Math 1314
Basic Rules of Differentiation

We can use the limit definition of the derivative to find the derivative of every function, but it isn't always convenient. Fortunately, there are some rules for finding derivatives which will make this easier.

First, a bit of notation:

$\frac{d}{dx}[f(x)]$ is a notation that means "the derivative of *f* with respect to *x*, evaluated at *x*."

Rule 1: The Derivative of a Constant

$\frac{d}{dx}[c] = 0,$ where *c* is a constant.

Example 1: If $f(x) = 12,$ find $f'(x)$.

Rule 2: The Power Rule

$\frac{d}{dx}[x^n] = nx^{n-1}$ for any real number *n*

Example 2: If $f(x) = x^4,$ find $f'(x)$.

Example 3: If $f(x) = \sqrt[3]{x}$, find $f'(x)$.

Example 4: If $f(x)=\frac{1}{x^5}$, find $f'(x)$.

Rule 3: Derivative of a Constant Multiple of a Function

$\frac{d}{dx}[cf(x)]=c\frac{d}{dx}[f(x)]$ where *c* is any real number

Example 5: If $f(x)=6x^3$, find $f'(x)$.

Example 6: If $f(x)=-3\sqrt{x}$, find $f'(x)$.

Rule 4: The Sum/Difference Rule

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

Example 7: Find the derivative: $f(x)=5x^4+3x^3-4-\frac{6}{x}$.

Rule 5: The Derivative of the Exponential Function

$$\frac{d}{dx}\left[e^{x}\right] = e^{x}$$

Example 8: Find the derivative: $f(x) = \sqrt{x} - 4x^{4} - 2x - 4e^{x}$

Rule 6: The Derivative of the Logarithmic Function

$$\frac{d}{dx}\left[\ln|x|\right] = \frac{1}{x}, \text{ provided } x \neq 0$$

Example 9: Find the derivative: $f(x) = 6x^{\frac{5}{3}} + x - 2 - 7\ln(x)$

Rule 7: The Derivative of an Exponential Function, base is not *e*

$$\frac{d}{dx}\left[a^{x}\right] = \ln a \cdot a^{x} \text{ where } a > 0$$

Example 10: Find the derivative: $f(x) = 5^{x}$

From this lesson, you should be able to

- State the basic rules for finding derivatives
- Select the appropriate rule to use for a given problem
- Find the derivative of a function using the basic rules