

Standard Form of an Exponential Function:

$$y = ab^{x-h} + k$$

Recall that a is your initial value, b is your base, and k is your horizontal asymptote. The base, b , is ALWAYS a constant value that is NEVER equal to one, and the exponent is always a variable.

Properties of Exponential Decay:

I. **Properties**

- If it goes down and decreases the entire time, then it is an exponential decay.
- The base, b , will be less than 1.
- One y -intercept, no x -intercept.
- End Behavior:
 - As x increases, $f(x)$ approaches the horizontal asymptote; as x decreases, $f(x)$ increases.

II. **Horizontal Asymptote:** $y = k$

- Recall, an asymptote is a **line** that a graph approaches, but never crosses. Horizontal asymptotes are **ALWAYS** written as a LINEAR EQUATION.

III. **Domain and Range:**

- For exponential functions, the domain is ALL REAL NUMBERS.
- For exponential functions, the range depends on the horizontal asymptote.

IV. **To Graph**

- Make an xy table
- Plot points and draw the horizontal asymptote

Examples of Exponential Decay Functions:

$$f(x) = \left(\frac{1}{2}\right)^x$$

$$y = 0.5^x$$

$$f(x) = 0.7^x - 6$$

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

Examples of Exponential Decay Functions:

1) $y = 0.5^x$

Base: 0.5

Initial Value: 1

H.A: $y = 0$

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

Base: $\frac{1}{4}$

Initial Value: 4

H.A: $y = 0$

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

Base: $\frac{1}{2}$

Initial Value: 1

H.A: $y = -4$

Guided Example 4:

Graph the exponential function $y = 2\left(\frac{1}{2}\right)^x$

x	y
-3	16
-2	8
-1	4
0	2
1	1
2	1/2
3	1/4

Growth or Decay? decay

Initial Value: 2 Base: 1/2

HA: y=0

Domain: IR Range: (0, ∞)

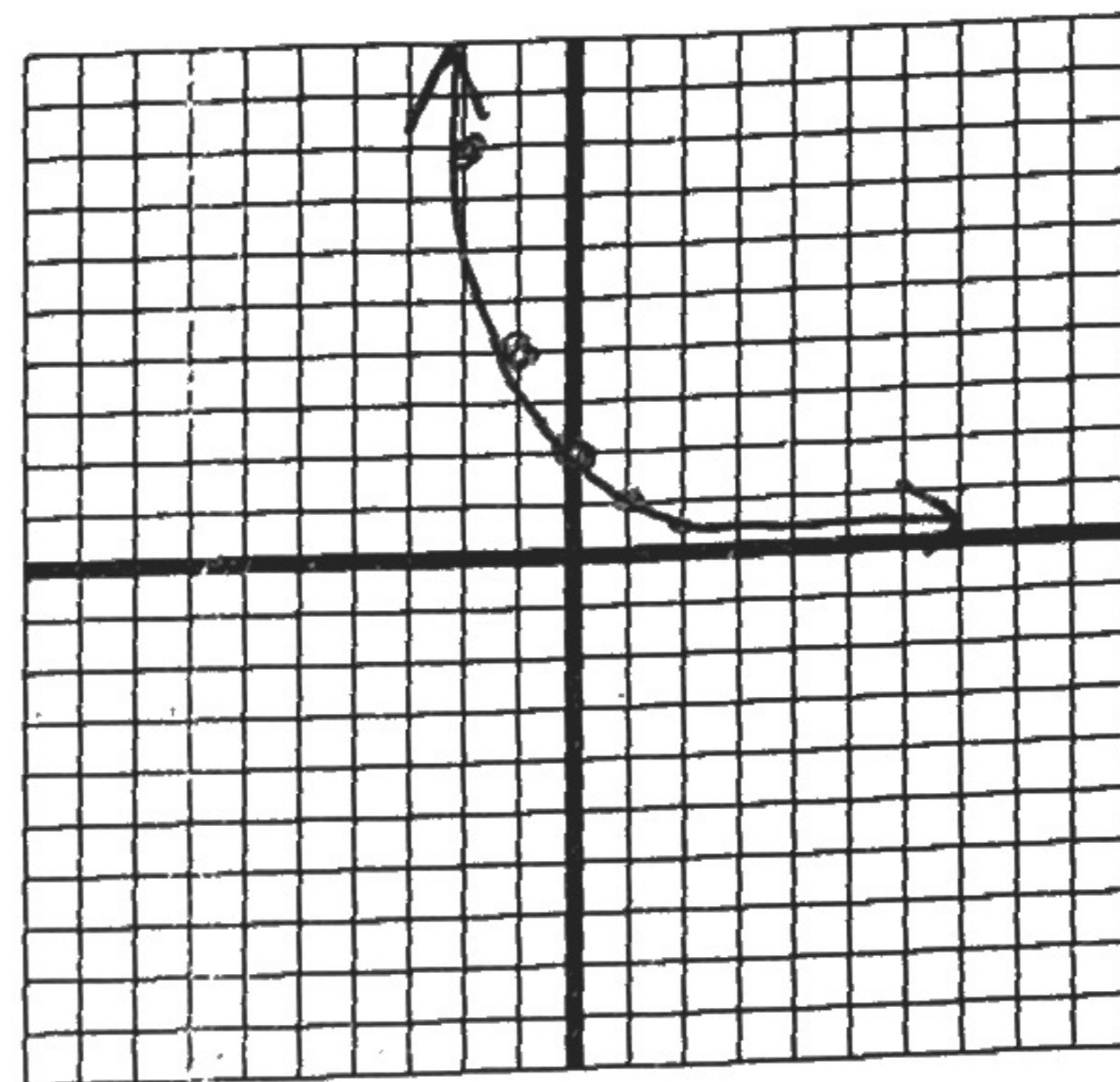
Max: none Min: none

Y-Intercept: (0, 2)

Increasing: none Decreasing: IR

End Behavior: As x increases, y approaches 0

As x decreases, y approaches ∞



Guided Example 5:

Graph the exponential function $y = \left(\frac{1}{3}\right)^x$

x	y
-3	27
-2	9
-1	3
0	1
1	1/3
2	1/9
3	1/27

Growth or Decay? decay

Initial Value: 1 Base: 1/3

HA: y=0

Domain: IR Range: (0, ∞)

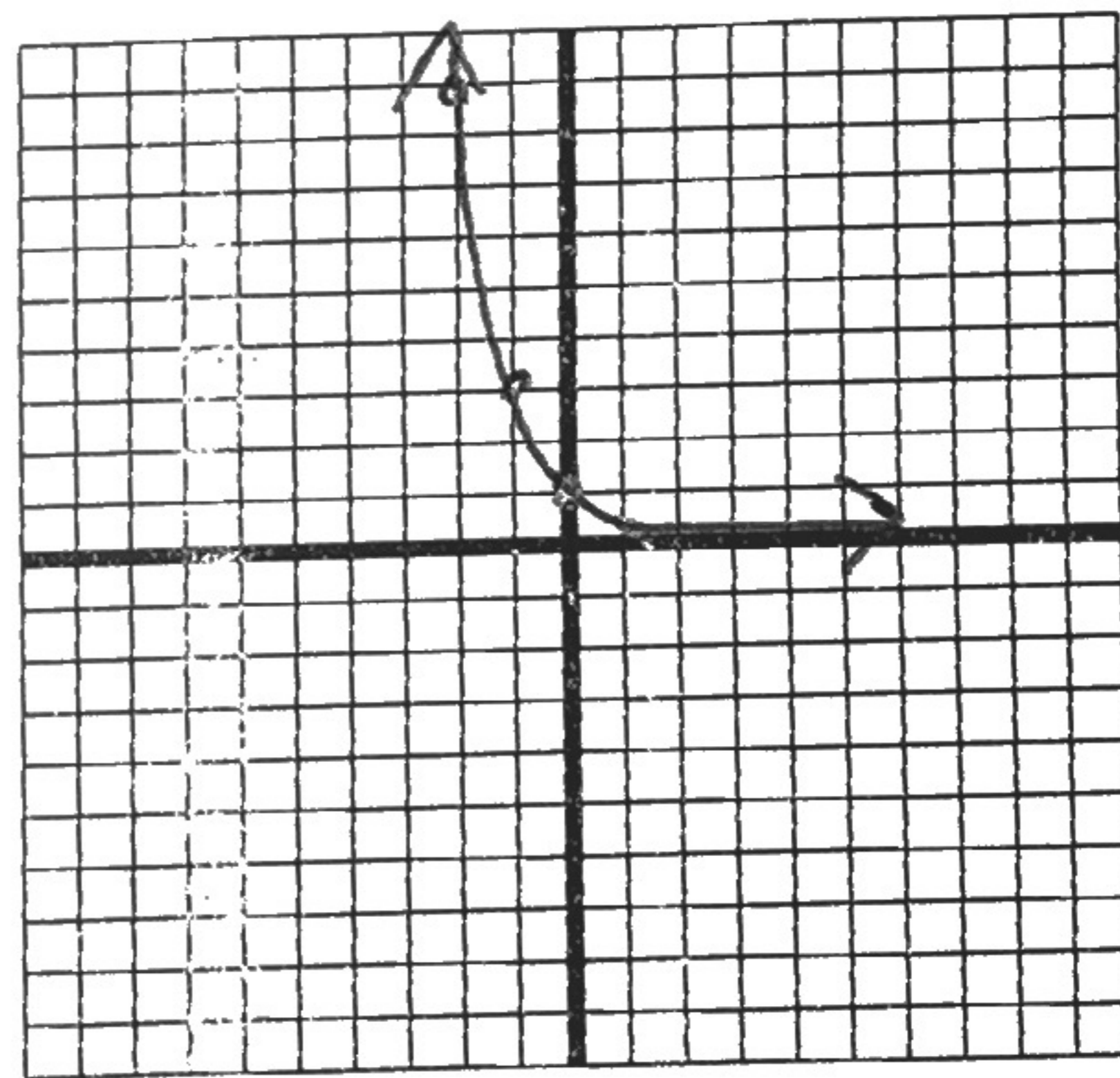
Max: none Min: none

Y-Intercept: (0, 1)

Increasing: none Decreasing: IR

End Behavior: As x increases, y approaches 0

As x decreases, y approaches ∞

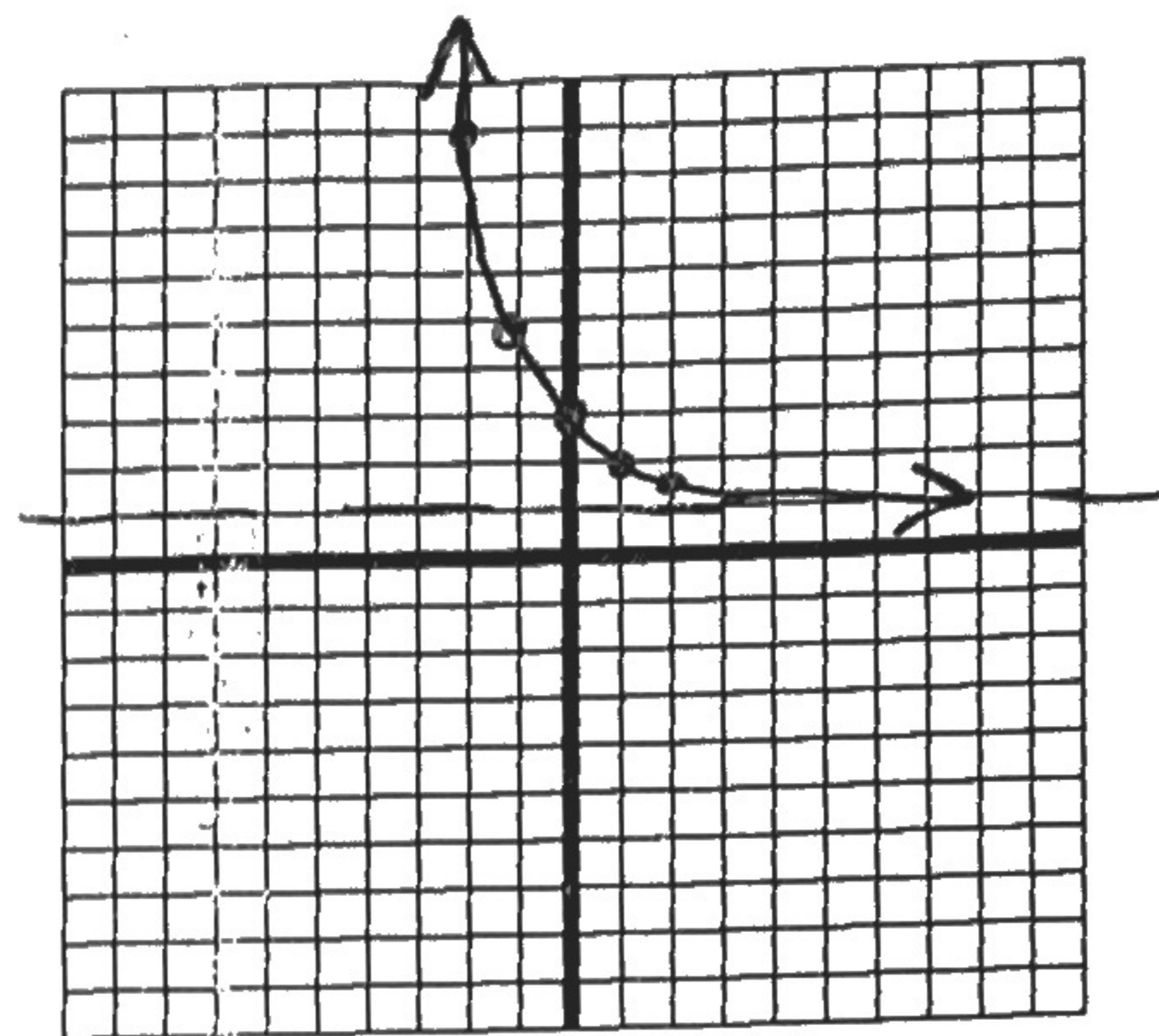


Guided Example 6:

Graph the exponential function $y = 2\left(\frac{1}{2}\right)^x + 1$

x	y
-3	17
-2	9
-1	5
0	3
1	2
2	1.5
3	1.25

Growth or Decay? decay
 Initial Value: 2 Base: 1/2
 HA: y=1 $y > 1$
 Domain: IR Range: (1, ∞)
 Max: none Min: none
 Y-Intercept: (0, 3)
 Increasing: none Decreasing: IR
 End Behavior: As x increases, y approaches 1
 As x decreases, y approaches ∞



Guided Example 7:

Graph the exponential function $y = \left(\frac{1}{3}\right)^{x-1}$

x	y
-3	81
-2	27
-1	9
0	3
1	1
2	1/3
3	1/9

Growth or Decay? decay
 Initial Value: 1 Base: 1/3
 HA: y=0 $y > 1$
 Domain: IR Range: (1, ∞)
 Max: none Min: none
 Y-Intercept: (0, 3)
 Increasing: none Decreasing: IR
 End Behavior: As x increases, y approaches 0
 As x decreases, y approaches ∞

