Calculus II Laboratory: Integration Experiments

This is a hand-in laboratory, and should be done with a partner (you and your partner should hand in one lab report). Your lab report should be a narrative of what you did, and the conclusions that you drew, following the numbered outline below. Please use complete sentences and good English usage. Your report should be self-contained and readable without reference to this handout. Feel free to consult your textbook, your notes and me about the problems in this lab. You may speak to anybody about technical *DERIVE* questions.

Integration by Parts

1. Use *DERIVE* to integrate $\ln(x), x\ln(x), x^2\ln(x), \cdots$.
2. When you have done enough cases to make a generalization, write down (or at least describe) a formula for the integral of $x^n \ln(x)$. Include some description of how you arrived at your formula.
3. Does your formula work for negative values of n? Be careful about the case $n = -1$.

Partial Fractions

In this problem you will explore the function

$$f(x) = \frac{2x^4}{x^4 + 7x^3 + 16x^2 + 27x + 5}.$$

1. Under the *Simplify* menu in *DERIVE*, you can find a *Factor* command. Factor the denominator into linear and quadratic factors, over the real numbers (note that factoring into *rational* factors is not good enough).
2. What real numbers make this denominator equal to zero? What sort of behavior would you expect in a *Plot* of this function? But what happens when you perform a *Plot*! Change the range of your plot a bit, to explain what's happening! Note that you can *Print* graphs from the *Plot* window if you wish, and you think it would be helpful.
3. What is the form for the partial fractions decomposition that you would expect for this function? How many constants will you need?
4. Under *Simplify* you can find an *Expand* command. With an appropriate choice of for the expansion, you should get the partial fractions decomposition. What are the values for the constants you anticipated above? — Feel free to *Print* out a chunk of *DERIVE* output, instead of trying to write these down by hand!
5. Explain *qualitatively* the relationship between the actual *DERIVE* output you get when you *Integrate* $f(x)$, and the partial fractions decomposition you got above (that is, which partial fraction terms lead to which integral pieces).