4.1, 4.2 - Graphs of Exponential Functions
4.4 - Graphs of Logarithmic Functions

Exponential Functions

$$f(x) = ab^x$$

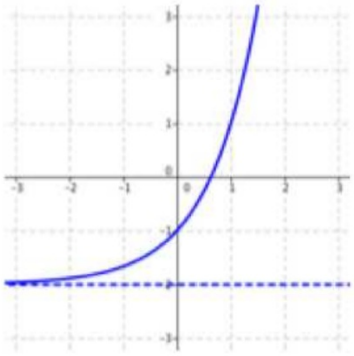
$$a \neq 0, \quad b > 0, \quad b \neq 1$$

b is called the growth or decay factor

$f(x) = 2^x$

Graphs of Exponential Functions

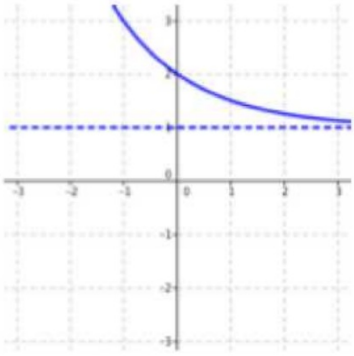
$$f(x) = ab^x$$



Exponential Growth

$b > 1$

*the RIGHT side of the graph moves AWAY from the asymptote



Exponential Decay

$0 < b < 1$

*the RIGHT side of the graph moves TOWARDS the asymptote

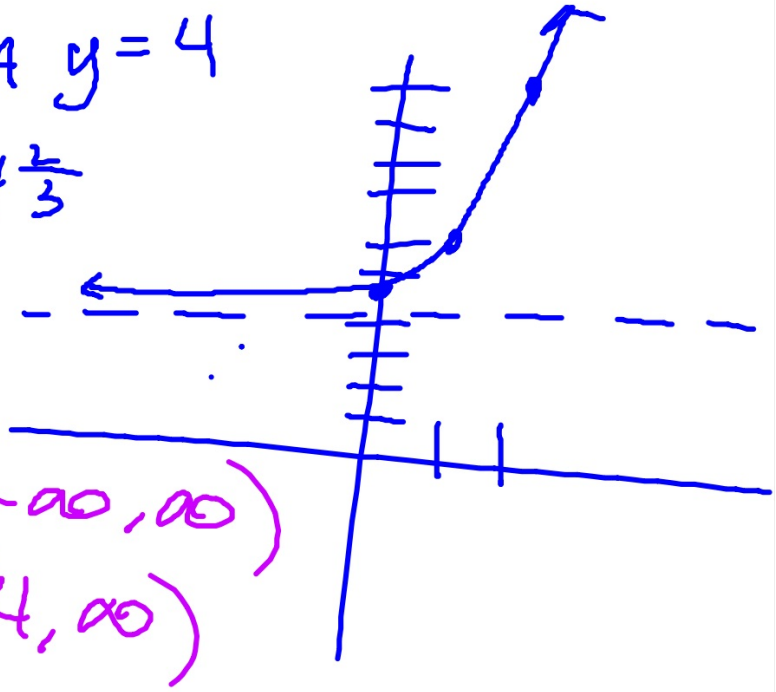
ex: Sketch. Then state the domain and range and classify as growth or decay.

a) $y = 2 \cdot 3^{x-1} + 4$

growth $(b = 3 > 1)$

HA $y = 4$

x	y
0	$2\left(\frac{1}{3}\right) + 4 = 4\frac{2}{3}$
1	$2 \cdot 3^0 + 4 = 6$
2	$2 \cdot 3^1 + 4 = 10$



D: $(-\infty, \infty)$

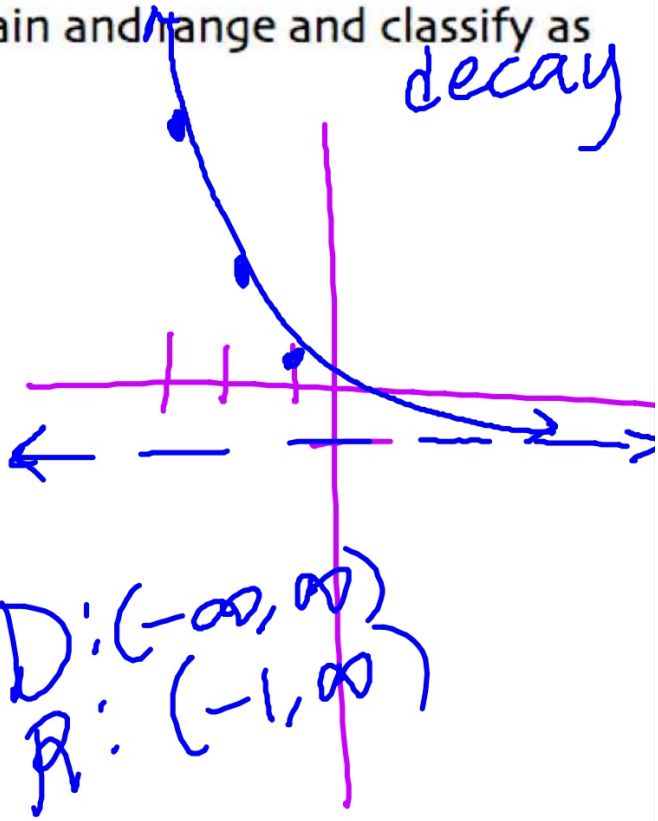
R: $(4, \infty)$

ex: Sketch. Then state the domain and range and classify as growth or decay.

b) $y = 3\left(\frac{1}{2}\right)^{x+2} - 1$

HA: $y = -1$

x	y
-3	$3 \cdot 2 - 1 = 5$
-2	2
-1	$\frac{3}{2} - 1 = \frac{1}{2}$



D: $(-\infty, \infty)$

R: $(-1, \infty)$

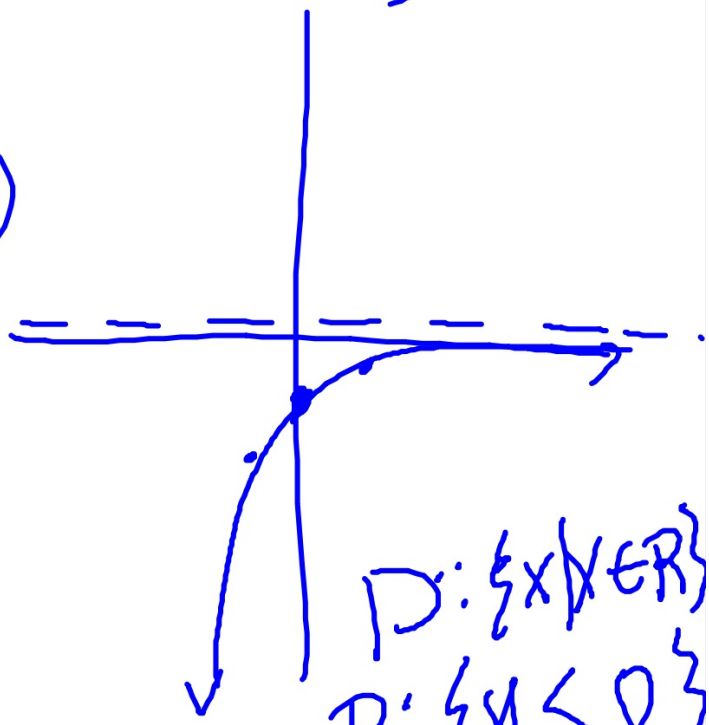
ex: Sketch. Then state the domain and range and classify as growth or decay.

c) $y = -\left(\frac{2}{3}\right)^x + 0$

HA: $y = 0$

x	y
−1	−3/2
0	−1
1	−2/3

decay



D: $\{x \mid x \in \mathbb{R}\}$

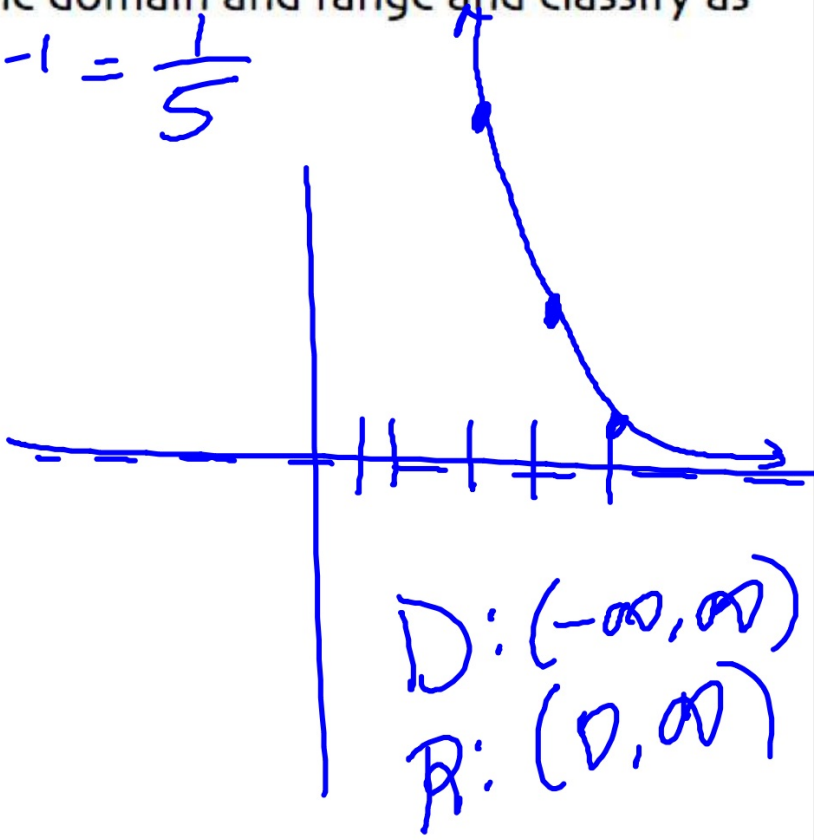
R: $\{y < 0\}$

ex: Sketch. Then state the domain and range and classify as growth or decay.

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

d) $y = 2 \cdot 5^{4-x}$

x	y
3	10
4	2
5	2/5



D: $(-\infty, \infty)$

R: $(0, \infty)$

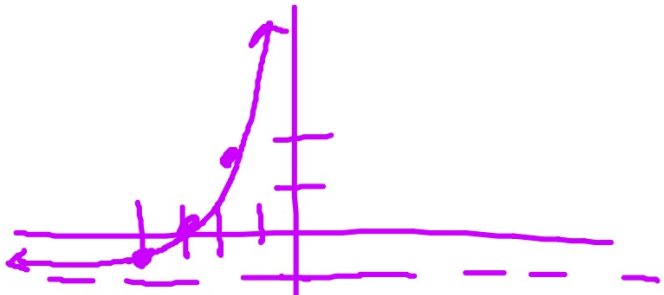
ex: Sketch. Then state the domain and range and classify as growth or decay.

$e \approx 2.7$ (growth)

e) $y = e^{x+3} - 1$

HA: $y = -1$

x	y
-2	$e^{1} - 1 = 1.7$
-3	$1 - 1 = 0$
-4	$.63$
	$e^{-1} - 1$



D: $(-\infty, \infty)$

R: $(-1, \infty)$

ex: WITHOUT graphing determine if the function represents growth or decay, then state the growth or decay factor.

a) $y = \frac{1}{2} \cdot 3^{x-4} + 5$

$b = 3$

growth

$b > 1$

ex: WITHOUT graphing determine if the function represents growth or decay, then state the growth or decay factor.

b) $y = -\left(\frac{4}{5}\right)^{x+1}$

$b = \frac{4}{5}$

decay

$0 < b < 1$

ex: WITHOUT graphing determine if the function represents growth or decay, then state the growth or decay factor.

c) $y = 5^{4-x} + 2$

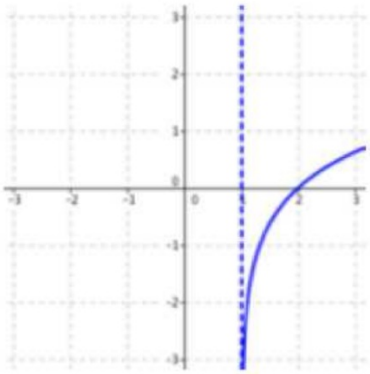
$5^{-1} = \frac{1}{5}$

$b = \frac{1}{5}$

decay

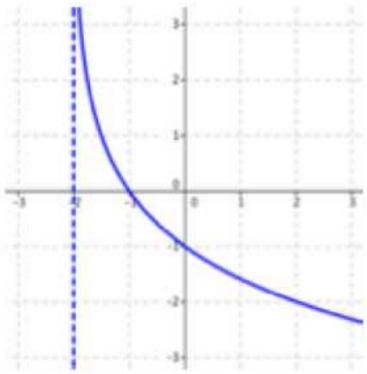
Graphs of Logarithmic Functions

$$f(x) = \log_b x$$



INCREASING

$b > 1$



DECREASING

$0 < b < 1$

ex: Sketch. Then state the domain and range and determine if the graph is increasing or decreasing.

a) $y = \log_2(x+1) - 3$

$y + 3 = \log_2(x+1)$

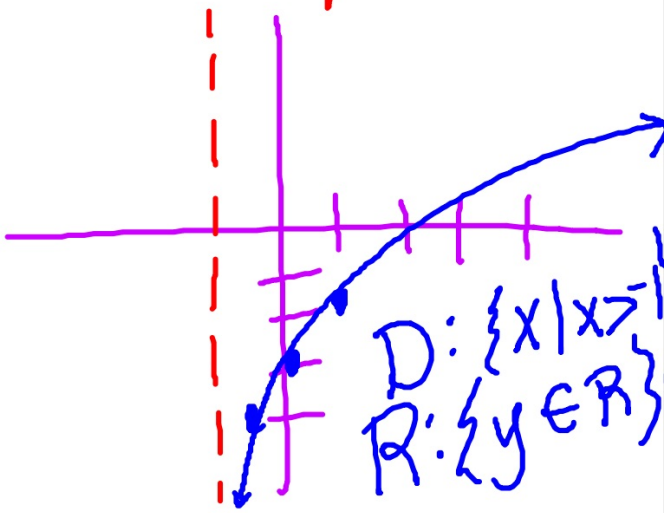
$2^{y+3} = 2^{\log_2(x+1)}$

$2^{y+3} = x+1$

$2^{y+3} - 1 = x$

VA $x = -1$

x	y
1	-2
0	-3
$-\frac{1}{2}$	-4



ex: Sketch. Then state the domain and range and determine if the graph is increasing or decreasing.

b) $y = 4\log_{\frac{1}{3}}(x-2)$

$\frac{y}{4} = \log_{1/3}(x-2)$

$\frac{1}{3}$ $\frac{1}{3}$

$\left(\frac{1}{3}\right)^{y/4} = x-2$

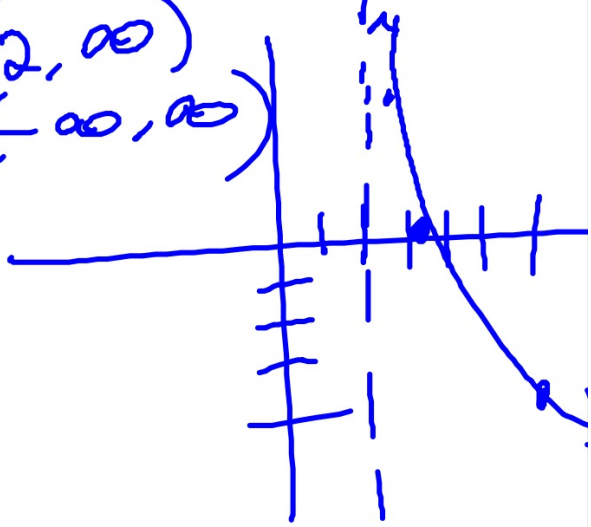
$\left(\frac{1}{3}\right)^{y/4} + 2 = x$

VA $x=2$

x	y
2 1/3	4
3	0
5	-4

D: $(2, \infty)$

R: $(-\infty, \infty)$



ex: Sketch. Then state the domain and range and determine if the graph is increasing or decreasing.

c) $y = -2\log_5(x+6)$

$$\frac{-y}{2} = \log_5(x+6)$$

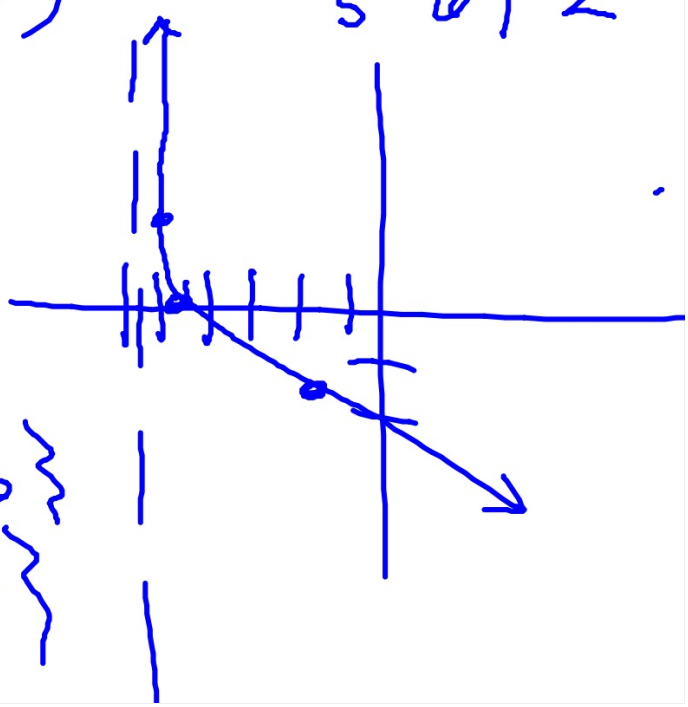
$$5^{\frac{-y}{2}} = x+6$$

$$5^{\frac{-y}{2}} - 6 = x$$

$D: \{x \mid x > -6\}$

$R: \{y \mid y \in R\}$

x	y
-1	-2
-5	0
$\frac{1}{5}$	-6
2	



ex: Sketch. Then state the domain and range and determine if the graph is increasing or decreasing.

e) $y = -\log(-x)$

$\frac{y}{-1} = \log(-x)$

$10^{-y} = 10^{\log(-x)}$

$10^{-y} = -x$

$-10^{-y} = x$

asymp. $x = 0$

x	y
-10	-1
-1	0
-1	1