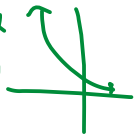
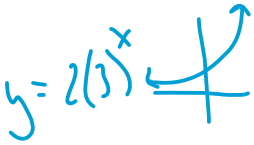
Graphing Exponential Functions

Fact: Exponential functions have graphs that contain a horizontal asymptote. A horizontal asymptote is a horizontal line that the graph gets increasingly close to as the values of *x* get increasingly large positive or negative.

For an exponential function given by $f(x) = a(b)^x$, with $a \neq 0$ and $b > 0, b \neq 1$ we have four possible graphs:

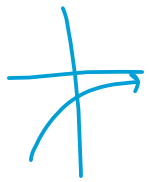
- If $a > 0$ and $0 < b < 1$ the graph is decreasing and above the x-axis i.e. $y = 2\left(\frac{1}{3}\right)^x$

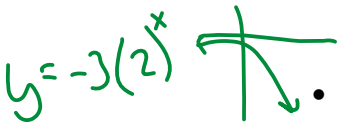




- If $a > 0$ and $b > 1$ the graph is increasing and above the x-axis

- If $a < 0$ and $0 < b < 1$ the graph is increasing and below the x-axis $y = -3\left(\frac{1}{2}\right)^x$





- If $a < 0$ and $b > 1$ the graph is decreasing and below the x-axis.

Examples: Sketch the graph of the following functions by hand. Explain what the values of *a* and *b* tell you about this graph. Also, find the domain and range of each function along with the equation of the horizontal asymptote.

1. $f(x) = 4(5)^x$

$a = 4$

$b = 5$

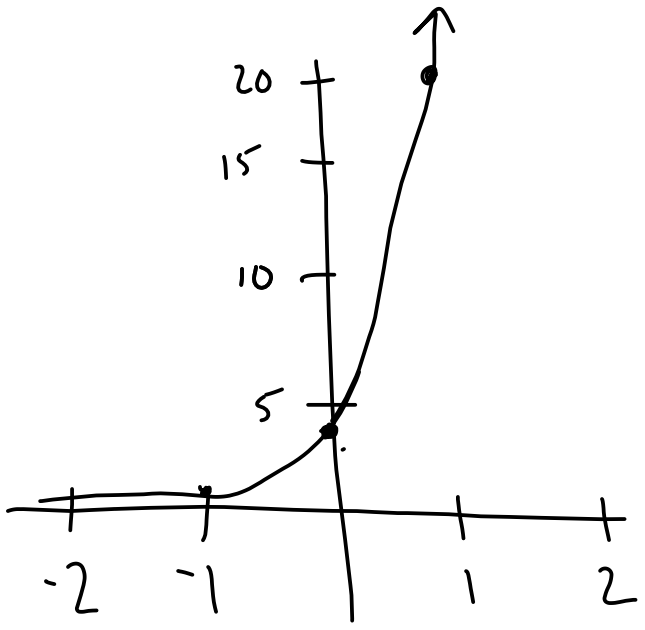
y-int $(0, a)$

x	y	
−1	4/5	÷5
0	$4(5)^0 = 4(1) = 4$	×5
1	20	×5
2	100	

Domain $(-\infty, \infty)$

Range $(0, \infty)$

$y = 0$ is horiz asy

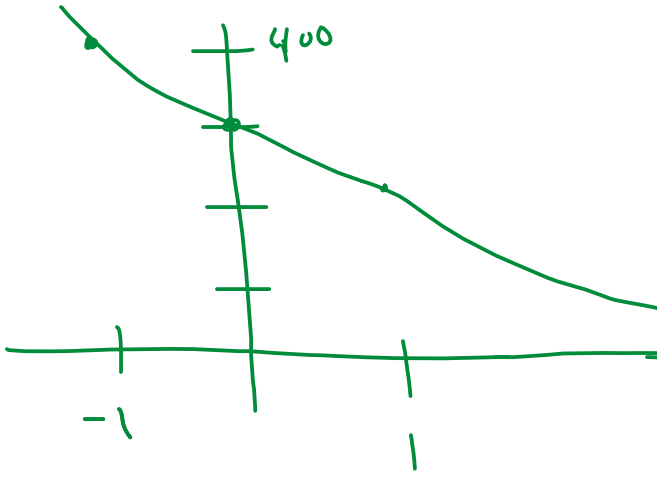


2. $f(x) = 300\left(\frac{3}{4}\right)^x$

$a = 300$

$b = \frac{3}{4}$

x	y	
-1	400	÷ 3/4
0	300	× 3/4
1	225	



Domain $(-\infty, \infty)$

Range $(0, \infty)$

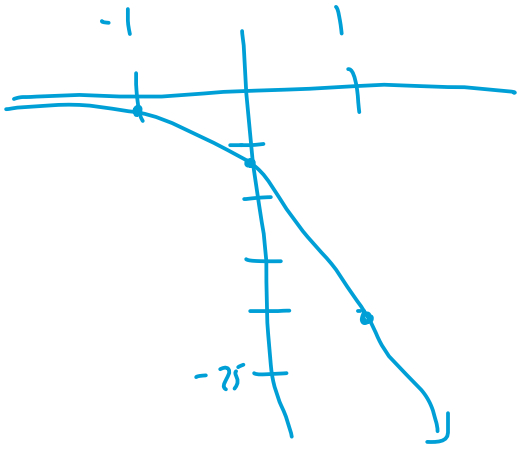
$y = 0$

3. $f(x) = -7(3)^x$

$a = -7$

$b = 3$

x	y	
-1	-7/3	÷ 3
0	-7	× 3
1	-21	× 3



Domain $(-\infty, \infty)$

Range $(-\infty, 0)$

$y = 0$

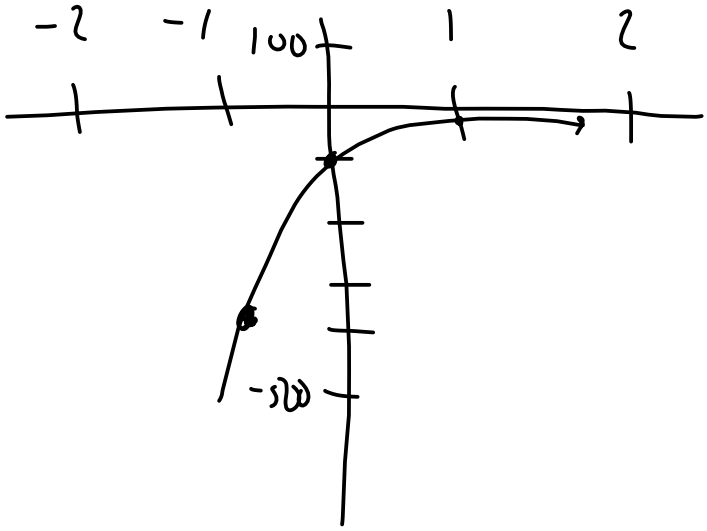
4. $f(x) = -100\left(\frac{1}{4}\right)^x$

$a = -100$

$b = \frac{1}{4}$

X	y
-2	-1600
-1	-400
0	-100
1	-25
2	$-\frac{25}{4}$

$\times \frac{1}{4}$



Domain $(-\infty, \infty)$

Range $(-\infty, 0)$

horiz. asy $y = 0$