Differentiation Worksheet

Chapter 2: §§2.1, 2.2, 2.3, & 2.4

The following is a worksheet on differentiation covering the sections listed above in the text. These questions are typical exam questions, and are very good for practice. Solutions will be distributed at a later date.

1. Find the derivative of the following functions, using the appropriate differentiation rules.

   (a) $y = \left(x + \sqrt{\ln(2x)}\right)^3$

   (b) $f(x) = \sin^3(1 - 3x)^5$

   (c) $g(t) = \tan^2(\sec(\sin(t^3)))$

   (d) $y = e^{x\cos(x)}$

   (e) $y = \left(x^4 + \sqrt{x + \sqrt[3]{x-1}}\right)^{\sqrt{2}}$

   (f) $g(s) = \sin(\cos(\tan(s)))$

Column A		Column B	
____ 1	An alkane	A.	C_4H_6
____ 2	An alkyne	B.	C_4H_9

2. Find the derivative of the following functions using the definition of derivative.

   (a) $f(x) = 2x^2 - 3x + 6$

   (b) $g(x) = \sqrt{2 - x}$

   (c) $f(t) = \dfrac{3t - 1}{2t - 1}$

   (d) $h(x) = \dfrac{1}{x^2 - x - 2}$

3. **Proofs**: Any proofs done in class are fair game for the midterm. They are important to know since they show that you can generalize the rules and not only apply them to specific functions. Some important ones include:

   (a) The Product Rule and Quotient Rule:

   $$\frac{d}{dx}\left[f(x)g(x)\right] = f'(x)g(x) + g'(x)f(x), \qquad \frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{f'(x)g(x) - g'(x)f(x)}{\left[g(x)\right]^2},$$

   where $g(x) \neq 0$ for the Quotient Rule.

   (b) The Chain Rule:

   $$\frac{d}{dx}\left[f(g(x)\right] = f'(g(x))g'(x).$$

(c) The Constant Multiple Rule, and the Sum and Difference Rules for differentiation:

$$\frac{d}{dx}[kf(x)] = kf'(x), \qquad \frac{d}{dx}[f(x) \pm g(x)] = f'(x) \pm g'(x),$$

where k is a constant in the Constant Multiple Rule.

(d) Prove that $\frac{d}{dx}[\sin(x)] = \cos(x)$, and $\frac{d}{dx}[\cos(x)] = -\sin(x)$ using the definition of derivative.