Answer all of the following questions. Additional sheets are available if necessary. No books or notes may be used. You may use a calculator. You may not use a calculator which has symbolic manipulation capabilities. When answering these questions, please be sure to 1) check answers when possible, 2) clearly indicate your answer and the reasoning used to arrive at that answer (*unsupported answers may not receive credit*).

Each question is followed by space to write your answer. Please lay out your solutions neatly in the space below the question. You are not expected to write each solution next to the statement of the question.

Name ______________________
Section ___________

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1. If $\int_1^0 f(x) \, dx = 5$, find the value of $\int_2^3 x f(x^2) \, dx$. 
2. Let $f(x) = \csc(x)$, the cosecant function, for $0 < x \leq \pi/2$.

(a) Sketch the graph of $f(x)$ and give the domain and range of the function $f$.

(b) On the same axes, sketch the graph of the inverse function $f^{-1}(x)$ and give the domain and range of the function $f^{-1}$. 
3. Let \( f(x) = xe^{x^2} \) for \( x \) a real number and let \( g \) be the inverse function to \( f \).

(a) Use calculus to show that the function \( f(x) \) is one-to-one.
(b) Find \( f(1) \).
(c) Find \( g(e) \).
(d) Find \( g'(e) \).
4. (a) Compute the first four derivatives of $f(x) = xe^x$.

(b) Guess a formula for the $n$th derivative of $f(x)$, $f^{(n)}(x)$. (Of course, you are eager to prove this by induction. But please don’t—you may need the time for the later problems.)
5. A sample of Kryptonite 210 has mass 300 grams at time \( t = 0 \) and decays to 100 grams after 180 days.

(a) Find the mass of the sample for all time.
(b) Find the mass after 100 days.
(c) Find the half-life of Kryptonite 210.
6. Use calculus to evaluate the following integrals.

(a) \[
\int_0^{1/2} \frac{1}{\sqrt{1-x^2}} \, dx
\]

(b) \[
\int \frac{x + 1}{x^2 + 4} \, dx
\]

(c) \[
\int \frac{\cos x}{\sin x} \, dx
\]
7. (a) Simplify the expression \( \sin^{-1}(\cos(7\pi/6)) \).

(b) If \( \cos u = 5/13 \) and \(-\pi \leq u \leq 0\), find \( \sin u \), \( \tan u \) and \( \cos 2u \).
8. Give a complete statement of L’Hopital’s rule for the indeterminate form \(0/0\).
9. Find the following limits.

(a) \( \lim_{x \to 0} \frac{e^x}{x} \)
(b) \( \lim_{x \to 0} \frac{\ln(1+2x)}{x} \)
(c) \( \lim_{x \to 0} \frac{e^x-1}{x} \)
(d) \( \lim_{x \to 0} (1 + 3x)^{1/x} \)