Example 1:
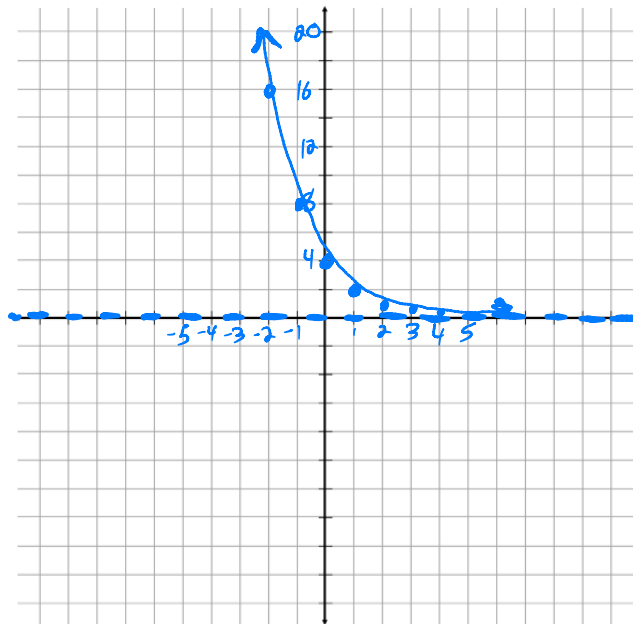
Graph each exponential function. Identify the domain, range, intercepts, intervals of increase/decrease, and the equation of any asymptotes.

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

x	y
-3	32 ⎫ ×½
-2	16 ⎬
-1	8
0	4
1	2
2	1
3	0.5

Domain: $\{X \in \mathbb{R}\}$

Range: $\{Y \in \mathbb{R} \mid y > 0\}$

x-int: NONE

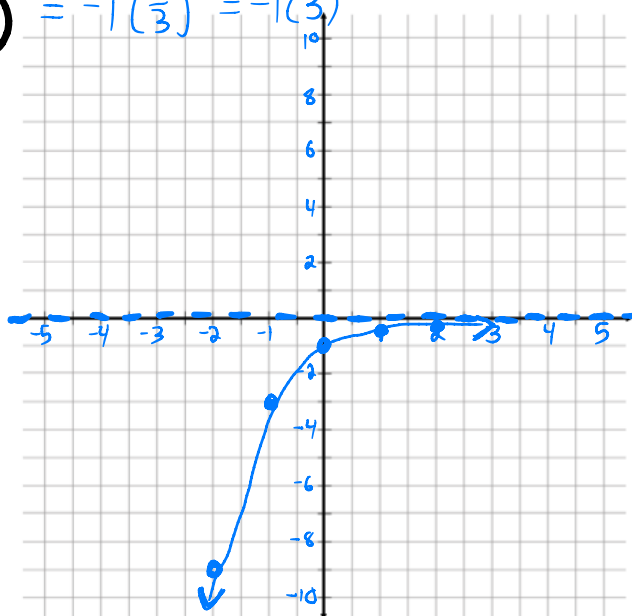**y-int:** $(0, 4)$

intervals of increase/decrease:

Decreasing

asymptote:

$y = 0$

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

x	y
-2	~9 ⎫ ×⅓
-1	-3 ⎬
0	-1
1	-0.33
2	-0.11

Domain: $\{X \in \mathbb{R}\}$

Range: $\{Y \in \mathbb{R} \mid y < 0\}$

x-int: NONE

y-int: $(0, -1)$

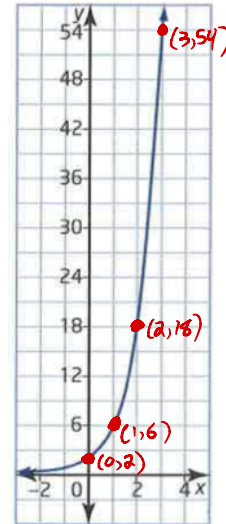**intervals of increase/decrease:**

Increasing

asymptote:

$y = 0$

Example 2:

Write the equation in the form $y = ab^x$ for the graph shown.

Start by determining the growth factor (b). As x changes by 1 unit, what factor does y change by?

x	y
0	?
1	6
2	18
3	54

$\times 3$
$\times 3$
$\times 3$

(3,54)
(2,18)
(1,6)
(0,2)

Next, determine the initial value (a) by plugging in the coordinates of one of the points (x, y) on the graph and the growth rate (b), then solve for a.

$$y = a\,(b)^x$$
$$y = a\,(3)^x$$
$$6 = a\,(3)^1$$
$$a = \frac{6}{3}$$
$$a = 2$$

Final Equation: $y = 2\,(3)^x$

Example 3: A radioactive sample has a half-life of 3 days. The initial sample is 200 mg. Write a function to relate the amount remaining, in milligrams, to the time, in days.

$$y = a\,(b)^x$$
$$y = 200\left(\frac{1}{2}\right)^{t/3}$$
$$A(t) = 200\left(\frac{1}{2}\right)^{t/3}$$

What do you know so far about when a function of the form $y = a(b)^x$ is <mark>increasing</mark> and when it is <mark>decreasing</mark>?

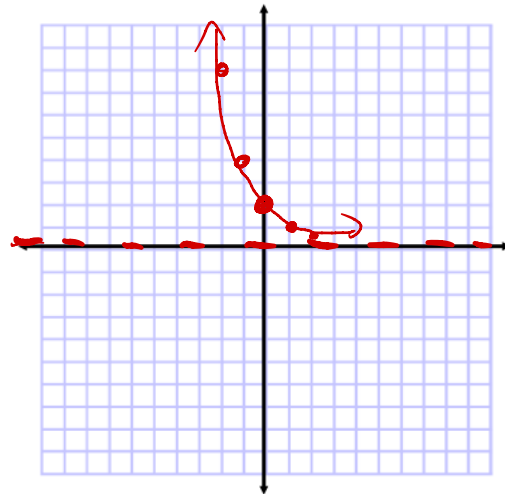| $a > 0$ $b > 1$ Increasing | $a > 0$ $0 < b < 1$ Decreasing |
| $a < 0$ $b > 1$ Decreasing | $a < 0$ $0 < b < 1$ Increasing |
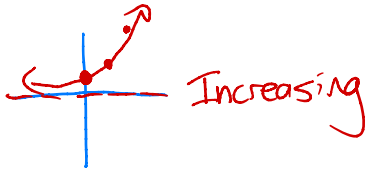
Example 4: Make a rough sketch of the graph of the following functions based on your knowledge of whether they are increasing or decreasing. $y = a(b)^x$
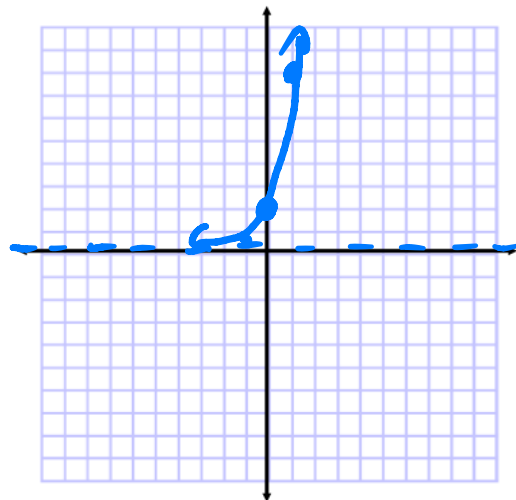
a) $y = 2\left(\frac{1}{2}\right)^x$

Decreasing

b) $y = 2(4)^x$

Increasing

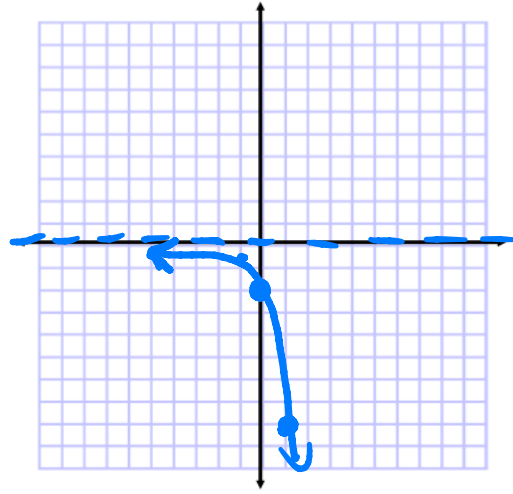**c)** $y = -2(4)^x$

Decreasing

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

Increasing