

Math 122: Sections 3.1-3.2 Study Guide

Derivative Rules:

- Derivative of constant: $\frac{d}{dx}c = 0$.
- Power rule: $\frac{d}{dx}x^n = nx^{n-1}$.
- Derivative of exponential: $\frac{d}{dx}a^x = \ln(a)a^x$. In particular, $\frac{d}{dx}e^x = e^x$.
- Derivative of Logarithm: $\frac{d}{dx}\log_b(x) = \frac{1}{x\ln(b)}$. In particular, $\frac{d}{dx}\ln(x) = \frac{1}{x}$.
- Constant Multiple Rule: Suppose $c \in \mathbb{R}$ and $f(x)$ is differentiable. Then: $\frac{d}{dx}cf(x) = c\frac{d}{dx}f(x)$.
- Sum rule: Suppose $f(x), g(x)$ are differentiable. Then: $\frac{d}{dx}(f(x) + g(x)) = \frac{d}{dx}f(x) + \frac{d}{dx}g(x)$

Notational Issues:

- $\frac{d}{dx}f(x)$ can be read as *differentiate $f(x)$ with respect to x* . Here, $\frac{d}{dx}$ is an *operator* or a *verb*. Note as well that the dx corresponds to the variable x . If we have $f(t)$ (here, t is our variable), then we would write: $\frac{d}{dt}f(t)$.
- The *derivative* of the function $f(x)$ is denoted $f'(x)$. So for example, if $f(x) = 3x$, then the derivative of $f(x)$ is $f'(x) = 3$.
- Suppose you are asked to differentiate $f(x) = 3x$. There are two correct ways of writing this:
 - (a) $\frac{d}{dx}f(x) = 3$. This reads: *We differentiate $f(x) = 3x$ to obtain 3.*
 - (b) $f'(x) = 3$. This reads: *The derivative of $f(x) = 3x$ is 3.*

It is **INCORRECT** to write: $\frac{d}{dx} = 3$, and you **will lose points for this abuse of notation**.

Instructions: Differentiate the following functions.

- 3
- $5x$
- $\sqrt{x}$
- $\frac{1}{\sqrt[3]{x}}$
- $x^{-5/2}$
- $x^{7/4}$
- $7x^5$
- 2^5
- e^x
- 5^x
- $\ln(x)$
- $\log_7(x)$
- $4x^4 + 3x^3 + 2x^2 + x + 1$
- $2^x + 3x^2 - 2\ln(x) + 4e^x$