Part I (due at the beginning of class Thursday, October 23)

Consider the following function: $f(x) = \begin{cases} x^2 & x < 0 \\ x^3 & x \geq 0 \end{cases}$.

1. For what real numbers is $f(x)$ differentiable?
2. For what real numbers is $f'(x)$ differentiable?
3. What, if anything, does this tell you about differentiability?

Bring your answers to class Thursday and we'll discuss. Have a great break!

Part II: Problems (due at the beginning of class Tuesday, October 28)

1. For each of the following, create and explain an example that satisfies the given criteria or explain why such an example doesn't exist.
   (a) Two functions $f(x)$ and $g(x)$ such that $\dfrac{d}{dx}\left(f(x)g(x)\right) = f'(x)g'(x)$.
   (b) Two functions $f(x)$ and $g(x)$ such that $\dfrac{d}{dx}\dfrac{f(x)}{g(x)} = \dfrac{f'(x)}{g'(x)}$.
2. If possible, find constants a and b such that the following piecewise-defined function is continuous and differentiable everywhere. If not possible, explain why not.

$$f(x) = \begin{cases} 3x + a, & \text{if } x < 1 \\ x^{b/2}, & \text{if } x \geq 1 \end{cases}$$