Unit 1: Graphing Exponential Functions

$f(x) = a\,c^{b(x-h)} + k$, where $y = k$ is an asymptote.

- coefficient
- exp number
- base

ex $2^4 = 2 \cdot 2 \cdot 2 \cdot 2$

won't see in this book: $(-2)^2 = (-2)(-2) = 4$

$-2^2 = -1 \cdot 2 \cdot 2$

$-1 \cdot 2^{b(x-h)}$

$a \cdot c$

The c parameter:

- c can never be negative
- c can't be one nor zero

c does b's job

$c > 1$ no flipping (just scaling)

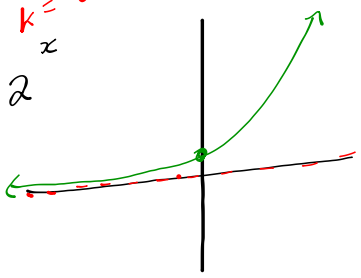
$0 < c < 1$ flipping left/right

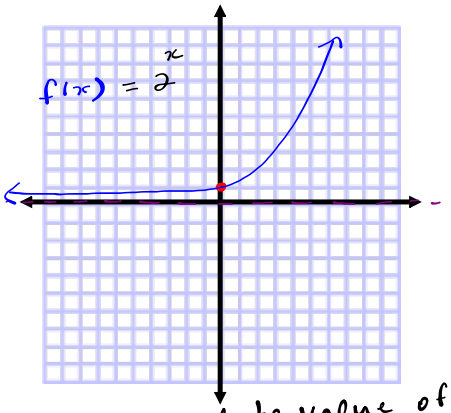
Recall:

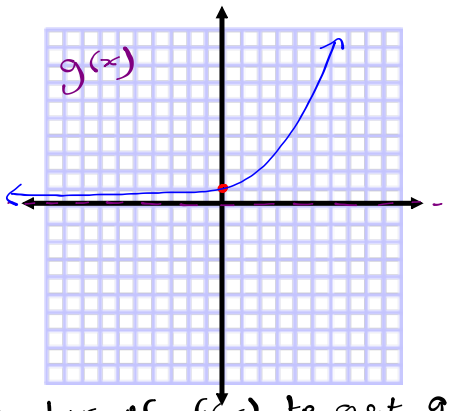
- a - flips up/down, scales
- b - flips left/right, scales
- h - horizontal translation
- k - vertical translation

initially $a = 1$, $b = 1$, $h = 0$, $k = 0$, $c = 2$

$y = 2^x$







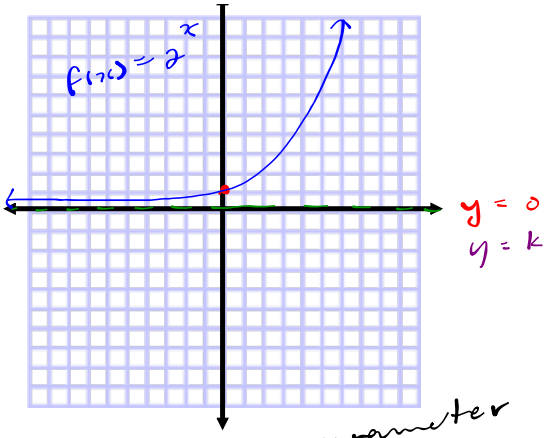
Q What happened to value of parameter of $f(x)$ to get $g(x)$

a) $a < 0$, $0 < c < 1$

b) $b < 0$, $0 < c < 1$

c) $h \uparrow$, $a < 0$

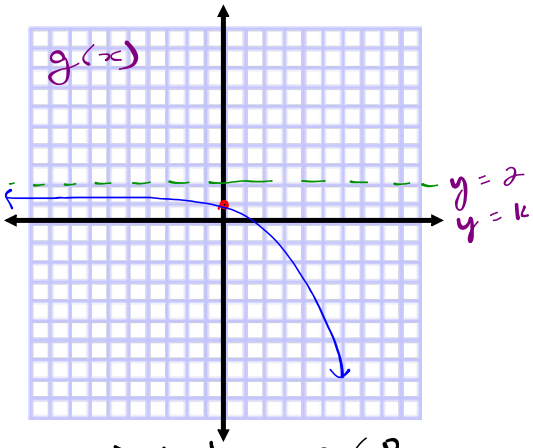
d) $a < 0$, $b < 0$



The parameter

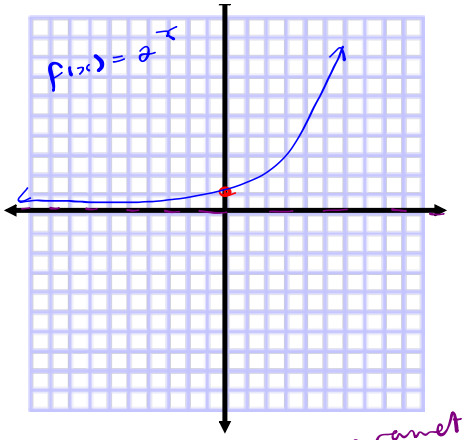
a) $0 < c < 1$, h ↑

b) k ↑, a < 0



c) h ↓, a < 0

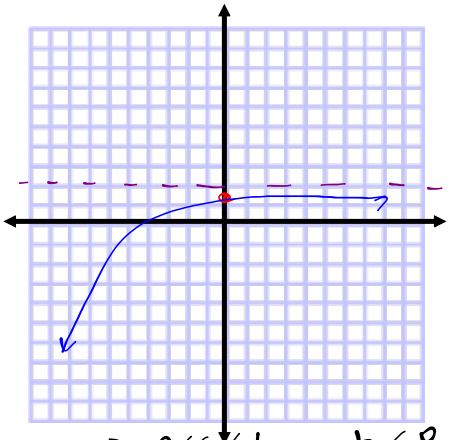
d) h ↓, k ↑



the parameters.

a) $a < 0$, $c > 1$

b) $b < 0$, $a > 0$



c) $0 < c < 1$, $b < 0$

d) $0 < c < 1$, $a < 0$

Graphing exp functions.

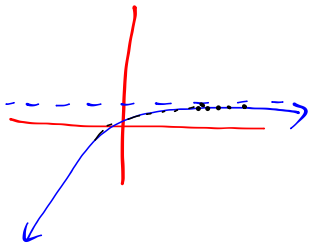
graph $f(x) = -1 \cdot 2^{-(x-3)} + 1$

$f(3) = -1 \cdot 1 + 1$

$f(3) = 0$

$f(x) = -2^{b(x-h)} + 1$

$y = a\,c^{b(x-h)} + k$



Step i. find value of parameters.

$c = 2$

$a = -1$

$b = -1$

$h = 3$

$k = 1$

asymptote

$y = k$

$y = 1$

Step ii Construct TOV

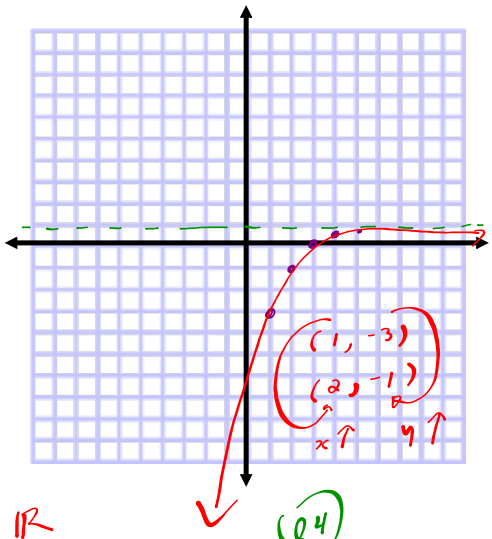
	x	y
h	-2	
h	-1	
	h	
	h+1	
	h+2	

	x	y
	1	-3
S	2	-1
C	3	0
Q	4	0.5
N	5	0.75

Find $f(1) = -2^{-(1-3)} + 1$

$f(1) = -1 \cdot 2^{2} + 1$

$f(1) = -3$



Step iii Draw points / asymptotes / and curve.

Domain $\mathbb{R}$

Range $(-\infty, 1)$

Q4

$a^0 = 1$

if $f(x) = -\frac{1}{2}^{(x+2)} - 3$

QI. Determine the positive interval

QII. Determine whether f is increasing over interval $[-2, 3]$

QIII. Determine the y-int.

$f(3) = -1 \cdot 0.5^{(-3+2)} - 3$

HmwK

p 1.33 - 1.35

1 and # 2

p 1.40 - 1.41

2 # 3

p 1.45

6

Unit 2: Determining the Equation of an Exponential Function

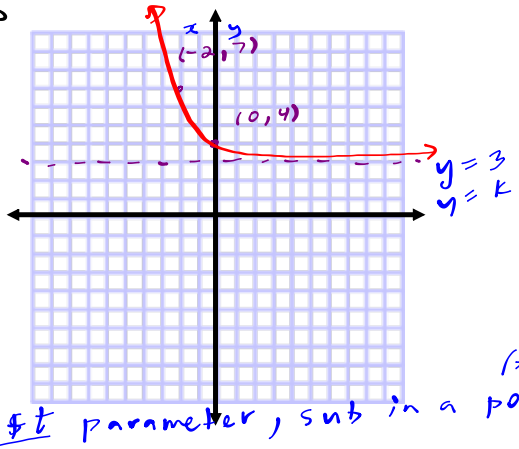
- given graph
- given word question

} find a/b/h/k/c

Given the graph, determine the equation of the exp function in the form

$$y = \pm c^{x} + k$$

$$y = a\,c^{b(x-h)} + k$$
$$y = a\,c^{(x-h)} + k$$
$$y = \pm c^{(x-h)} + k$$
$$y = \pm c^{x} + k$$



step i. Label and find k

$$y = \pm c^{x} + 3$$

step ii. determine the sign of a by referring to graph.

$$y = c^{x} + 3$$

step iii. To find value of last parameter, sub in a point (x, y) temporarily

sub (-2, 7)

$$7 = c^{-2} + 3$$

$$4 = c^{-2}$$

$$c = \sqrt[-2]{4}$$

solve

BEDMAS

1 -2

x √ y

4

$$c = 0.5$$

$$y = 0.5^{x} + 3$$

→ root index

→

Find the equation in form

$$y = \pm c^{x} + k$$

$y = \pm c^{x} + 0$

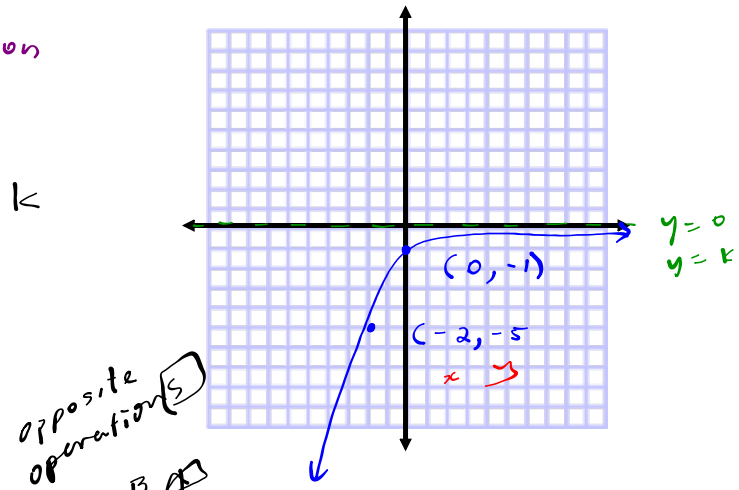
$y = -c^{x}$

$-5 = -c^{2}$

$\frac{-5}{-1} = \frac{-1 \cdot c}{-1}$

$\sqrt{5} = \sqrt{c^{2}}$

$c = 0.45$



opposite operations

BEDMAS

$y = -0.45^{x}$

Word questions where rate is not a percent %

→ where sthg is growing exponentially.

$A(t) = a\,c^{kt}$

t - x - time ✱ be sure to indicate unit of time

A(t) - y - amount/population after certain amount of t-time

a - initial amount = 3

c - rate of change = 4

k - b - the rate constant → how many times per unit of time the function grows (exponentially)

$k = \frac{\text{unit of time}}{\text{given time}}$ } same units

ex. 3 bacteria quadruples every 20 mins. time in hours!

how many times per hours does it grow?

$k = \frac{1\text{ hr}}{20\text{ mins}}$

$k = \frac{60\text{ min}}{20\text{ min}}$

$k = 3$

Typical Exam Question

If we start off w 10 bacterium. tripling every 15 mins, find the equation that represents the amount of bacteria as a function of time in hours.

$A(t) = a \cdot c^{x \cdot t}$

$A(t) = 10 \cdot 3^{4 \cdot t}$

- time in hours

$x = \frac{\text{unit of time}}{\text{given time}}$

$= \frac{1 \text{ hour}}{15 \text{ min}}$

$= \frac{60}{15}$

Word Question where rate is a percent %
(expressed as a decimal)

→ Financial question

$A(t) = A_0\left(1 \pm \frac{r}{k}\right)^{k \cdot t}$

t - x - time - note - its unit depends on type of interest rate.

ex. 19% annually so t = time in years.

$A(t)$ - y - amount after t - time

A_0 - initial amount

r - interest rate (expressed as decimal ex 19% → 0.19)

k - rate constant - compounding constant → how many times per unit of time interest gets added to your principal

ex 19% annually compounding daily

k_1 = unit of time / given time

$k = 365$

$k = \frac{1 \text{ year}}{1 \text{ day}}$

$k = \frac{365}{1}$

Car trip $2000

$A(t) = 2000\left(1 + \frac{0.19}{365}\right)^{365 \cdot t}$

Lowhat you owe.

Sarah maxes out her line-of-credit that has a limit of $5000. If she has an annual interest rate of 7% compounded monthly, find the equation that represents the amount owed as a function of time.

Q1. How much will Sarah owe in 1 month?

$$A(t) = 5000\left(1 + \left(\frac{0.07}{12}\right)\right)^{(12 \cdot t)}$$

↳ since t is in years, must convert 1 month to years.

$$\frac{1 \text{ month}}{12 \text{ months}} = \frac{? \text{ years}}{1 \text{ years}}$$

put conversion ratio 1 year = 12 months

$$x = \frac{1}{12}$$

$A\left(\frac{1}{12}\right) = \$5029.17$

Hmwk
p 2.13 - 2.14
p 2.16 #2
p 2.18

→ and for handout, just find the equation.