8.4 Logarithms and Logarithmic Functions

- I can graph a logarithmic function
- I can evaluate logarthims
- I can rewrite into logarithmic or exponential forms
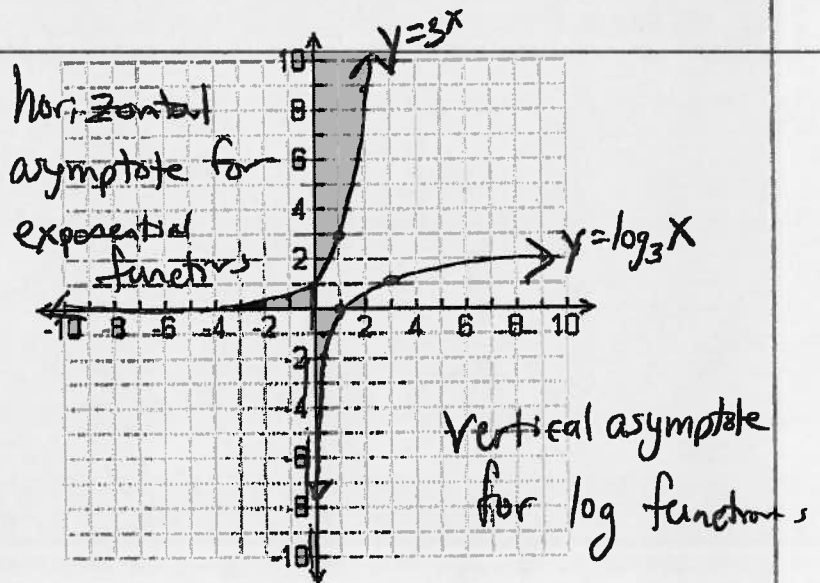
Logarithmic functions are ___inverse___ of exponential functions. X and y values are interchanged.

exponential $y=3^x$		logarithmic $x = 3^y$ $(y = \log_3 x)$	
X	Y	X	Y
-2	$\frac{1}{9}$	$\frac{1}{9}$	-2
-1	$\frac{1}{3}$	$\frac{1}{3}$	-1
0	1	1	0
1	3	3	1
2	9	9	2

$y=3^x$

horizontal asymptote for exponential functions

$y=\log_3 X$

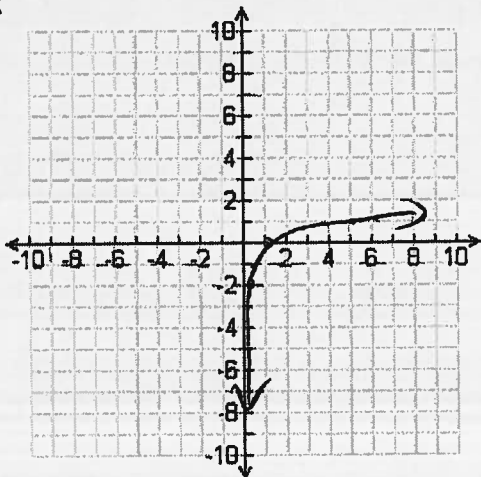Vertical asymptote for log functions

Logarithmic form: $\log_b a = c$

Exponential form: $b^c = a$

The expression $\log_b y$ is read as "log base b of y."

Ex 1: Graph the following logarithmic functions.

$y = \log_5 x$

X	Y
$\frac{1}{25}$	-2
$\frac{1}{5}$	-1
1	0
5	1
25	2

Domain: ___X > 0___   Asymptote: ___X = 0___

Range: ___ℝ___   Y-intercept: ___none___

X Int. ___1___

Quick check:

$y = \log_{10} x$

X	Y
$\frac{1}{100}$	-2
$\frac{1}{10}$	-1
1	0
10	1
100	2
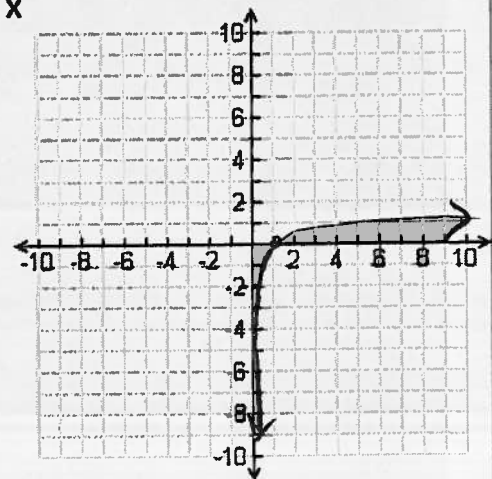
Domain: ___X > 0___   Asymptote: ___X = 0___

Range: ___ℝ___   Y-intercept: ___none___

x int: ___1___

Logarithmic form: $\log_b a = c$	Exponential form: $b^c = a$

logs equal the exponent

natural log: **In**   common log: **log**

base is **e**   base is **10**

Ex 2: Rewrite in logarithmic form.

a.) $3^x = 20$

$\log_3 20 = x$

b.) $y = e^5$

$\log_e y = 5$
$\ln y = 5$

c.) $10^4 = 10,000$

$\log_{10} 10,000 = 4$
$\log 10,000 = 4$

Ex 3: Rewrite in exponential form.

a.) $\log_4 x = 3$

$4^3 = x$

b.) $\log 4 = y$

$10^y = 4$

c.) $\ln e = z$

$e^z = e$

Do and Discuss:

Which of the following is equivalent to $2^5 = 32$?

$\boxed{\log_2 32 = 5}$ $\log_5 2 = 32$ $\log_{32} 5 = 2$

Write $5^3 = 125$ in logarithmic form.

$\log_5 125 = 3$

Which of the following is equivalent to $\log_4 16 = x$?

$16^x = 4$ $\boxed{4^x = 16}$ $4^{16} = x$

Write $\log_2 64 = 6$ in exponential form.

$2^6 = 64$

Ex 4: Evaluate the following logarithms without a calculator.

$\log_3 81 = 4$

$3^? = 81$

$\log_4 0.25 = -1$

$4^? = 0.25$
$4^? = \frac{1}{4}$

$\log_{1/4} 256 = -16$

$\left(\frac{1}{4}\right)^? = 256$

$\log_{49} 7 = \frac{1}{2}$

$49^? = 7$

$\log_{1/3} 9 = -2$

$\frac{1}{3}^? = 9$

$\log_{16} 4 = \frac{1}{2}$

$16^? = 4$

$\log 100 = 2$

$10^? = 100$

$\ln e^4 = 4$

$e^? = e^4$

Additional Resources: Section 7.4 from the textbook