Logarithms

Common logarithm (base 10):

$$\log_{10} x = \log x$$

Natural logarithm (base e):

$$\log_e x = \ln x$$

Properties of logarithms:

- \(\log_b 1 = 0\) \quad \ln 1 = 0
- \(\log_b b = 1\) \quad \ln e = 1
- \(\log_b b^x = x \ln e^x = x\)
- \(b^{\log_b x} = x\) \quad \(e^{\ln x} = x\)

Laws of logarithms:

1. \(\log_b (xy) = \log_b x + \log_b y\)
2. \(\log_b \left(\frac{x}{y}\right) = \log_b x - \log_b y\)
3. \(\log_b (x^y) = y \cdot \log_b x\)

Change of base formula:

$$\log_b x = \frac{\log_a x}{\log_a b}, \quad b > 0 \text{ and } x > 0$$