Logarithms

$\log_b y = x$ if and only if $b^x = y$

"log base b of y equals x" — exponential form

logarithmic form

$\log_b n = c$ ← equal to; goes to exponent

↑ base stays in base

$b^c = n$

1. Rewrite the following into

Logarithmic Form:	Exponential Form:
A. $\log_2 8 = 3$	A. $2^3 = 8$
B. $\log_4 1 = 0$	B. $4^0 = 1$
C. $\log_{12} 12 = 1$	C. $12^1 = 12$
D. $\log_{1/4} 4 = -1$	D. $(\frac{1}{4})^{-1} = 4$

Log Properties:

$\log_b b = 1$ why → $b^1 = b$

$\log_b 1 = 0$ why → $b^0 = 1$

2. Evaluate:

a. $\log_4 64$

$\log_4 64 = x$

$4^x = 64$

$4^x = 4^3$

$\boxed{x = 3}$

b. $\log_5 0.2$

$\log_5 0.2 = x$

$5^x = 0.2$

$5^x = \frac{1}{5}$

$5^x = 5^{-1}$

$\boxed{x = -1}$

c. $\log_{1/5} 125 = x$

$\left(\frac{1}{5}\right)^x = 125$

$(5^{-1})^x = 5^3$

$-x = 3$

$\boxed{x = -3}$

d. $\log_{36} 6 = x$

$36^x = 6$

$(6^2)^x = 6$

$6^{2x} = 6$

$2x = 1$

$\boxed{x = 1/2}$

Common Log:

$\log_{10} x$ $\log x$ has implied base of 10

Natural Log:

$\log_e x = \ln x$ $\ln x$ same as logarithm just base of e

3. Using a calculator find:

a. $\log 12$

$= \boxed{1.079}$

b. $\ln 3$

$= \boxed{1.0986}$

Inverse Functions:

Logarithms are inverses of exponential functions

$f(x) = b^x$ inverse of $g(x) = \log_b x$

* composition of inverses = x

$g(f(x)) = \log_b (b^x) = x$

$f(g(x)) = b^{\log_b x} = x$

4. Simplify:

a. $10^{\log 4}$

$= 10^{\log_{10} 4}$

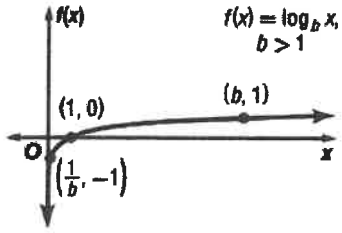
$= \boxed{4}$

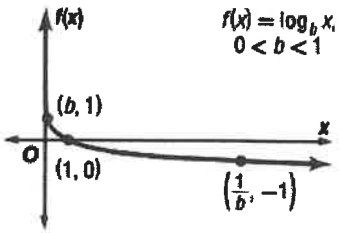
b. $\log_5 5^x$

$= \boxed{x}$

KeyConcept Parent Function of Logarithmic Functions

Parent function:	$f(x) = \log_b x$	**Type of graph:**	continuous, one-to-one
Domain:	all positive real numbers	**Range:**	all real numbers
Asymptote:	$f(x)$-axis	**Intercept:**	(1, 0)



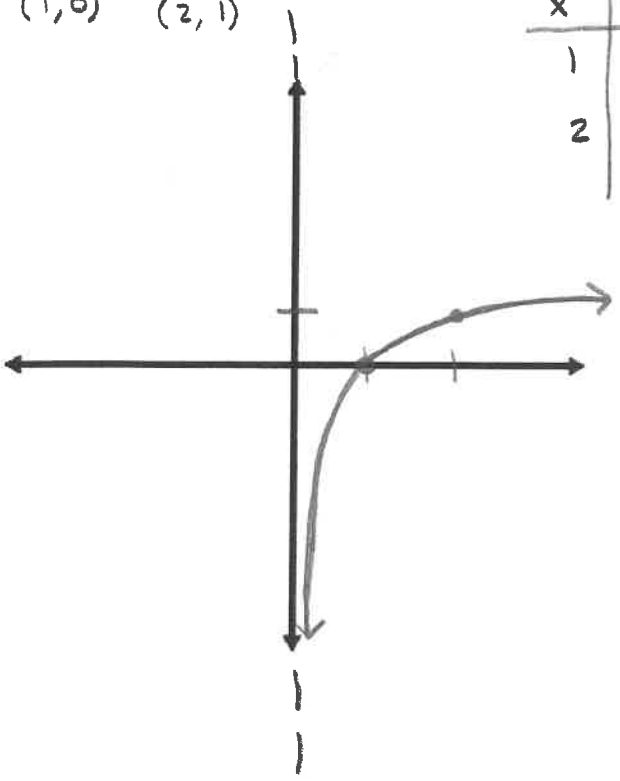


5. Graph the following and state the domain and range:

a. $y = \log_2 x$ base of 2

original (1, 0) (2, 1)

x	y
1	0
2	1

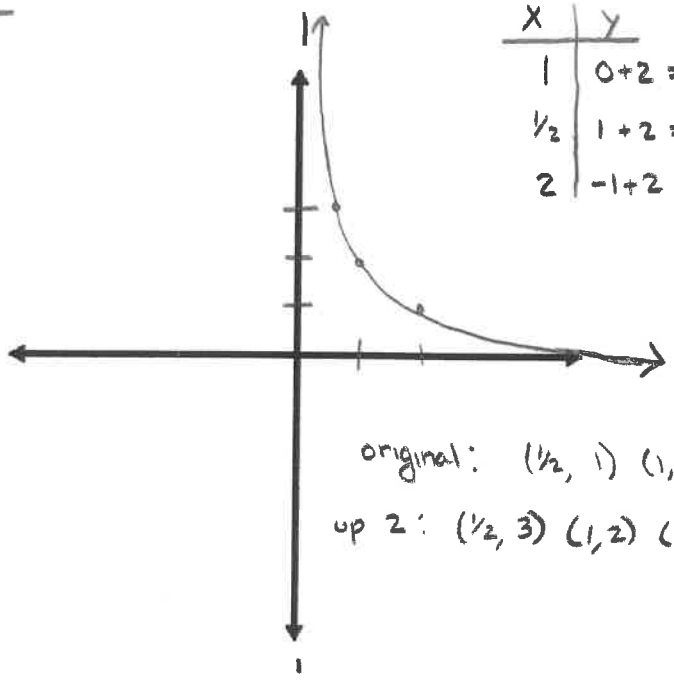


domain : (0, ∞)

range : (−∞, ∞)

b. $y = \log_{0.5} x + 2$ up 2

x	y
1	0+2 = 2
½	1+2 = 3
2	−1+2 = 1



original: (½, 1) (1, 0) (2, −1)

up 2: (½, 3) (1, 2) (2, 1)

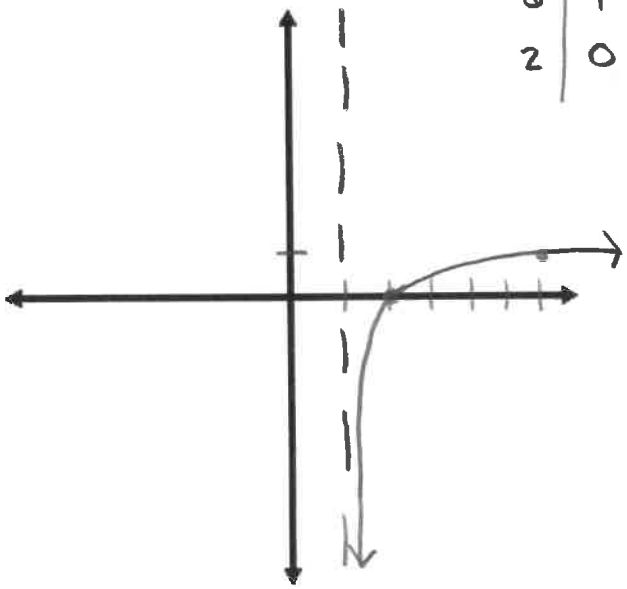
domain : (0, ∞)

range : (−∞, ∞)

c. $y = \log_5(x-1)$

right 1

x	y
6	1
2	0



original : (1,0) (5,1)

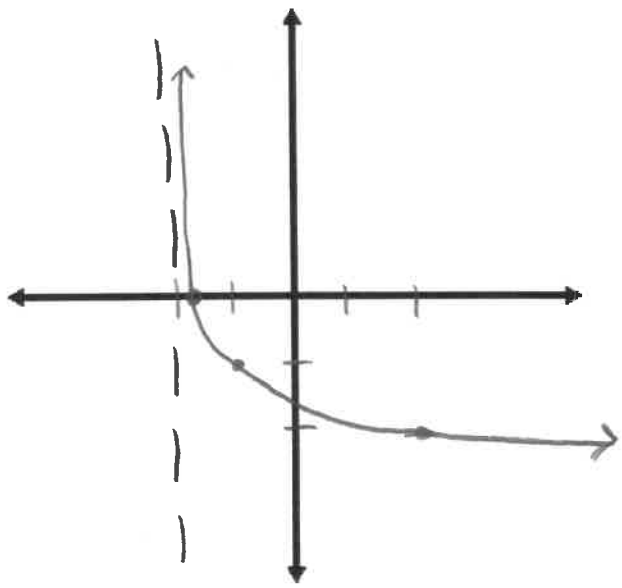
right 1 : (2,0) (6,1)

domain : (1, ∞)

range : (-∞, ∞)

d. $y = \log_{1/4}(x+2) - 1$

left 2
down 1



original : (1,0) (1/4, 1) (4,-1)

left 2 : (-1,0) (-7/4, 1) (2,-1)

down 1 : (-1,-1) (-7/4, 0) (2,-2)

domain : (-2, ∞)

range : (-∞, ∞)