Mathematics 136 – Advanced Placement Calculus
Discussion 2 – Review of Differentiation Formulas
September 16, 2009

Background

Over the last few days we have been thinking about the definition of the derivative of $f(x)$ at x:

$$f'(x) = \lim_{h\to 0} \frac{f(x+h) - f(x)}{h}.$$

Of course, if we had to use the definition every time we wanted to compute a derivative, it would be very awkward and time consuming. From your high school calculus course, you should recall a number of methods for computing derivatives of functions defined by formulas. We want to review those today and work some examples. *The goal is to finish work on this and hand it in by the end of today's class meeting.*

A. *The general rules.* Say you know that the derivatives of $f(x)$ and $g(x)$ exist at x.

1. Say *in words, and with a formula* how you would find the derivative of the function $cf(x) + g(x)$ (c constant) at x.
2. Say *in words, and with a formula* how you would find the derivative of the product function $f(x)g(x)$ at x.
3. Say *in words, and with a formula* how you would find the derivative of the quotient function $\frac{f(x)}{g(x)}$ at x.
4. Say *in words, and with a formula* how you would find the derivative of the composite function $f(g(x))$ at x.

B. Use the rules from part A, and derivatives for known functions like powers x^n, exponentials e^x, $\ln(x)$, $\sin(x)$, $\cos(x)$, and so on to find derivatives for each of the following. In each case, show all work, write the calculations carefully as equations of the form $f'(x) = \cdots$, and say which of the rules from part A you are using.

1. $f(x) = 6x^3 + 7x^{\frac{1}{2}} - 3x^{-\frac{5}{3}} + \pi^e$.
2. $g(x) = e^x - \sqrt{x} + \dfrac{1}{x^7}$.
3. $h(x) = e^x \cos(x)$.
4. $k(x) = \dfrac{x^2+1}{x^4+2}$.
5. $\ell(x) = x\ln(5x^2+1)$.
6. $m(x) = \sqrt{e^x+1}$.
7. $n(x) = \cos(\sin(x^3))$.
8. $p(x) = \left(x + \dfrac{1}{x}\right)^4$.