Mathematics 116   Name: _____

Professor Alan H. Stein

Due Friday, March 28   This problem set will be graded on the basis of 100 points but will
be worth 50 points.

Make sure that you check the course website for instructions, fill out the pledge form and
hand it in with your paper. The instructions for problem sets and take-home examinations
along with the pledge form are available from the *General Policies* portion of the web site.
No paper will be accepted without a signed pledge form. Remember that your paper may
be handed in before the deadline but that no late papers will be accepted regardless of
the reason. The course website also includes an explanation of how your average will be
calculated if you fail to complete this assignment.

Note that, since most of the calculations involved can be done routinely using either a calcu-
lator or a symbolic manipulation program such as Maple or Mathematica, it will obviously
be necessary to show, through your work, exactly how you came up with your solutions.

1. Write down an effective strategy for calculating derivatives. The strategy should work
   for any function built from basic, elementary functions as long as one is familiar with
   the basic differentiation formulas, including the product, quotient and chain rules and
   the formulas for derivatives of basic, elementary functions. *Explain the strategy using
   plain language, using complete sentences and avoiding the use of mathematical notation.
   Indeed, note that if you are tempted to use mathematical notation, then you are not
   writing down a strategy.*

2. Write down an effective strategy for calculating integrals. *Explain the strategy using
   plain language, using complete sentences and avoiding the use of mathematical notation.
   Indeed, note that if you are tempted to use mathematical notation, then you are not
   writing down a strategy.*

3. Calculate $\lim_{x\to 0}(1 - \cos x)\cot^2 x$. *Extra Credit: Find the limit two completely different
   ways.*

4. Perform a partial fractions decomposition for $\dfrac{3x - 2}{x^2 - 5x + 6}$. *Extra Credit: Find its inte-
   gral.*

5. Perform a partial fractions decomposition for $\dfrac{x^2 - 11x + 7}{x^3 + 5x^2 + 4x + 20}$. *Extra Credit: Find
   its integral.*

For the remaining questions, you may use formulas for the integrals of power functions, the exponential function and the sine and cosine functions along with the integral of $\dfrac{1}{\sqrt{1-x^2}}$. Any other integration formulas for elementary functions must be derived.

6. Calculate $\int \sin^2 x \cos^2 x \, dx$.

7. Calculate $\int \dfrac{x^3}{\sqrt{25-x^2}} \, dx$.

8. Calculate $\int \dfrac{x+2}{x+1} \, dx$.

9. Calculate $\int \sin^2 x \cos^3 x \, dx$.

10. Calculate $\int \arctan(5x) \, dx$.

11. Calculate $\int \dfrac{\ln x}{x^2} \, dx$.

12. Calculate $\int t^2 \sin t \, dt$.

13. Calculate $\int \dfrac{x}{\sqrt{25-x^2}} \, dx$.

Extra Credit

Extra credit will be awarded for the best joke. All jokes must observe standards of good taste. The determination of the best joke will be made by popular vote in class when the papers are returned.