Name: _____

Problem Set 4
SHOW ALL WORK FOR CREDIT
You may submit solutions on a separate sheet of paper if you prefer.

Assigned: 2/4/08 Due: 2/15/08 (2 pts off for each day late)

1. For each function below, do the following:
   a) Simplify the function and take the derivative normally.
   b) Take the derivative of each part of the function and multiply them. **("fake" product rule)**
   c) Use the **real** product rule to find the derivative.

i. $y = (2x)(3x)$
a) b) c)

ii. $y = (x^2)(1/x^2)$
a) b) c)

iii. $y = (2x + 3)(x - 5)$
a) b) c)

iv. Explain why taking the derivative of each "factor" function and multiplying doesn't work.

2. Find the derivative of each function first by simplifying and taking the derivative and then by using the chain rule.

a) $y = (2x + 1)^2$

simplify and take the derivative

use the chain rule

b) $y = \sqrt{25x^2}$

simplify and take the derivative

use the chain rule

c) $y = (4x^2)^6$

simplify and take the derivative

use the chain rule

3. Use the product rule and/or chain rule to find the derivative of each function.

a) $y = x \cdot \cos x$

b) $y = \sin^2 x$
(Hint: this means $\sin x \cdot \sin x$)

c) $y = \cos (7x^2 + \cos x)$

d) $y = \ln (5x + 7)$

e) $y = \dfrac{\cos x}{x}$

(Hint: start by writing this as a product...)

f) $y = \ln x \, (5x + 7)$

g) $y = \cos x \, (\sin x)$

h) $y = \cos (\sin x)$

4. a) Does the "quotient rule" work? In other words, if you have a function that is the quotient of two other functions, can you just take the derivative of each part and divide?

In mathematical language, this would be if $y = \dfrac{f(x)}{g(x)}$, does $y' = \dfrac{f'(x)}{g'(x)}$?

Use sample functions to determine whether this product rule works or not.

b) Find a **"real"** quotient rule for $y = \frac{f(x)}{g(x)}$ **HINT:** $y \cdot g(x) = f(x)$ Think about the product rule...

5. a) Find the derivative of $y = (f(x))^4$ using the chain rule (your answer will be in terms of f(x) and f'(x))

b) Show that using the **product rule** gives the same answer.
(Hint: Start by finding the derivative of $(f(x))^2$)

6. a) Predict the derivative of $y = \sin(\ln(x^3))$

b) Use your derivative to find the slope at $x = 2$.

c) Find the average slope of the function between $x = 2$ and $x = 2.001$.

d) Based on your answers to (b) and (c), do you think your derivative is correct? Explain.

7. a) Use the chain rule to find the derivative of each function. Simplify your answers.

i) $y = \ln(x^2)$ ii) $y = \ln(x^3)$ iii. $y = \ln(x^4)$ iv. $y = \ln(x^5)$

b) Generalize a rule for $y = \ln(x^n)$ where n is any number. (Your answer will have "n" in it)

c) Use a rule of logarithms to show why your rule in (b) works.