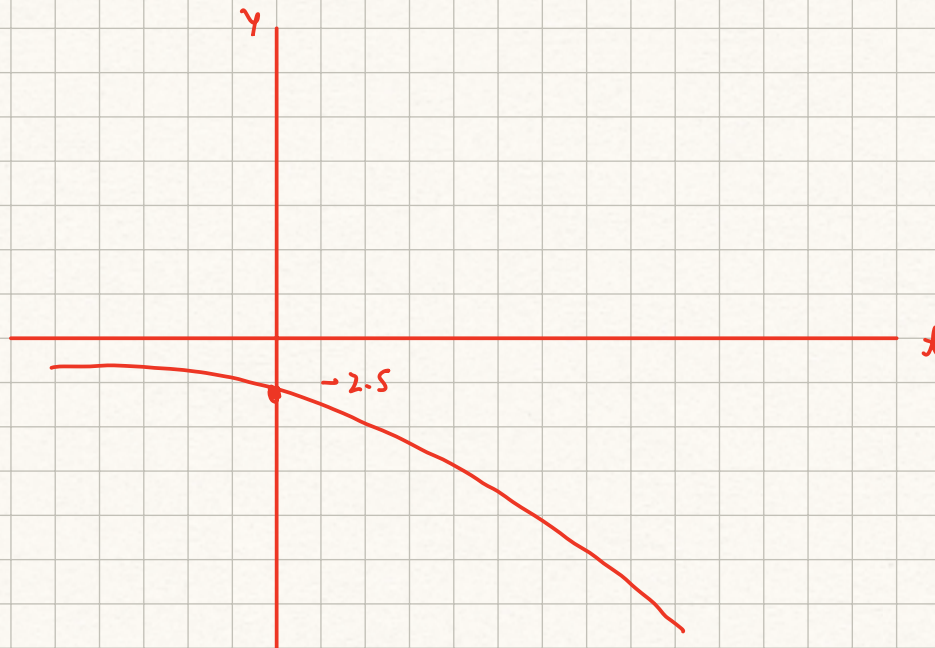


Ex:

$$y = -2.5(1.72)^x$$

- Identify if it is growth or decay.
- Explain why. $1.72 > 1$
- Identify the initial value. -2.5
- Identify growth/decay rate. 72%
- Sketch graph.



Increasing — as a graph is read from left to right, it gets higher.

Growth — as a graph is read from left to right, it gets further from horizontal axis.

Decreasing vs. Decay are similarly defined.

Ex:

$$y = -2.5 (3.72)^x$$

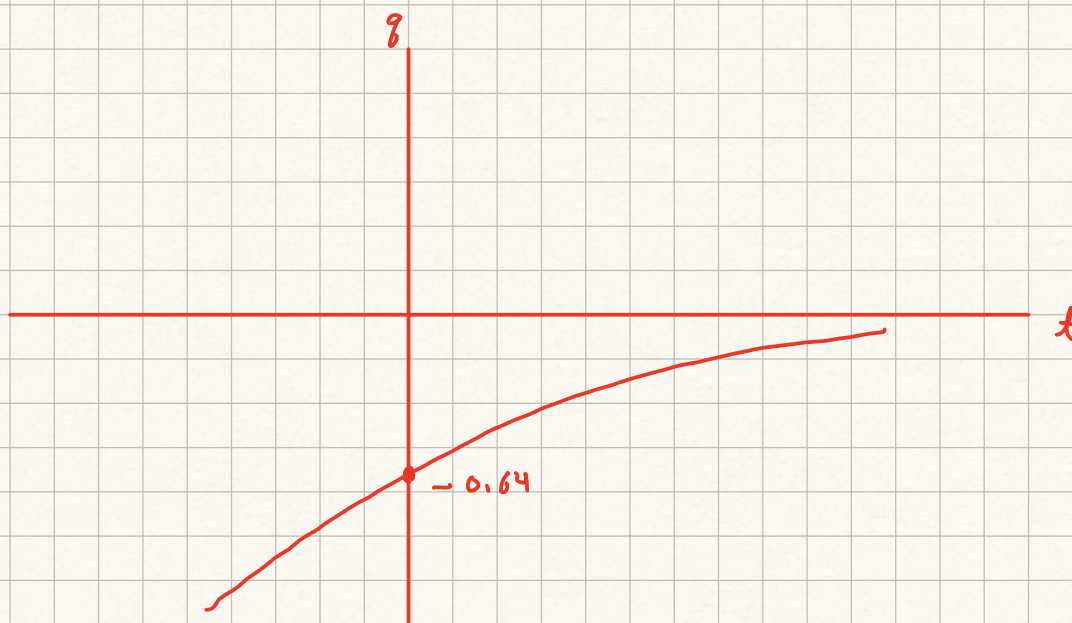
What is the percent growth rate?

$$3.72 - 1 = 2.72 = 272\%$$

Ex:

$$g = -0.64 (0.12)^x$$

- Identify if it is growth or decay.
- Explain why. $0.12 < 1$
- Identify the initial value. -0.64
- Identify growth/decay rate. 88% $1 - 0.12 = 0.88 = 88\%$
- Sketch graph.



Ex:

$$y = 3.81 (1.2)^{3x}$$

$$= 3.81 [(1.2)^3]^x$$

$$= 3.81 [1.728]^x$$

Growth Rate is 72.8% , not 20%

$$y = 3.81 (0.92)^{4x}$$

$$= 3.81 (0.92^4)^x$$

$$= 3.81 (0.716)^x$$

↖ 28.4% since $1 - 0.716 = 0.284$

$$y = 3.81 (0.92)^{-x}$$

$$= 3.81 (0.92^{-1})^x$$

$$= 3.81 (1.087)^x$$

↖ 8.7% growth

Ex:

Write an exponential function with a 72% growth rate in the form

$$y = 3.81 (0.92)^{rx}$$

$$= 3.81 (0.92^r)^x$$

↖ want this to turn out to be 1.72

$$0.92^r = 1.72$$

$$\log(0.92^r) = \log(1.72)$$

$$r \cdot \log(0.92) = \log(1.72)$$

$$r = \frac{\log(1.72)}{\log(0.92)} = \frac{0.236}{-0.036} = -6.6$$

$$\therefore y = 3.81 (0.92)^{-6.6x}$$

Note:

We can write any exponential growth or decay amount using any base we want.

Most common bases are 10 and $e = 2.71828...$

$$y = a \cdot 10^{rx} \quad \text{or} \quad y = a e^{rx}$$

Ex:

Write $y = 5.7 e^{0.2x}$ in the form $y = a \cdot b^x$

$$y = 5.7 (e^{0.2})^x$$

$$= 5.7 (1.221)^x$$

↖ 22.1% growth rate (per unit time)

Ex:

Write $y = 7.2 e^{-0.34t}$ in the form $y = a \cdot b^t$ and identify both continuous and non-continuous growth/decay rate.

Decay since $-0.34 < 0$ (negative)

34% continuous rate

$$y = 7.2 (e^{-0.34})^t$$

$$= 7.2 (0.712)^t$$

$\uparrow$ $1 - 0.712 = 0.288 = 28.8\%$ non-continuous rate

Ex:

Find the continuous and non-continuous growth rate for

$$y = 7.9 (1.13)^t$$

13% non-continuous rate

$$y = 7.9 e^{rt} = 7.9 (e^r)^t = 7.9 e^{0.122t}$$

12.2% continuous rate

Need $e^r = 1.13 \longrightarrow e^r = 1.13$

~~$$\log(e^r) = \log(1.13)$$~~

$$r = \ln(1.13) = 0.122$$

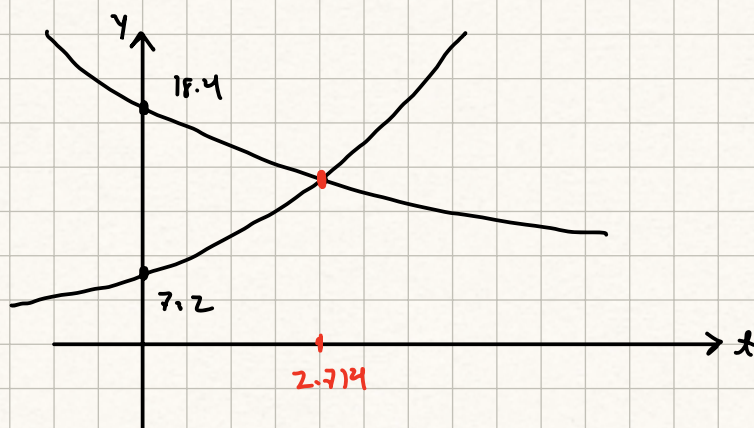
~~$$r \cdot \log(e) = \log(1.13)$$~~

~~$$r = \frac{\log(1.13)}{\log(e)} = \frac{0.053}{0.434} = 0.122$$~~

Ex:

Do $y = 7.2 (1.3)^t$ and $y = 18.4 (0.92)^t$ intersect for a positive t value?

If so, find the intersection.



$$7.2 (1.3)^t = 18.4 (0.92)^t$$

$$\frac{(1.3)^t}{(0.92)^t} = \frac{18.4}{7.2}$$

$$\left(\frac{1.3}{0.92}\right)^t = \frac{18.4}{7.2}$$

$$1.413^t = 2.556$$

$$\ln(1.413^t) = \ln(2.556)$$

$$t \cdot \ln(1.413) = \ln(2.556)$$

$$t = \frac{\ln(2.556)}{\ln(1.413)} = 2.714$$

$$t = 2.714$$

Ex:

$$\text{Solve for } t: 7.2 e^{1.3t} = 18.4 e^{-0.93t}$$

$$\frac{e^{1.3t}}{e^{-0.93t}} = \frac{18.4}{7.2}$$

$$e^{2.23t} = 2.556$$

$$\ln(e^{2.23t}) = \ln(2.556)$$

$$2.23t = 0.938$$

$$t = 0.421$$