Lab 3: The Substitution Rule

In this lab you will do several problems that will help you understand and practice with the substitution rule. Do the problems neatly in pencil on a **separate** piece of paper and staple your pages. Clearly lay out your work using proper notation and circle/highlight/box your final answer. **Problems with just an answer and no work will not receive credit.** You are encouraged to work groups of 2 to 4 people. If you do work with more than one person, you only need to hand in one lab write-up per group; make sure you put everyone's name on it. This lab is worth 40 points. This is due next **Wednesday, July 16.**

1. (8 pts) Clearly explain why the substitution rule can't be used to compute $\int \frac{1}{1+x^2}\,dx$ but **can** be used to compute $\int \frac{x}{1+x^2}\,dx$. As part of your explanation, compute $\int \frac{x}{1+x^2}\,dx$.

2. (10 pts) Compute $\int (2x^2+3x)^2(4x+3)\ dx$ in two ways: with the substitution rule, and by multiplying out the integrand and using basic integral rules. Confirm that your results match.

3. (8 pts) Use substitution to compute $\int \frac{(3+\ln x)^2(2-\ln x)}{4x}\,dx$. Note that you'll also have to apply what we called "back substitution".

4. (6 pts) Use substitution to compute $\int e^{t+e^t}\,dt$. If you're having trouble at first, try rewriting the integrand with an exponent rule.

5. (8 pts) If f is continuous and $\int_0^9 f(x)dx = 4$, find $\int_0^3 xf(x^2)dx$.