Section 2.3

Differentiation Formulas

DIFFERENTIATION FORMULAS FOR BASIC FUNCTIONS

1. The derivative of a constant function, $f(x) = c$

$$\frac{d}{dx}(c) = 0$$

2. The derivative of the identity function,

$f(x) = x$

$$\frac{d}{dx}(x) = 1$$

THE POWER RULE

Let n be any integer other than zero. Then the derivative of the function $f(x) = x^n$ is

$$\frac{d}{dx}(x^n) = nx^{n-1}$$

THE CONSTANT MULTIPLE RULE

If c is a constant and f is a differentiable function, then

$$\frac{d}{dx}[c \cdot f(x)] = c \cdot \frac{d}{dx} f(x)$$

THE ADDITION AND SUBTRACTION RULES

If f and g are both differentiable functions, then

$$\frac{d}{dx}[f(x) + g(x)] = \frac{d}{dx} f(x) + \frac{d}{dx} g(x)$$

$$\frac{d}{dx}[f(x) - g(x)] = \frac{d}{dx} f(x) - \frac{d}{dx} g(x)$$

THE PRODUCT RULE

If f and g are both differentiable functions, then

$$\frac{d}{dx}[f(x) \cdot g(x)] = f(x) \cdot \frac{d}{dx} g(x) + g(x) \cdot \frac{d}{dx} f(x)$$

Another way to write this is

$$\frac{d}{dx}[f(x) \cdot g(x)] = f(x) \cdot g'(x) + g(x) \cdot f'(x)$$

THE QUOTIENT RULE

If f and g are differentiable, then

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

Another way to write this is

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

A MNEMONIC DEVICE FOR THE QUOTIENT RULE

If the function in the numerator is called “hi” and the function in the denominator is called “ho,” the quotient rule can be remembered with the following mnemonic phrase.

ho *D* hi   minus   hi *D* ho   over   ho ho

In mathematical notation, this would be

$$\frac{\textbf{ho } \boldsymbol{D} \textbf{ hi} - \textbf{hi } \boldsymbol{D} \textbf{ ho}}{\textbf{ho ho}}$$

Recall that “*D*” means “derivative of.”

All the derivative rules are summarized in the box on page 140 of the text.