Name:_____

Worksheet 8 - parsing functions and taking complicated derivatives

You need to practice taking derivatives until you can find them about as quickly as you can physically write them down. The hardest part is sometimes "parsing" the function – understanding the how the function is put together. Then you'll know which derivative rules you'll need, and in what order. **Parentheses are important!**

1. Write down the constant rule, sum rule, product rule, quotient rule, and chain rule for taking derivatives.

2. If $f(x) = \sin x$ and $g(x) = e^{2x}$, find the derivatives of

   (a) $f(x)g(x)$

   (b) $f(x)/g(x)$

   (c) $g(f(x))$

3. Find the derivative of $\sin(xe^x)$. Start by parsing the function. Here, $f(x) = \sin(xe^x)$ can be thought of as
$$f(x) = g\Big((h(x)k(x)\Big),$$
   so you'll need the chain rule, and then the product rule for the derivative of the inside.
$$f'(x) = g'\Big(h(x)k(x)\Big)\frac{d}{dx}\Big(h(x)k(x)\Big) = g'\Big(h(x)k(x)\Big)\Big(h'(x)k(x) + h(x)k'(x)\Big)$$

4. Parse these functions, determine which rules in which order to use, and then find their derivatives. Be careful to place the parentheses correctly.

   (a) $\sin(xe^{3x})$

   (b) $\sin^2(xe^{3x})$

   (c) $\sin(x^2 + x)$

   (d) $x^2 \sin(x^2 + x)$

   (e) $(x^2 + x^3)\sin(x^2 + x)$

   (f) $[\sin(x^2 + x) + x]^4$