Name: _______________________________ PID: ________________

TA: ________________________ Sec. No: _____ Sec. Time: _____

Math 10B.
Final Examination
March 16, 2011

Turn off and put away your cell phone.
You may use any type of calculator, but no other electronic devices during this exam.
You may use one page of notes, but no books or other assistance during this exam.
Read each question carefully, and answer each question completely.
Show all of your work; no credit will be given for unsupported answers.
Write your solutions clearly and legibly; no credit will be given for illegible solutions.
If any question is not clear, ask for clarification.

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1. (4 points) Evaluate the integral \[ \int_{-2}^{2} x^{2011} \cos(x) \, dx. \] Be sure to explain how you arrived at your answer.

2. (6 points) Determine if the following integral converges or diverges: \[ \int_{2}^{\infty} \frac{|\sin(x)|}{x^2} \, dx. \]
3. (6 points) Evaluate the following indefinite integrals.

(a) \[ \int xe^{3x^2} \, dx \]

(b) \[ \int \frac{\sqrt{x} - 1}{2\sqrt{x}} \, dx \]
4. (6 points) Let \( f(x) = \int_{\frac{x}{2}}^{x} \frac{e^{t}}{\sin(t)} \, dt \). Use integration by parts to evaluate

\[ \int_{\frac{\pi}{2}}^{\pi} f(x) \cos(x) \, dx. \]
5. (6 points) The region enclosed by

\[ y = e^{5x}, \quad y = e^x, \quad x = 1 \]

is rotated about the \( x \)-axis. Find the volume of the resulting solid of revolution.
6. (6 points) The widths (in meters) of a swimming pool were measured at 2-meter intervals as indicated in the figure. Estimate the area of the pool using:

(a) Left-hand rule

(b) Right-hand rule

(c) Trapezoidal rule
7. (6 points) Consider \( f'(x) \) given above.
(Note you are given the graph of the derivative of \( f \)).

(a) On which interval is \( f \) decreasing? Explain.

(b) At which value(s) of \( x \) does \( f(x) \) have a local minimum? Explain.

(c) Suppose \( f(-2) = 0 \). Find \( f(4) \). Hint: You will need to use FTC.
8. (6 points) Salt water with a concentration of 0.1 lb/gal salt is fed at a rate of 5 gal/sec into a tank with a volume of 100 gallons initially filled with pure water. As the salt water is fed into the tank, water is drained out of the tank through a small hole in the bottom of the tank at a rate of 5 gal/sec.

(a) Denote the quantity of salt in the tank by $Q(t)$. Write a differential equation for $Q(t)$ and solve it.

(b) When will the tank contain 1 pound of salt?

(c) How much salt will be in the tank after a long time?