What is a LOGARITHM?

A logarithm (log) is another way of writing exponents

Logarithmic Form		Exponential Form
$\log_b a = x$	⟷	$b^x = a$

log base b of a equals x

Converting LOG → EXP

Directions: Write each equation in exponential form.

1. $\log_3 9 = 2$ $3^2 = 9$	**2.** $\log_7 1 = 0$ $7^0 = 1$
3. $\log_4 \frac{1}{16} = -2$ $4^{-2} = 1/16$	**4.** $\log_9 27 = \frac{3}{2}$ $9^{3/2} = 27$

Converting EXP → LOG

Directions: Write each equation in logarithmic form.

5. $14^2 = 196$ $\log_{14} 196 = 2$	**6.** $3^4 = 81$ $\log_3 81 = 4$
7. $2^{-3} = \frac{1}{8}$ $\log_2 \frac{1}{8} = -3$	**8.** $36^{\frac{1}{2}} = 6$ $\log_{36} 6 = \frac{1}{2}$

Common Log

A logarithm with base 10 is called a **common log** and can be written without the base

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

Evaluating Logs

Directions: Use your knowledge of exponents to evalute the following logs.

9. $\log_7 49 = x$ $7^x = 49$ $x = 2$	**10.** $\log_{12} 1 = x$ $12^x = 1$ $x = 0$
11. $\log 100 = x$ $10^x = 100$ $x = 2$	**12.** $\log_9 \frac{1}{81} = x$ $9^x = \frac{1}{81}$ $x = -2$

Change of Base Formula

Some logarithms are not as easy to evaluate as those above, and will require the **change of base formula**

$$\log_b a = \frac{\log a}{\log b}$$

Directions: Evaluate each log using the change of base formula.

13. $\log_{16} 64$ $\frac{\log 64}{\log 16} = 1.5$	**14.** $\log_8 32$ $\frac{\log 32}{\log 8} = 1.\overline{6}$

Logarithmic
Parent Function

$f(x) = \log x$

$\log(x-h)+k$

D: (h, ∞)

R: $\mathbb{R}$

VA: $x = h$

x-int $y=0$

A logartihmic function is the **inverse** of an exponential function.
(x and y values are reversed)

You will need to use the inverse exponential function, then invert the values from the tables to make the log function.

Step 1: Create a table of values for the inverse parent function
Step 2: Create the inverse table by switching the x-values and y-values
Step 3: Make any changes to these new x and y values based on h and k
Step 4: Graph the function.

Directions: Graph each function and identify its key characteristics.

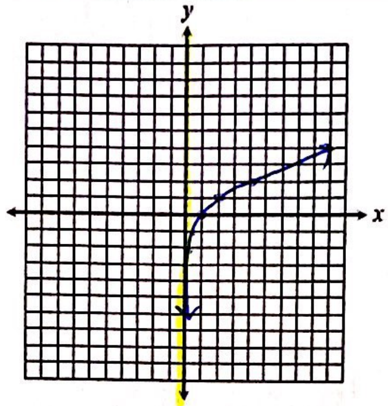
15. $f(x) = \log_2 x$

inv

x	2^x
-2	.25
-1	.5
0	1
1	2
2	4

orig

x	$\log_2 x$
.25	-2
.5	-1
1	0
2	1
4	2



Domain: $(0, \infty)$

Range: $\mathbb{R}$

x-intercept: $(1, 0)$

Asymptote: $x = 0$

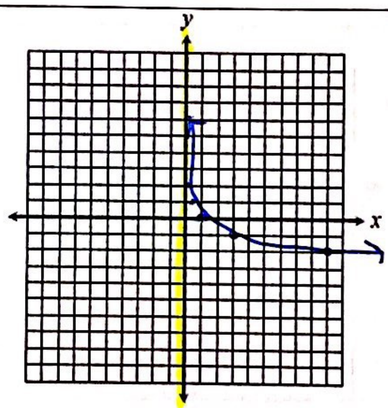
16. $f(x) = \log_{\frac{1}{3}} x$

inv

x	$\frac{1}{3}^x$
-2	9
-1	3
0	1
1	.3
2	.1

orig

x	$\log_{1/3} x$
9	-2
3	-1
1	0
.3	1
.1	2



Domain: $(0, \infty)$

Range: $\mathbb{R}$

x-intercept: $(1, 0)$

Asymptote: $x = 0$

17. $f(x) = \log_4(x-1)$

inv

x	4^x
-2	.06
-1	.25
0	1
1	4
2	16

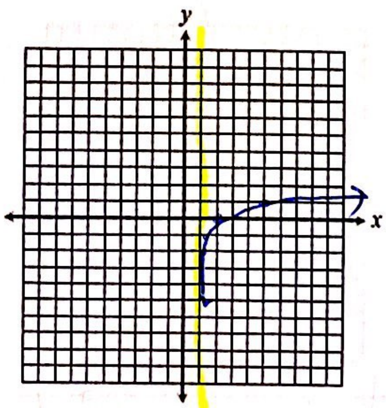
orig

x	$\log_4 x$
.06	-2
.25	-1
1	0
4	1
16	2

transf.

x	y
1.06	-2
1.25	-1
2	0
5	1
17	2

x: right 1



Domain: $(1, \infty)$

Range: $\mathbb{R}$

x-intercept: $(2, 0)$

Asymptote: $x = 1$

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18. $f(x) = \log_3 x - 2$

inv

x	3^x
-2	.1
-1	.3
0	1
1	3
2	9

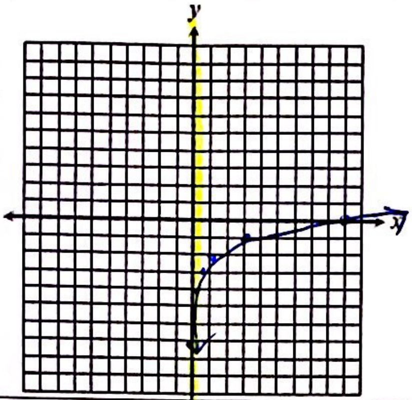
orig

x	$\log_3 x$
.1	-2
.3	-1
1	0
3	1
9	2

transf

x	y
.1	-4
.3	-3
1	-2
3	-1
9	0

y: down 2



Domain: $(0, \infty)$

Range: $\mathbb{R}$

x-intercept: $(9, 0)$

Asymptote: $x = 0$

19. $f(x) = \log_{\frac{1}{2}}(x + 9) + 4$

inv

x	$\frac{1}{2}^x$
-2	4
-1	2
0	1
1	.5
2	.25

orig

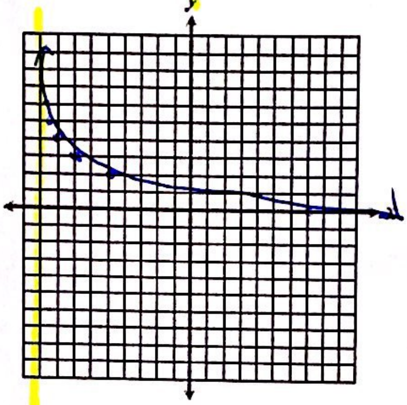
x	$\log_{1/2} x$
4	-2
2	-1
1	0
.5	1
.25	2

transf.

x	y
-5	2
-7	3
-8	4
-8.5	5
-8.75	6

x left 9

y up 4



Domain: $(-9, \infty)$

Range: $\mathbb{R}$

x-intercept: $(7, 0)$

Asymptote: $x = -9$

20. $f(x) = \log_5(x - 2) + 1$

inv

x	5^x
-2	.05
-1	.2
0	1
1	5
2	25

orig

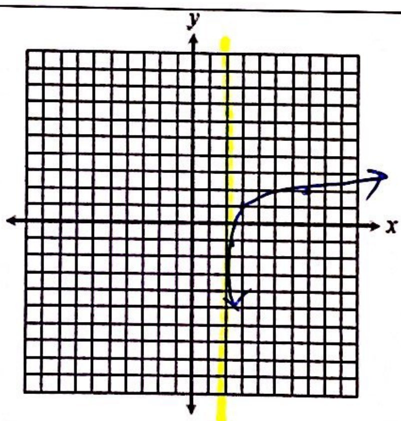
x	$\log_5 x$
.05	-2
.2	-1
1	0
5	1
25	2

transf

x	y
2.05	-1
2.2	0
3	1
7	2
27	3

right 2

up 1



Domain: $(2, \infty)$

Range: $\mathbb{R}$

x-intercept: $(2.2, 0)$

Asymptote: $x = 2$

21. $f(x) = \log_2(x + 1) - 3$

inv

x	2^x
-2	.25
-1	.5
0	1
1	2
2	4

orig

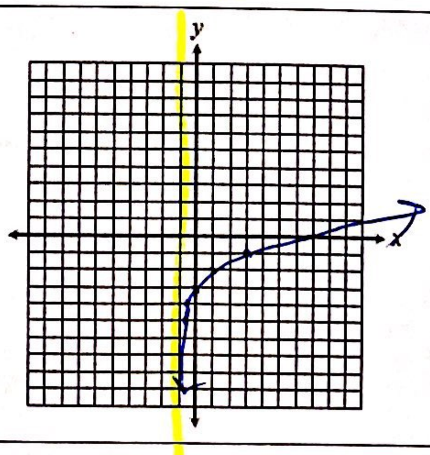
x	$\log_2 x$
.25	-2
.5	-1
1	0
2	1
4	2

transf

x	y
-.75	-5
-.5	-4
0	-3
1	-2
3	-1

left 1

down 3



Domain: $(-1, \infty)$

Range: $\mathbb{R}$

x-intercept: $(7, 0)$

Asymptote: $x = -1$