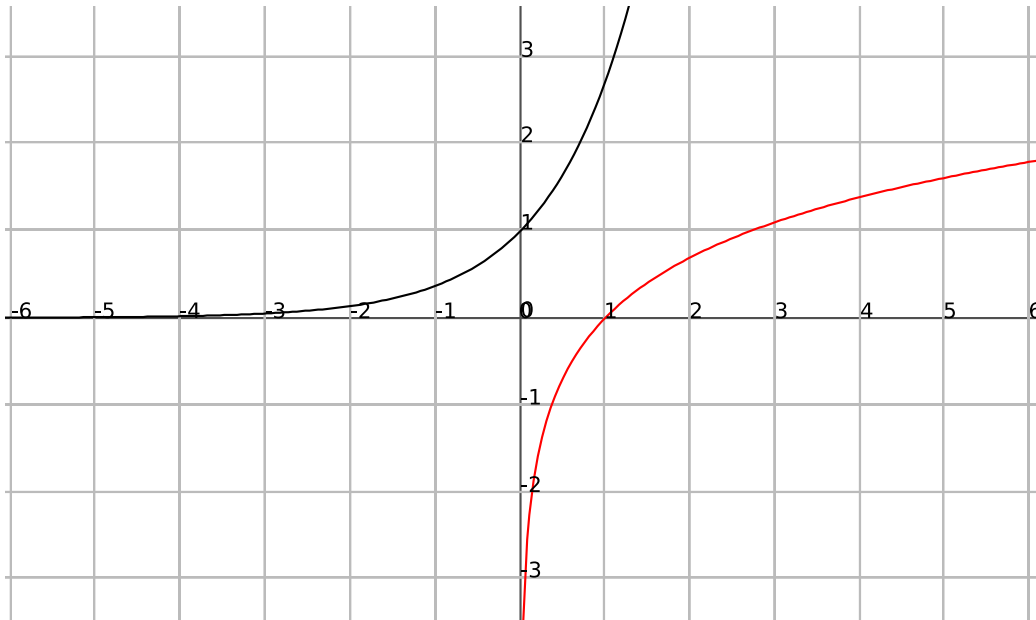


Overview of e^x and $\ln x$ Functions

- **Graphs**



- **Function Properties**

Natural Exponential Function $y = e^x$ **Natural Logarithm Function $y = \ln x$**

- Domain = \mathbb{R}
- Range = $(0, \infty)$
- $\lim_{x \rightarrow \infty} e^x = \infty$
- $\lim_{x \rightarrow -\infty} e^x = 0$
- e chosen so that $\lim_{h \rightarrow 0} \frac{e^h - 1}{h} = 1$
- $2 < e < 3$ and $e \approx 2.71828\dots$
- $e = \lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^n$
- $e^0 = 1$ and $e^1 = e$
- Domain = $(0, \infty)$
- Range = \mathbb{R}
- $\lim_{x \rightarrow \infty} \ln x = \infty$
- $\lim_{x \rightarrow 0^+} \ln x = -\infty$
- $y = \ln x$ is the inverse function for $y = e^x$
- $y = \ln x$ if and only if $e^y = x$
- $\begin{cases} \ln e^x = x & \text{for all } x \text{ in } \mathbb{R} \\ e^{\ln x} = x & \text{for all } x > 0 \end{cases}$
- $\ln 1 = 0$ and $\ln e = 1$

- Algebraic Properties

Natural Exponential Function $y = e^x$ Natural Logarithm Function $y = \ln x$

- $e^x e^y = e^{x+y}$

- $\ln(xy) = \ln x + \ln y$

- $e^{x-y} = \frac{e^x}{e^y}$

- $\ln\left(\frac{x}{y}\right) = \ln x - \ln y$

- $(e^x)^y = e^{xy}$

- $\ln(x^y) = y \ln x$

- $e^{(x^y)}$ cannot be simplified

- $\ln(x+y)$ or $\frac{\ln x}{\ln y}$ cannot be simplified

- Derivatives and Integrals

Natural Exponential Function $y = e^x$ Natural Logarithm Function $y = \ln x$

- $\frac{d}{dx} e^x = e^x$

- $\frac{d}{dx} \ln x = \frac{1}{x}$

- $\frac{d}{dx} e^{u(x)} = e^{u(x)} \frac{du}{dx} = e^{u(x)} u'(x)$

- $\frac{d}{dx} \ln u(x) = \frac{1}{u(x)} \frac{du}{dx} = \frac{u'(x)}{u(x)}$

- $\int e^x dx = e^x + C$

- $\int \frac{1}{x} dx = \ln|x| + C$