



## MATHEMATICS 201-BNK-05

Advanced Calculus

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# Properties of Exponents and Logarithms

### Properties of Exponents and Radicals

$$b^n = \underbrace{b \cdot b \cdot b \cdots b}_{n \text{ times}} \quad b^0 = 1$$

$$b^{-n} = \frac{1}{b^n}$$

$$b^p b^q = b^{p+q}$$

$$\frac{b^p}{b^q} = b^{p-q}$$

$$(b^p)^q = b^{pq}$$

$$(ab)^p = a^p b^p$$

$$\left(\frac{a}{b}\right)^p = \frac{a^p}{b^p}$$

$$a^{\frac{1}{n}} = \sqrt[n]{a}$$

$$\sqrt[n]{ab} = \sqrt[n]{a} \sqrt[n]{b}$$

$$\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$$

$$b^{\frac{m}{n}} = \sqrt[n]{b^m} = (\sqrt[n]{b})^m$$

$$\sqrt[m]{\sqrt[n]{a}} = \sqrt[n]{\sqrt[m]{a}} = \sqrt[mn]{a}$$

### Properties of Logarithms

$$a = b^x \Leftrightarrow x = \log_b a$$

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

$$\log_b 1 = 0$$

$$\log_b b = 1$$

$$\log_b b^x = x$$

$$b^{\log_b x} = x$$

$$\log_b xy = \log_b x + \log_b y$$

$$\log_b \frac{x}{y} = \log_b x - \log_b y$$

$$\log_b x^r = r \log_b x$$

$$\log_b x = \frac{\log_a x}{\log_a b}$$

### Definitions of $e$

$$e = \lim_{x \rightarrow 0} (1+x)^{\frac{1}{x}}$$

$$e = \lim_{t \rightarrow \infty} \left(1 + \frac{1}{t}\right)^t$$

### Properties of the Natural Logarithm

$$y = e^x \Leftrightarrow x = \ln y$$

$$\ln x = \log_e x$$

$$\ln 1 = 0$$

$$\ln e = 1$$

$$\ln e^x = x$$

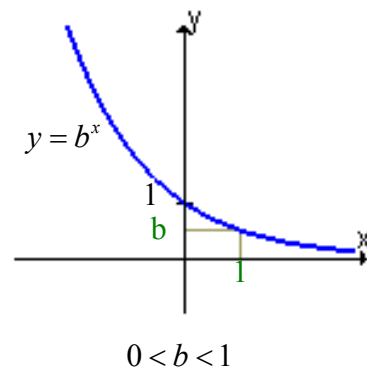
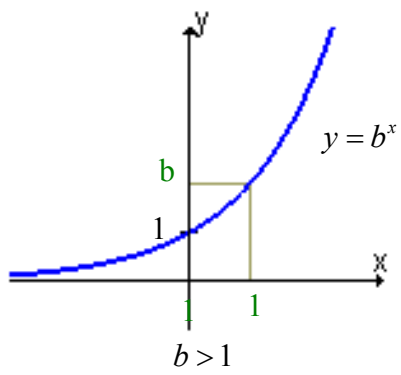
$$e^{\ln x} = x$$

$$\ln xy = \ln x + \ln y$$

$$\ln \frac{x}{y} = \ln x - \ln y$$

$$\ln x^r = r \ln x$$

## Graphs of Exponential Functions



## Graphs of Logarithmic Functions

