT have to simplify your final numerical answer.
5. *(continued)*

(b) Consider an isosceles trapezoid with a base of length 4 and sides of length 2. Find the angles of the trapezoid that maximize the area of the trapezoid.
6. State and prove Rolle’s Theorem.