The Logarithm Function
Preliminaries and Objectives

Preliminaries
- Exponential functions
- Inverse functions and their graphs

Objectives
- Write exponential equations in logarithmic form
- Understand properties of the graphs of logarithmic functions
$y = 10^x$

- increasing
- goes through $(0, 1)$
- approaches $x$-axis to the left
- bends upward
- Domain: $\mathbb{R}$
- Range: $y > 0$
$y = 10^x$
Notation

\[ y = 10^x \]
Notation

\[ y = 10^x \quad \text{and} \quad x = 10^y \]
Notation

\[ y = 10^x \]

\[ x = 10^y \]

\[ y = \log_{10} x \]
Example 1

\[ \log_{10} 1000 = y \]

\[ 10^y = 1000 \]
$y = 10^x$

- increasing
- goes through $(0, 1)$
- approaches $x$-axis to the left
- bends upward
- Domain: $\mathbb{R}$
- Range: $y > 0$
Inverse of $y = 10^x$

- increasing
- goes through $(0, 1)$
- approaches $x$-axis to the left
- bends upward
- Domain: $\mathbb{R}$
- Range: $y > 0$

- increasing
- goes through $(1,0)$
- approaches $y$-axis downward
- bends to the right
- Domain: $x > 0$
- Range: $\mathbb{R}$
Example 2

\[ \log_2 8 = 3 \]

\[ \log_b 4 = x \]
Example 2

\[ \log_2 8 = 3 \]

\[ \log_b 4 = x \]

\[ b^x = 4 \]
Example 3

Find the exact value of $x$ without using a calculator

\[ \log_2 1 = x \]
\[ \log_8 8 = x \]
\[ \log_5 25 = x \]
\[ \log_{10} \sqrt{10} = x \]
\[ \log_7 \sqrt[3]{49} = x \]
Example 3

Find the exact value of $x$ without using a calculator

$log_{2} 1 = x \quad \rightarrow \quad 2^x = 1 \quad \rightarrow \quad x = 0$

$log_{8} 8 = x \quad \rightarrow \quad 8^x = 8 \quad \rightarrow \quad x = 1$

$log_{5} 25 = x \quad \rightarrow \quad 5^x = 25 \quad \rightarrow \quad x = 2$

$log_{10} \sqrt{10} = x \quad \rightarrow \quad 10^x = 10^{\frac{1}{2}} \quad \rightarrow \quad x = \frac{1}{2}$

$log_{7} \sqrt[3]{49} = x \quad \rightarrow \quad 7^x = (49)^{\frac{1}{3}} = (7^2)^{\frac{1}{3}} \quad \rightarrow \quad x = \frac{2}{3}$
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