Section 5.1 – 5.2 (The Natural Logarithmic Function: Differentiation / Integrations)

In algebra, we define the natural logarithm (ln) as being the inverse of the exponential function (e^x). Recall that the value of $y = e^x$ is always ________________________. A similar definition is given in section 5.1 with

$\ln x = \int_1^x \frac{1}{t}\,dt$ (ln x Domain? Range? Concavity?) ln x = log ___________

Examples: Recall the properties of logarithmic expressions by expanding the following…

$\ln \frac{15x}{11}$ $\ln (3x + 5)^2$ $\ln \sqrt{x^2 + 3x}$

Given the definition above for ln x, it follows that $\frac{d}{dx}[\ln u] = \frac{1}{u}\frac{du}{dx} = \frac{u'}{u}$, $u > 0$

Examples: Differentiate the following…

$\frac{d}{dx}\ln(3x)$ $\frac{d}{dx}\ln(3x - 1)^2$ $\frac{d}{dx}\ln\left(\frac{x(x^2+3)^2}{\sqrt{x+2}}\right)$

Keep in mind that the natural logarithm is only defined for positive numbers, so often you will see $\frac{d}{dx}\ln|u| = \frac{u'}{u}$

Example: Differentiate $y = \ln|\sin x|$ with time…

Given the derivative of logarithmic functions, it follows that $\int \frac{1}{x}\,dx = \ln|x| + C$ and $\int \frac{1}{u}\,du = \ln|u| + C$

Examples: Integrate

$\int \frac{-4}{x}\,dx$ $\int \frac{4}{2x+1}\,dx$ $\int \frac{2x^3+1}{x^4+2x}\,dx$

Review examples 5-7 in the book and the guidelines for integration prior to working some of the homework exercises

--- Note: Integrals of the 6 basic trig functions (and some examples) are listed on pp. 332-3 ---

Homework problems: (5.1) 21,23,29,33,41,45,46,51,61 (5.2) 2,3,9,15,22,33