Math 115 Quiz 5: § 3.1-4 Basic Shortcuts **Mon 25 October 2010**

Name: _____

You have 30 minutes to complete this quiz. Make your variables clear and consistent (so if you want to say, for example, $\frac{dy}{dx}$, you should also mention $y = f(x)$, or "y is a function of x"). Calculators are OK.

1. **Definitions/Concepts.** (1 pt each) State the following:

   (a) Product Rule:

   (b) Quotient Rule:

   (c) Chain Rule:

2. **Questions/Problems.** The acceleration due to gravity, g, at a distance r from the center of the earth is given by

$$g = \frac{GM}{r^2},$$

   where M is the mass of the earth and G is a constant.

   (a) (1 pt) Find $\frac{dg}{dr}$.

   (b) (2 pts) What is the practical interpretation (in terms of acceleration) of $\frac{dg}{dr}$? Why would you expect it to be negative?

   (c) (1 pt) You are told that $M = 6 \cdot M^{24}$ and $G = 6.67 \cdot 10^{-20}$ where M is in kilograms and r in kilometers. What is the value of $\frac{dg}{dr}$ at the surface of the earth ($r = 6400$ km)?

   (d) (1pt) What does this tell you about whether or not it is reasonable to assume g is constant near the surface of the earth?

3. **Computations/Algebra.** (1 pt each) Differentiate with respect to x. You must show work to get credit.

   (a) $f(x) = \frac{x^2+3x+2}{x+1}$

   (b) $g(x) = x^k + k^x$

ChAlLeNgE PrObLeM: Use the identity

$$\ln(a^x) = x \ln a$$

and the chain rule to write an alternate justification of the formula

$$\frac{d}{dx} a^x = (\ln a) a^x.$$