Bellwork:
- List transformations
- Find asymptote
- Graph

For $b > 0$, and $b \neq 1$

- Read as “$\log_b x = y$ equals $y$ to which $b$ is raised to get $x$”
- The $y$ is the $\text{exponent}$ or $\text{solution}$

Example 1: Rewrite in exponential form the rewrite in logarithmic form

<table>
<thead>
<tr>
<th>Logarithmic form</th>
<th>Exponential form</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\log_b x = y$</td>
<td>$b^y = x$</td>
</tr>
<tr>
<td>$\log_2 81 = 2$</td>
<td>$2^2 = 81$</td>
</tr>
<tr>
<td>$\log_\frac{1}{8} \frac{1}{8} = 3$</td>
<td>$\frac{1}{8}^3 = \frac{1}{8}$</td>
</tr>
<tr>
<td>$\log_{10} \frac{1}{10} = -2$</td>
<td>$10^{-2} = \frac{1}{100}$</td>
</tr>
<tr>
<td>$\log_{81} 81 = 4$</td>
<td>$3^4 = 81$</td>
</tr>
</tbody>
</table>

Common Logarithm: logarithmic function with $\text{base } 10$ This is the $\text{LOG}$ on calculator.

Natural Logarithm: inverse of $e$. This is the $\text{LN}$ on calculator. Base is $e$

Example 2: Evaluating logarithmic functions

NO CALCULATOR $\Box$
- $f(x) = \log_2 x$, $x = 32$
  - $f(32) = \log_2 32 = 5$
- $f(x) = \log_3 x$, $x = 1$
  - $f(1) = \log_3 1 = 0$
- $f(x) = \log_4 x$, $x = 2$
  - $f(2) = \log_4 2 = \frac{1}{2}$

CALCULATOR $\Box$
- $f(x) = \log x$ when $x = 10$
  - $f(10) = \log_{10} 10 = 1$
- $f(x) = \ln x$ when $x = 2$
  - $f(2) = \ln 2 = 0.693$

What is the domain of $f(x) = \log_b x$?

$X > 0$

What is the domain of $f(x) = \ln x$?

$(0, \infty)$

Properties of Logarithms
- $\log_b 1 = 0$ because $b^0 = 1$
- $\log_b b = 1$ because $b^1 = b$

Inverse Property:

$\log_a a^x = x$

One-to-one Property:

$\log_b x = \log_b y \Rightarrow x = y$
Example 3: Use properties of logarithms to simplify each expression

\[
\log_8 512 = 3 \quad 22^{\log_{22} 15.2} = 15.2 \quad \log_4 1 = 0
\]

\[
\log_3 x = \log_3 12 \quad 6^{\log_6 30} = 30 \quad \log(4 - 3x) = \log(x + 2)
\]

\[
x = 12 \quad x = \frac{1}{2}
\]

Properties of Common Logarithm and Natural Logarithm

\[
\log 1 = 0 \quad \log 10 = 1 \quad \log 10^x = x \quad 10^{\log x} = x
\]

\[
\ln 1 = 0 \quad \ln e = 1 \quad \ln e^x = x \quad e^{\ln x} = x
\]

Example 4: Use properties of common and natural log to simplify each expression

\[
\ln e^x = x \quad e^{\ln x} = x
\]

\[
\ln e = 1 \quad 2 \ln e = 2
\]

\[
\log 10000 = 4 \quad 10^{\log 12} = 12 \quad \ln 1 = 0
\]

Graphing Logarithms

\[
f(x) = 2^x \quad f(x) = \log_2 x
\]

\[
\begin{array}{|c|c|}
\hline
x & y \\
\hline
-2 & 2^{-2} = \frac{1}{4} \\
-1 & 2^{-1} = \frac{1}{2} \\
0 & 2^0 = 1 \\
1 & 2^1 = 2 \\
2 & 2^2 = 4 \\
\hline
\end{array}
\]

\[
Y = a \log_b (x-h) + k
\]

\[
f(x) = 0.5 \ln x
\]

Domain: \((0, \infty)\)

x-int: 
\[
0.5 \ln x = 0 \quad (1, 0)
\]

VA: 
\[
x = 0
\]

\[
g(x) = \log(x - 1)
\]

Domain: \((1, \infty)\)

x-int: 

VA: 
\[
x = 1
\]