GENERAL INSTRUCTIONS

1. DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

2. The exam pages are two sided.

3. Closed book, except for a graphing calculator and a 3 × 5 file card. Note: you may not use the calculator as a substitute for calculus. (Note: The exams this quarter will not permit calculators of any kind.)

4. The following are all prohibited: Cell phones, laptops, iPods, electronic dictionaries, and any other electronic devices or communication devices. All electronic or communication devices you have with you must be turned completely off and put inside something (pack, purse, etc.) and out of sight.

5. The point values are as indicated in each problem; total 100 points.

6. Write all answers on the test paper. Extra paper is provided at the end for long answers or scratch work.

7. Show enough of your work that your method is obvious. Be sure that every statement you write is correct. Cross out any material you do not wish to have considered. Correct answers with insufficient justification or accompanied by additional incorrect statements will not receive full credit. Correct guesses to problems requiring significant work, and correct answers obtained after a sequence of mostly incorrect steps, will receive no credit.

8. Be sure you say what you mean, and use correct notation. Credit will be based on what you say, not what you mean.

9. When exact values are specified, give answers such as $\frac{1}{7}$, $\sqrt{2}$, ln(2), or $\frac{2\pi}{9}$. Calculator approximations will not be accepted.

10. Final answers must always be simplified unless otherwise specified.

11. Grading complaints must be submitted in writing at the beginning of the class period after the one in which the exam is returned (usually by the Tuesday after the exam).

12. Time: 50 minutes.

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1. (8 points) State the Fundamental Theorem of Calculus (either of the versions I gave in class).

2. (6 points) Use the left hand Riemann sum with 3 subintervals to estimate \( \int_{-1}^{1} \sin^2(x) \, dx \). Show your work by writing out all of the terms of the sum.

3. (8 points/part) Find all antiderivatives of the following functions:
   (a) \( f(x) = 3x^2 \). (Also, find an antiderivative \( F \) such that \( F(-1) = 0 \).)
   
   (b) \( g(t) = t\sqrt{t} \).

   (c) \( h(z) = -ze^{-z^2} \).

   (d) \( q(x) = x \sin(3x^4) \), in terms of elementary functions and a function \( F \) such that \( F'(x) = \sin(3x^2) \).
4. (6 points) At the right is a graph of the function \( f(x) = e^{-x^2} \). Using its symmetry about the \( y \)-axis, and the information \( \int_{0}^{1} e^{-x^2} \, dx \approx 0.746824 \) and \( \int_{1}^{2} e^{-x^2} \, dx \approx 0.135257 \) (correct to 6 decimal places), find \( \int_{-1}^{2} e^{-x^2} \, dx \). Show your steps.

5. Consider, but do not solve, the following problem: We wish to estimate \( \int_{1}^{5} e^{-x^2} \, dx \) to an accuracy of 0.05.

   (a) (6 points) What do we need to check to know that the standard error estimate for Riemann sums applies to this problem?

   (b) (10 points) How many subdivisions of the interval should be used to ensure that the right hand Riemann sum for the integral satisfies the required accuracy? (Do not compute the Riemann sum).
6. At the right is the graph of the function 
\( y = f(x) \). (The lines are straight.)
(a) (18 points) On the grid below, sketch
the graph of the antiderivative \( F(x) \) of \( f(x) \)
which satisfies \( F(0) = 7 \). Label all local
maximums, local minimums, and inflection
points of \( F \), giving their \( x \) and \( y \) coordinates.

(b) (8 points) Find the average value of \( f \) on the interval \([0, 6]\).

7. (6 points) If \( f(t) \) is measured in meters/second\(^2\) and \( t \) is measured in seconds, what are
the units of \( \int_{a}^{b} f(t) \, dt \)?

Extra credit. (This problem will only be counted if you get a grade of B or better on the
main part of this exam.)

When the brakes of a car are applied hard, the result is a fixed constant deceleration
until the car comes to a stop. Use antiderivatives to show that if the car is going twice as
fast when the brakes are applied, it travels four times as far before it stops.