Section 3.1: Derivatives of Polynomials and Exponential Functions

(1) In this section, we learn several differentiation rules. These all come from the limit definition of derivative, but you should also memorize them. Fill in the derivative rules below:

Rule	Example	Notes
$\frac{d}{dx}(c) = 0$	$\frac{d}{dx}(3) = 0$	where c is any constant
$\frac{d}{dx}(x) = 1$	$\frac{d}{dx}(x) = 1$	
$\frac{d}{dx}(x^n) = nx^{n-1}$	$\frac{d}{dx}(x^5) = 5x^4$	where n is any real number (Power Rule)
$\frac{d}{dx}(cf(x)) = c\frac{d}{dx}(f(x))$	$\frac{d}{dx}(3x^2) = 3\frac{d}{dx}(x^2) = 3 \cdot 2x = 6x$	where c is any constant (Constant Multiple Rule)
$\frac{d}{dx}(f(x) + g(x)) = \frac{d}{dx}f(x) + \frac{d}{dx}g(x)$	$\frac{d}{dx}(x^3 + 3x) = \frac{d}{dx}(x^3) + \frac{d}{dx}(3x) = 3x^2 + 3$	(The Sum Rule)
$\frac{d}{dx}(f(x) - g(x)) = \frac{d}{dx}f(x) - \frac{d}{dx}g(x)$	$\frac{d}{dx}(x - 3x^2 - 4) = 1 - 6x$	(The Difference Rule)
$\frac{d}{dx}(e^x) = e^x$	$\frac{d}{dx}(4e^x) = 4e^x$	

(2) Explain the difference between the first rule and the Constant Multiple rule. When would you use each one?

The first rule is for constant function, but the constant multiple rule is for a differentiable function with a constant coefficient. If the function is just a constant, then the derivative is just zero. If the function is the product of a constant and a differentiable function, then use constant multiple rule.

(3) How would you simplify $\dfrac{2xe^x + \sqrt{6x} + 2x^5}{x}$ so that we could find the derivative using the above rules?

$$\frac{2xe^x + \sqrt{6x} + 2x^5}{x} = \frac{2xe^x}{x} + \frac{\sqrt{6}\sqrt{x}}{x} + \frac{2x^5}{x} = 2e^x + \sqrt{6}x^{-1/2} + 2x^4$$

Extra Practice in Book: 3.1: Derivative Rules (3-32) until comfortable with all rules. 35, 45, 49, 57, 65