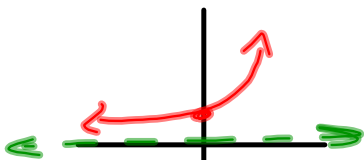


$$y = 2^x$$



BASE

$y = 3^x$

x	y
2	9

$y = 4^x$

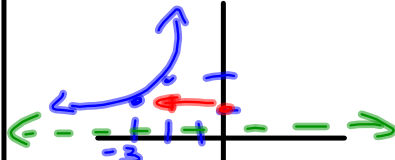
x	y
2	16

$y = 12^x$

x	y
2	144

$$y = 2^{x+3}$$

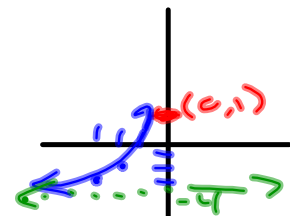
left 3



x	y
-3	1
-2	2

$$y = 2^{x+3} - 4$$

Asymptote



x	y
-3	1
-2	2

Graph  $y = \log_5 x$

WAY

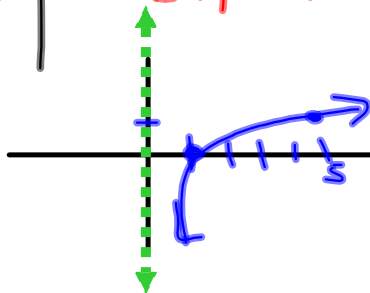
②  $y = \log_5 x$   
 BASE 5 BASE

$5^y = x$

$x = 5^y$

x	y
1	0 Exp = 0
5	1 Exp = 1

$x = 5^0$   
 $x = 5^1$

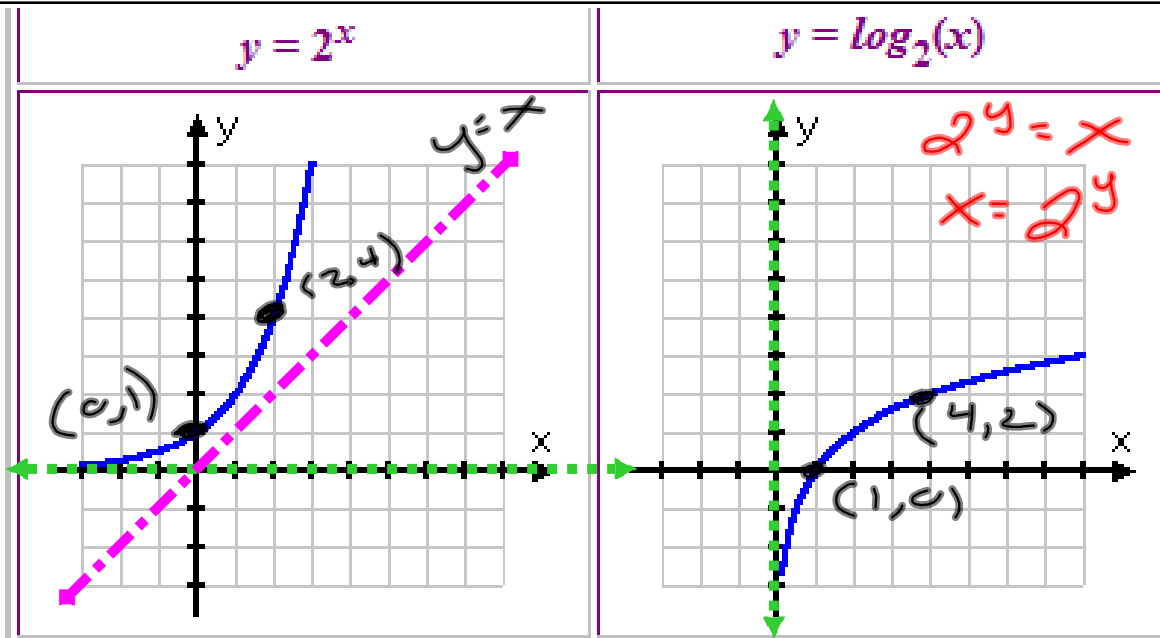


$y = 5^x$

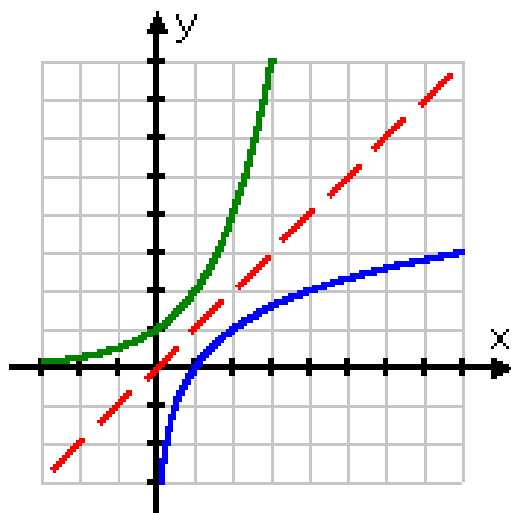
Exp	x	y
Exp = 0	0	1 = $5^0$
Exp = 1	1	5 = $5^1$



$y = 5^x$  |  $x = 5^y$   
 what is this definition?  
Inverse



comparison of the two graphs,  
showing the inversion line in red



$$y = \log_3(x+2) - 5$$

+5
+5

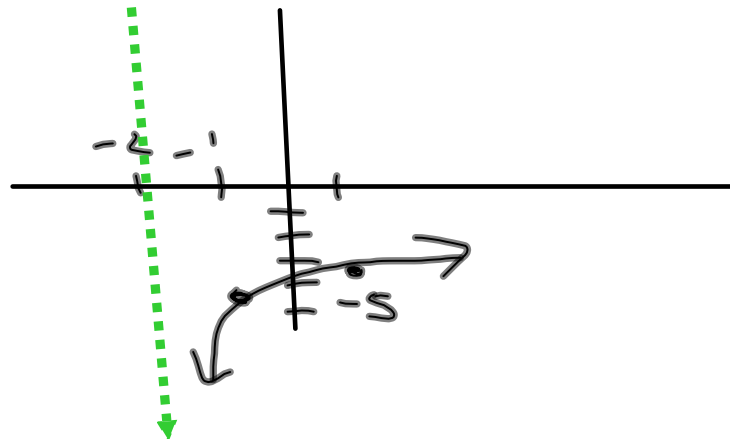
$$y + 5 = \log_3(x+2)$$

$$3^{y+5} = x+2$$

$$3^{y+5} - 2 = x$$

$$x = 3^{y+5} - 2$$

$3^0 - 2$	x	y	
$1 - 2$	-1	-5	↙ $y+5=0$ $y=-5$
$3^1 - 2$	1	-4	↙ $y+5=1$ $y=-4$
$3 - 2$			



$$y = \log_3(x+2) - 5$$

Prior knowledge

$\log 0 = \text{undefined} \Rightarrow$  vertical asymptote

$$\log 1 = 0$$

$$\log_{10} 10 = 1$$

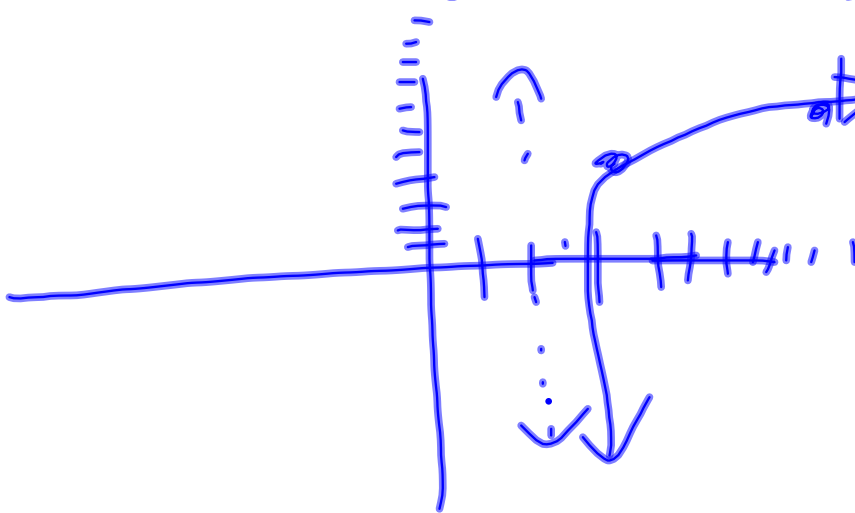
$$y = \log_{11}(x-2) + 4$$

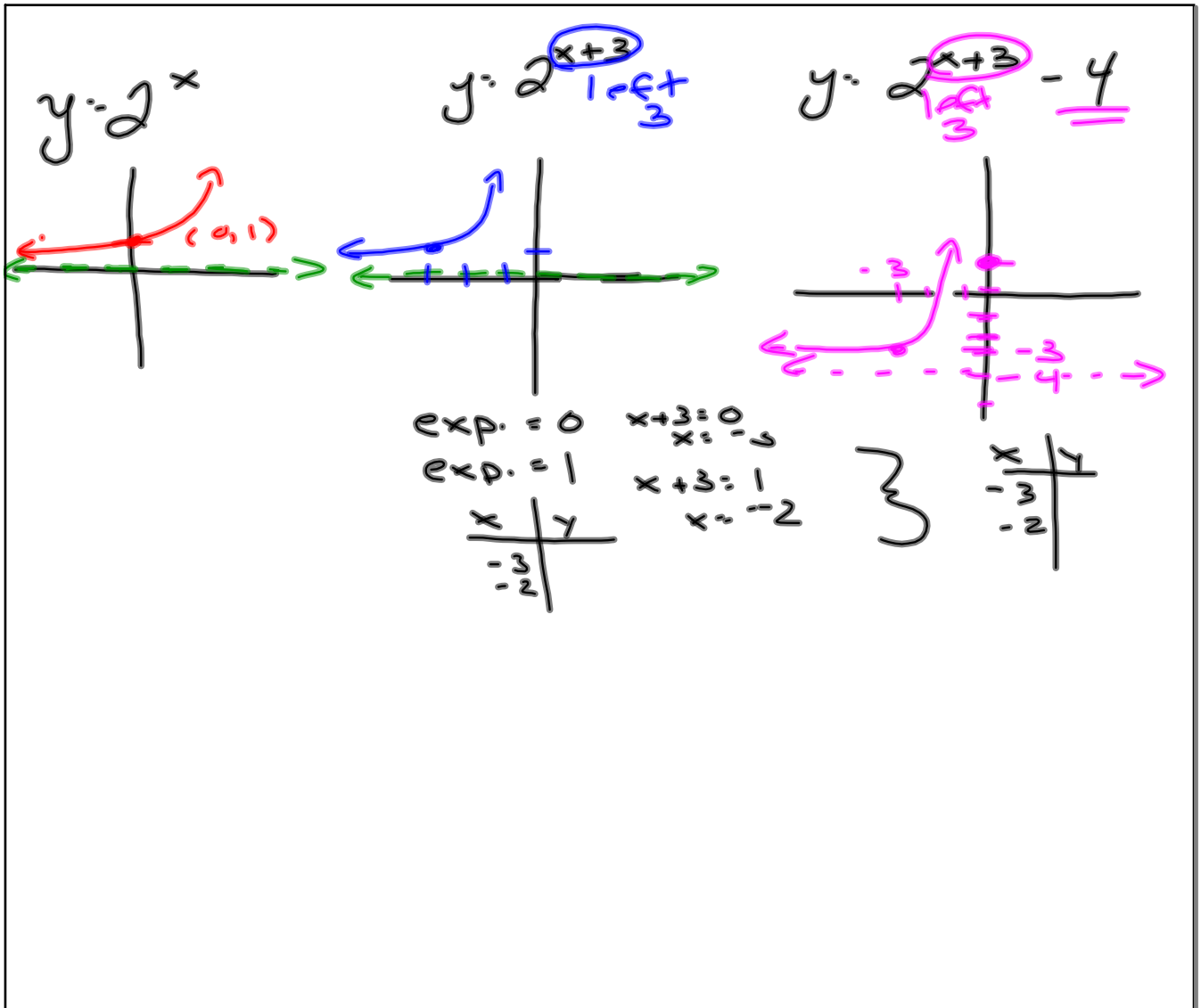
$$y - 4 = \log_{11}(x-2)$$

$$y - 4 = x - 2$$

$$y - 4 + 2 = x$$

x	y
3	4
3	5





What does it mean to switch x and y?

Inverse

$y = 2x + 1$     inverse

x	y
1	3
2	5
3	7

$x = 2y + 1$

Solve for y.

Plug In

x	y
3	1
5	2
7	3

answer



Graph  $y = \log_5 x$

\* Change to exponential

$y = \log_5 x$

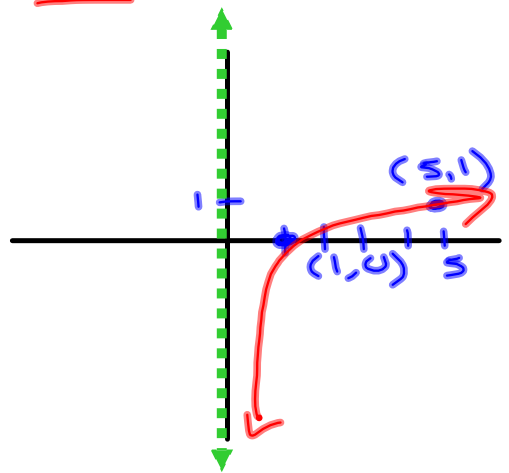
$5^y = x$  Now Graph

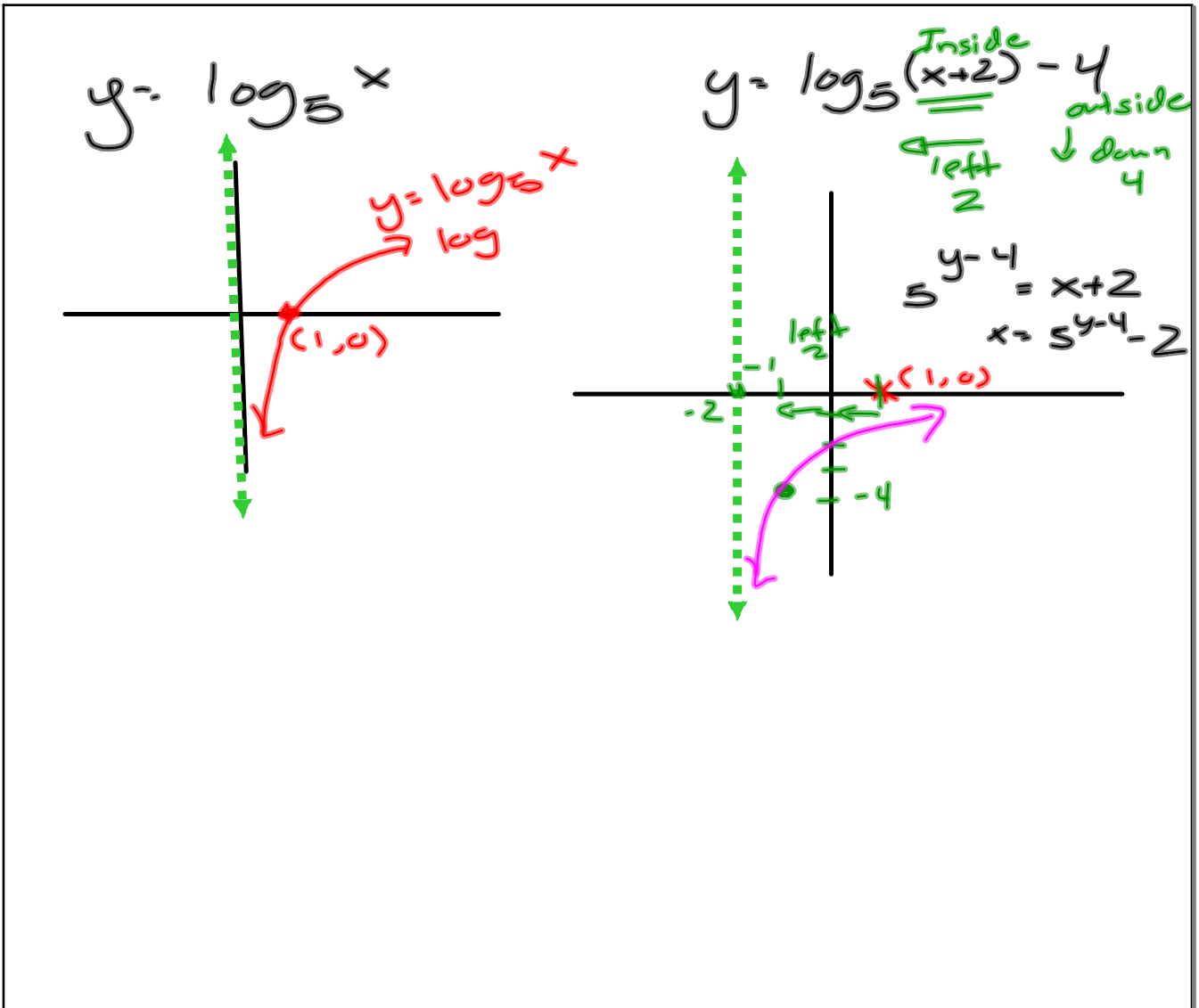
$x = 5^y$

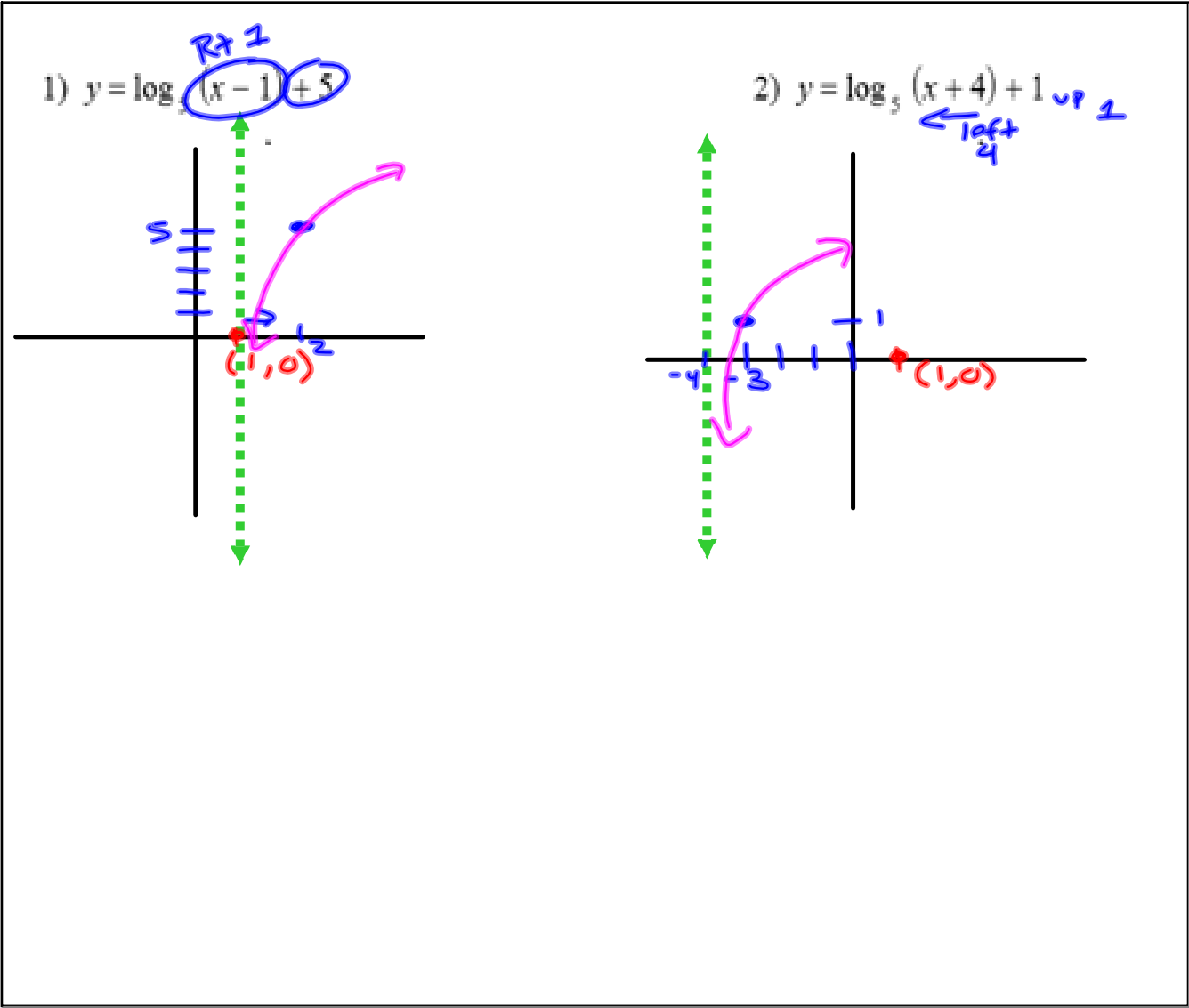
$5^0 =$	$x$	$y$	$exp = 0$
	1	0	
$5^1 =$	5	1	$exp = 1$



$y = 5^x$	$x$	$y$
$Exp = 0$	0	1 = $5^0$
$Exp = 1$	1	5 = $5^1$







$$\textcircled{2} \quad y = \log_4(x-3) + 5$$

$$4^{y-5} = \cancel{\log_4}(x-3)$$

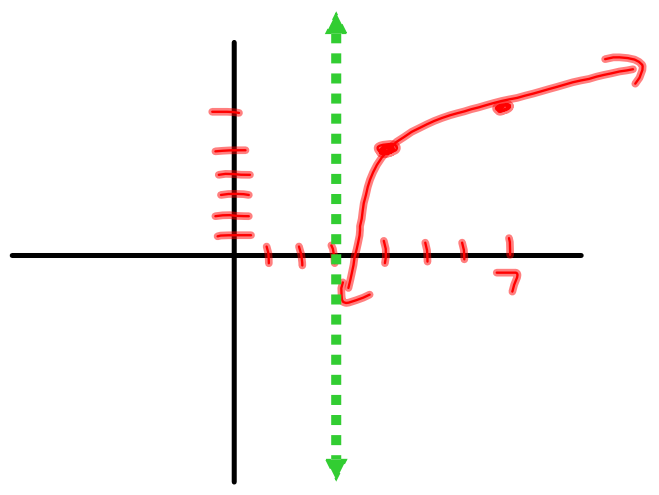
$$4^{y-5} = x-3$$

$$4^{y-5} + 3 = x$$

$$x = 4^{y-5} + 3$$

x	y	Exp.
$4^{5-5} + 3$	5	$y-5=0$
$4^0 + 3$	5	$y=5$
$4^1 + 3$	6	$y-5=1$
$4^2 + 3$	7	$y=6$
$4^3 + 3$		
$4^4 + 3$		
$4^5 + 3$		

- ① move value in front & behind the log.
- ② write as exp.
- ③ isolate the x



$$y = \log_8(x-3) + 4$$

\*  $\log 0 = \text{undefined} \Rightarrow \text{asymptote}$

\*  $\log 1 = 0$

\*  $\log_5 5 = 1$

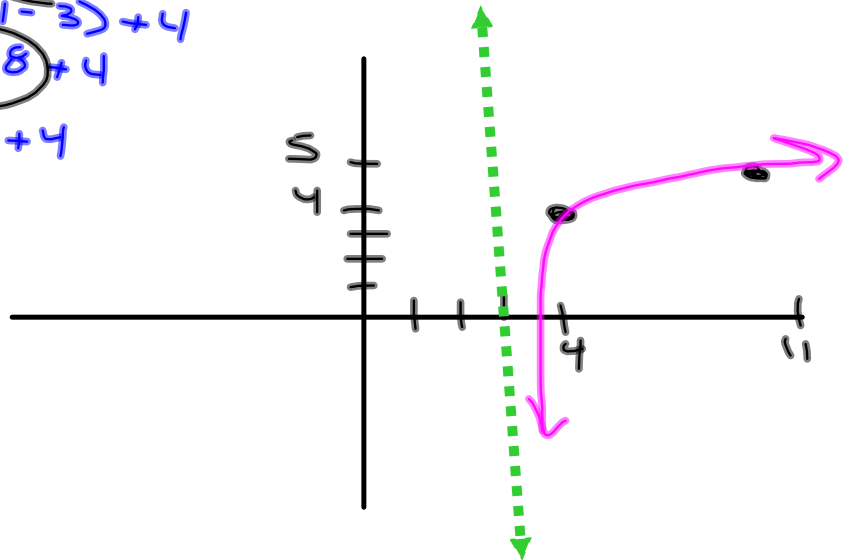
Steps :

① take the "inside" = 0  
 $(x-3) = 0$   
 $x = 3$

② take the "inside" = 1  
 $(x-3) = 1$   
 $x = 4$

③ take inside = the base  
 $(x-3) = 8$   
 $x = 11$

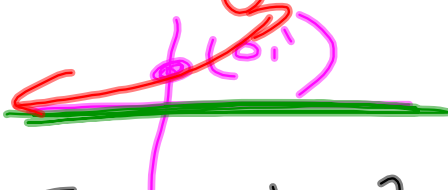
x	y
3	<del><math>\log_8(3-3)+4</math> <math>\log_8(0)+4</math> asymptote</del>
4	4 $\log_8(4-3)+4$ $\log_8 1+4$ $0+4$
11	5 $\log_8(11-3)+4$ $\log_8 8+4$ $1+4$



1 way to graph

$$y = \log_5 x$$

Change



Exponential

$$y = 5^x$$

$$5^y = \log_5 x$$

$$5^y = x$$

\*

\* Look back in your notes

\* what is different?

$$x = 5^y$$

what is this called?

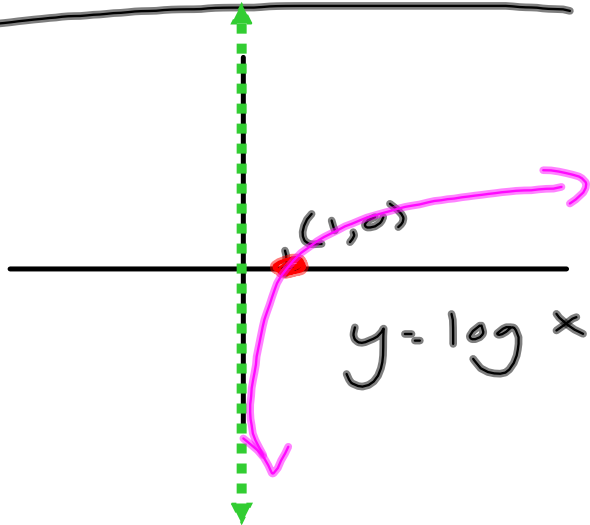
Inverse



$$y = x^2 + 16x^3 + 17x - 45x^{10}$$

$$x = y^2 + 16y^3 + 17y - 45y^{10}$$

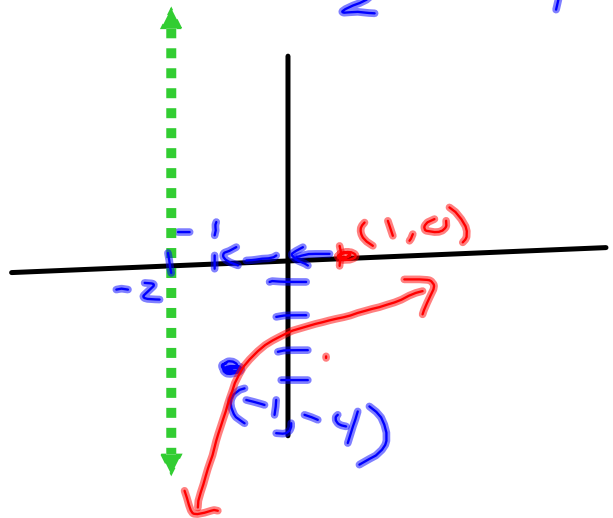
Parent Function :



Graph

$$y = \log_5(x+2) - 4$$

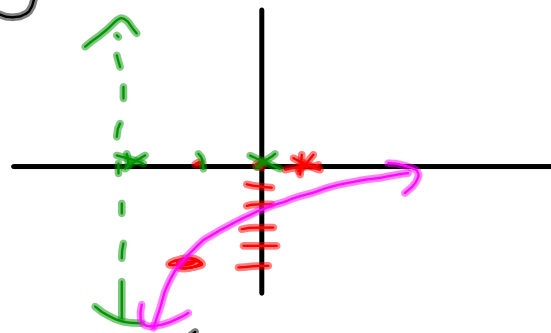
↑                    ↑  
1 of +            down  
2                    4



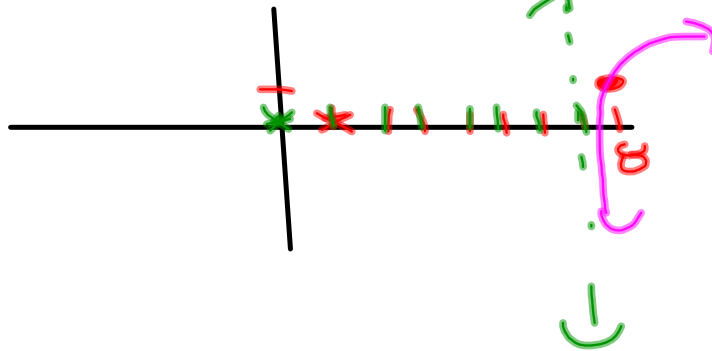


Graph

$$y = \log_3(x+2) - 5$$



$$y = \log_8(x-7) + 1$$



# Change to exponential

$$y = \log_5 x$$

① Change to exponential

$$5^y = x$$

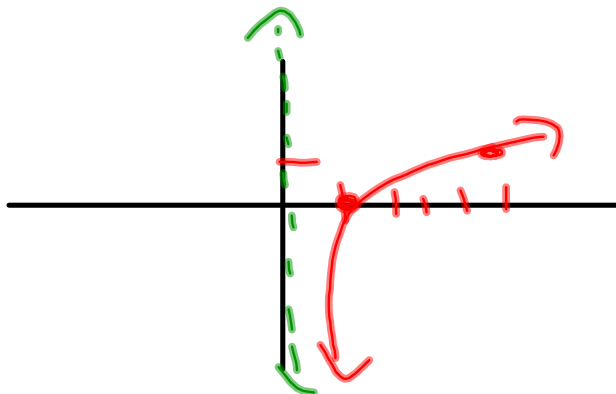
$$x = 5^y$$

Exponent = 0

Exponent = 1

x	y
1	0
5	1

y = 0  
y = 1



Exponential

$$y = 5^x$$

Exp = 0

Exp = 1

x	y
0	1
1	5

↑  
5  
↑  
Function  
y

$$y = \log_3(x+2) - 5$$

exponential

① move the "-5"

$$y + 5 = \log_3(x+2)$$

$$3^{y+5} = x+2$$

$$3^{y+5} - 2 = x$$

$$x = 3^{y+5} - 2$$

$$x = 3^{-5+5} - 2$$

$$x = 3^0 - 2$$

$$x = 1 - 2$$

$$x = -1$$

$$x = 3^{-4+5} - 2$$

$$x = 3^1 - 2$$

$$x = 3 - 2$$

$$x = 1$$

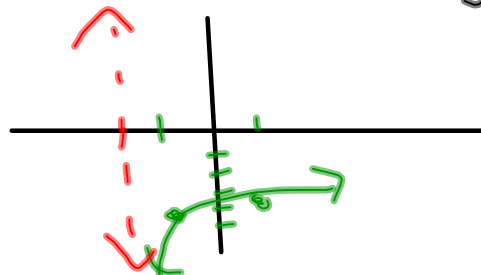
x	y
-1	-5
1	-4

$$\leftarrow y+5=0$$

$$y = -5$$

$$\leftarrow y+5=1$$

$$y = -4$$



$$y = \log_8 (x-3) + 4$$

using  
x/y table

Have to know

\*  $\log 0 = \text{undefined}$   $\rightarrow$  asymptote vertical

\*  $\log 1 = 0$

\*  $\log_{10} 10 = 1$

Steps:

① take the inside  
 $(x-3) = 0$   
 $x = 3$

② take the inside  
 $x-3 = 1$   
 $x = 4$

③ set inside = base  
 $x-3 = 8$   
 $x = 11$

x	y
3	
4	

$$y = \log_3(x+2) - 5$$

+5      +5

---

$$y + 5 = \log_3(x+2)$$

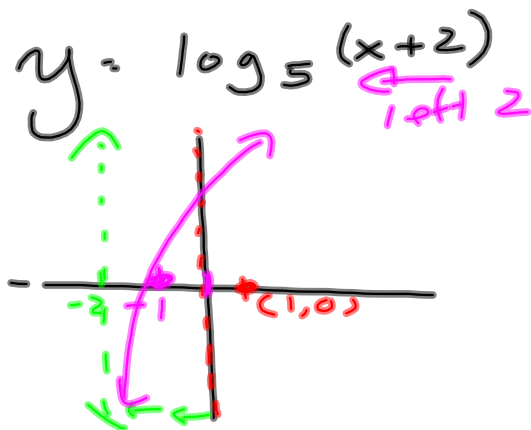
BASE

$$3^{y+5} = (x+2)$$

$y = -(\log_3(L))$

EXP.

BASE



$$y = \log_5(x+2)$$

over laps w/ exponential

change to exponential

$$5^y = \log_5(x+2)$$

$$5^y = (x+2) \rightarrow 5^y - 2 = x$$

$$5^y = x + 2$$

$$5^y - 2 = x$$

$$x = 5^y - 2$$

	x	y
Exp=0	-1	0
Exp=2	3	1

asymptote  
vertical  
@  $x = -2$

$$y = \log_8 (x-3) + 4$$

$$\log 0 = \text{und} \quad \log 1 = 0$$

$$\log_b 10 = 1 \quad \log_b B = 1$$

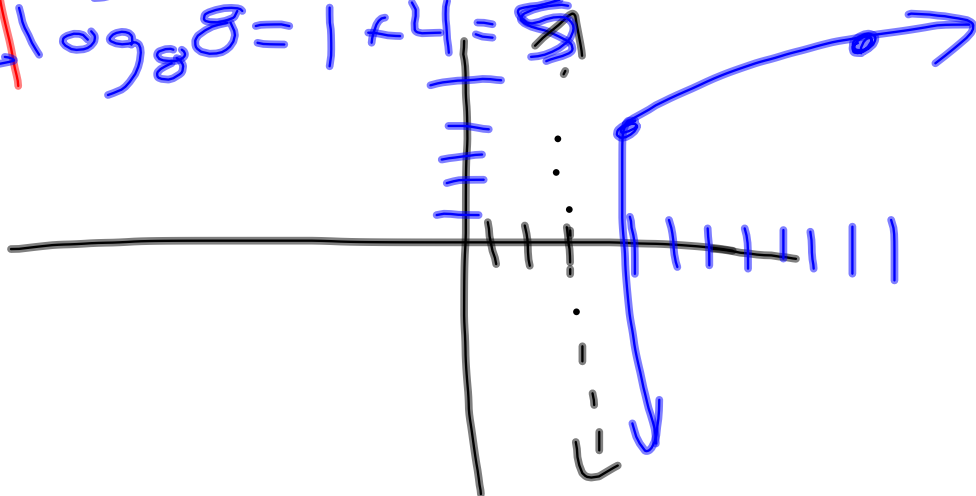
$$x-3 = 0 \rightarrow x = 3$$

$$x-3 = 1 \rightarrow x = 4$$

$$x-3 = 8 \rightarrow x = 11$$

$$\log_8 (x-3) + 4$$

x	y
3	$\log_8 0$ V.A.
4	$\log_8 1 = 0 + 4 = 4$
11	$\log_8 8 = 1 + 4 = 5$



$y = \log_8(x-3) + 4$

\*  $\log 0 = \text{undefined}$   
 $\uparrow$  asymptote

\*  $\log 1 = 0$

cal  $\log_{10} \boxed{\log_2}$

\*  $\log_{10} 10 = 1$

steps:

① take inside  $(x-3) = 0$   
 $x = 3$

②  $(x-3) = 1$   
 $x = 4$

③ set inside = to the base  
 $(x-3) = 8$   
 $x = 11$

x	y
3	$\log_8(3-3) = \log_8 0 \rightarrow \text{undefined}$ asymptote
4	$\log_8 1 = 0 + 4 = 4$
11	$\log_8 8 = 1 + 4 = 5$

transformation

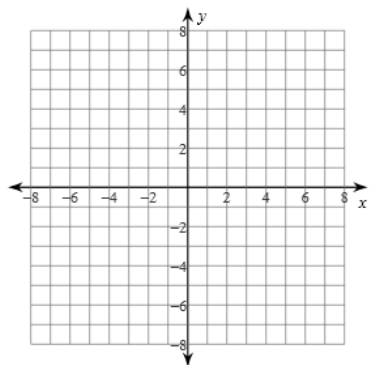


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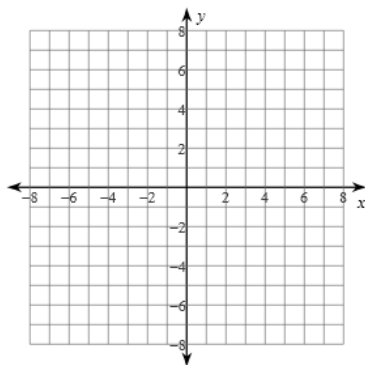
### Graphing Log Functions

Sketch the graph of each function.

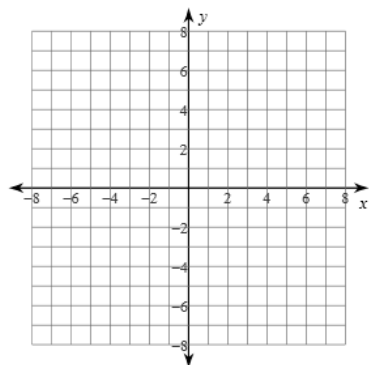
1)  $y = \log_5 (x - 1) + 5$



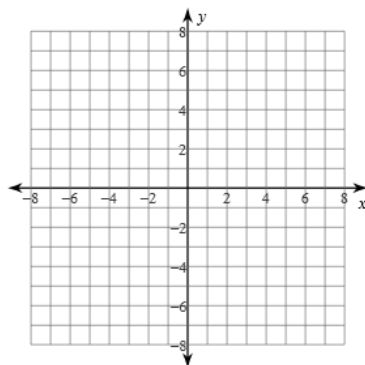
2)  $y = \log_5 (x + 4) + 1$



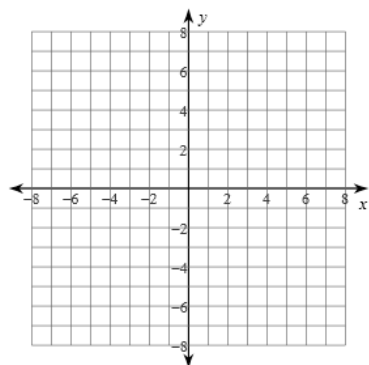
3)  $y = \ln (x - 3) - 3$



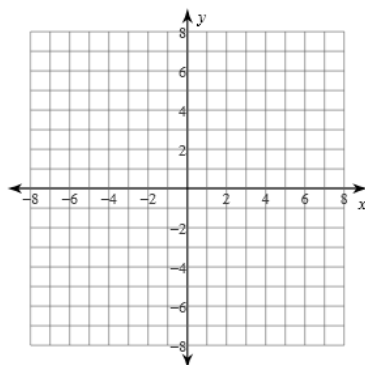
4)  $y = \ln (x + 6) - 1$



5)  $y = \log (x + 2) - 3$



6)  $y = \log (x + 1) - 1$

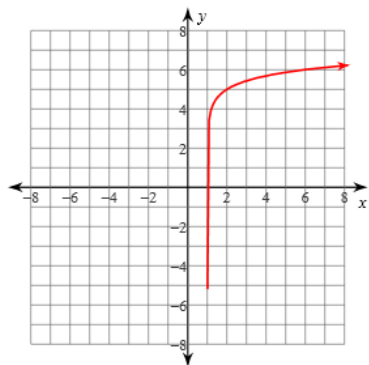


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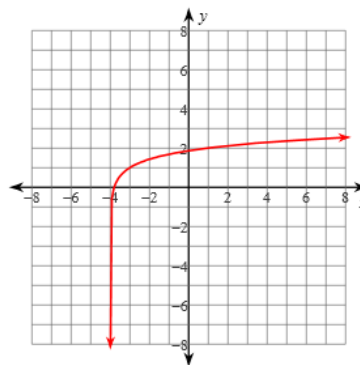
### Graphing Log Functions

Sketch the graph of each function.

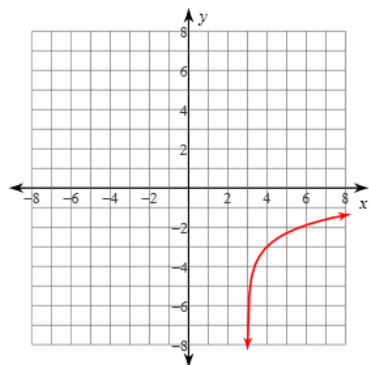
1)  $y = \log_5 (x - 1) + 5$



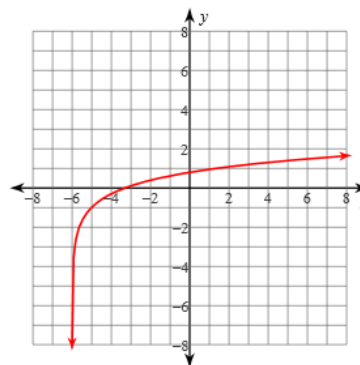
2)  $y = \log_5 (x + 4) + 1$



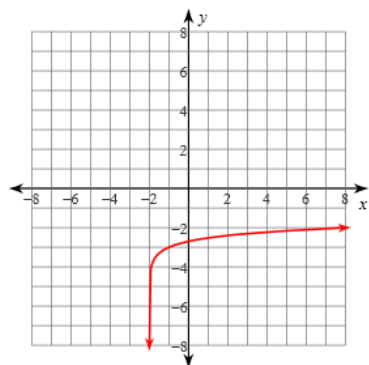
3)  $y = \ln (x - 3) - 3$



4)  $y = \ln (x + 6) - 1$



5)  $y = \log (x + 2) - 3$



6)  $y = \log (x + 1) - 1$

