7.1

Characteristics of Exponential Functions

Focus on...

- analysing graphs of exponential functions
- solving problems that involve exponential growth or decay

7.2

Transformations of Exponential Functions

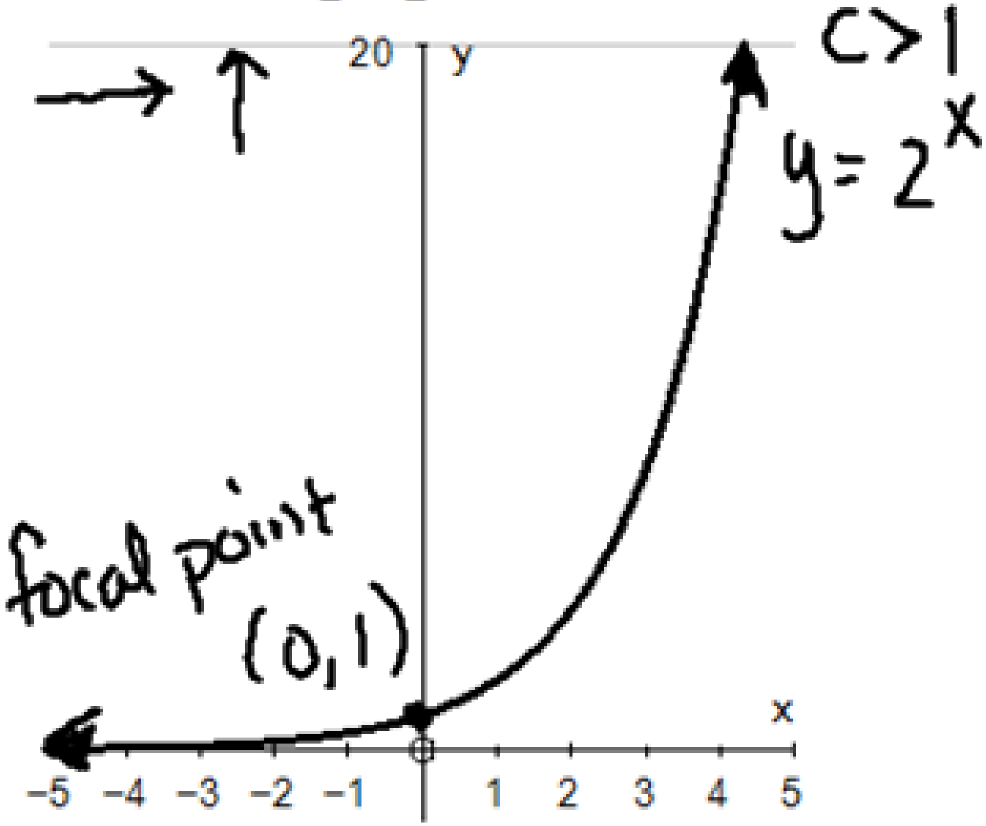
Focus on...

- applying translations, stretches, and reflections to the graphs of exponential functions
- representing these transformations in the equations of exponential functions
- solving problems that involve exponential growth or decay

Chapter 7.1 & 7.2 – Exponential Functions $2^0 = 1, \pi^0 = 1, c^0 = 1$

- The simplest exponential function is $y = c^x$ where $c > 0, c \in R$
- Two types of graphs produced:

Increasing (growth) curve



Domain: $\{x \mid x \in R\}$

Range: $\{y \mid y > 0\}$

HA: $y=0$

x-int: NONE

y-int: $(0,1)$

$y = 2^x$

$y = 2^{-5} = \frac{1}{2^5} = \frac{1}{32}$

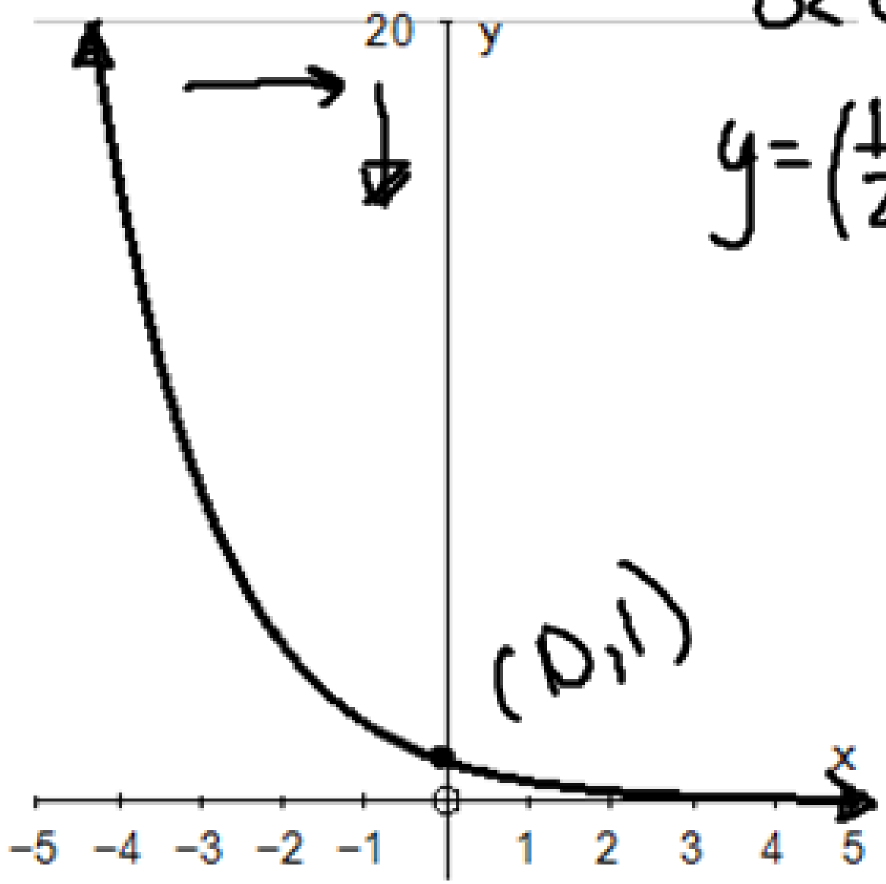
$y = 2^{-10} = \frac{1}{2^{10}} = \frac{1}{1024}$

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

$y = \left(\frac{1}{2}\right)^{10} = \frac{1^{10}}{2^{10}}$

$= \frac{1}{1024}$

decreasing (decay) curve



$0 < c < 1$

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

Domain: $\{x \mid x \in \mathbb{R}\}$

Range: $\{y \mid y > 0\}$

HA: $y = 0$

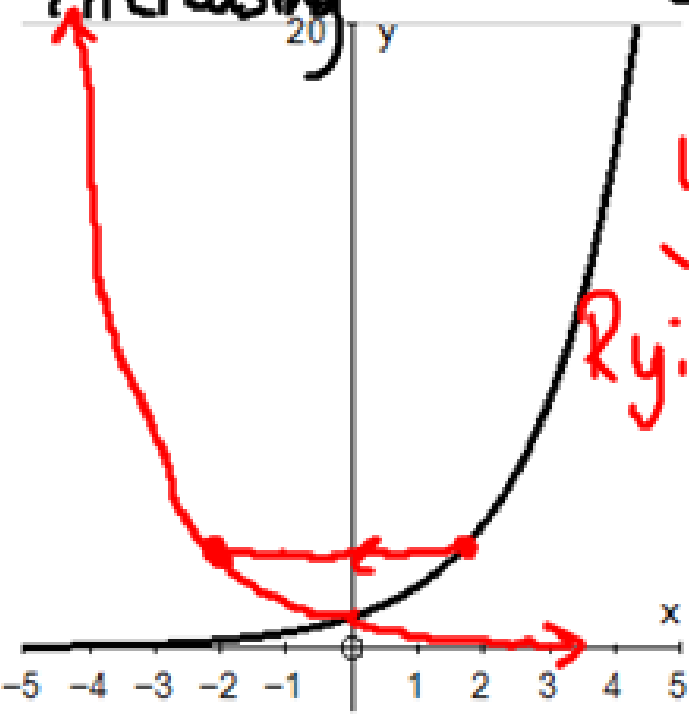
x-int: NONE

y-int: $(0,1)$

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

Reflections in the y- axis

increasing $c > 1$



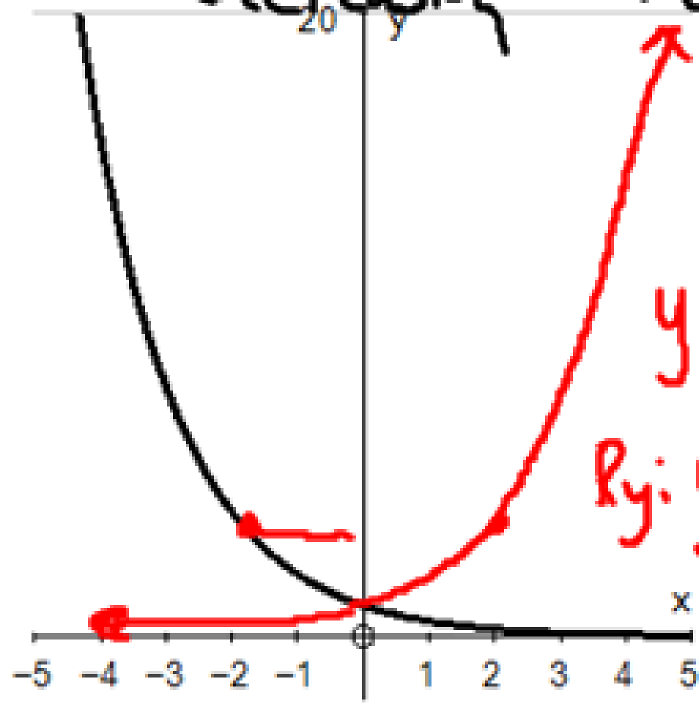
$y = c^x$

R_y: $y = c^{-x}$

the increasing curve becomes a decreasing curve.

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

decreasing $0 < c < 1$



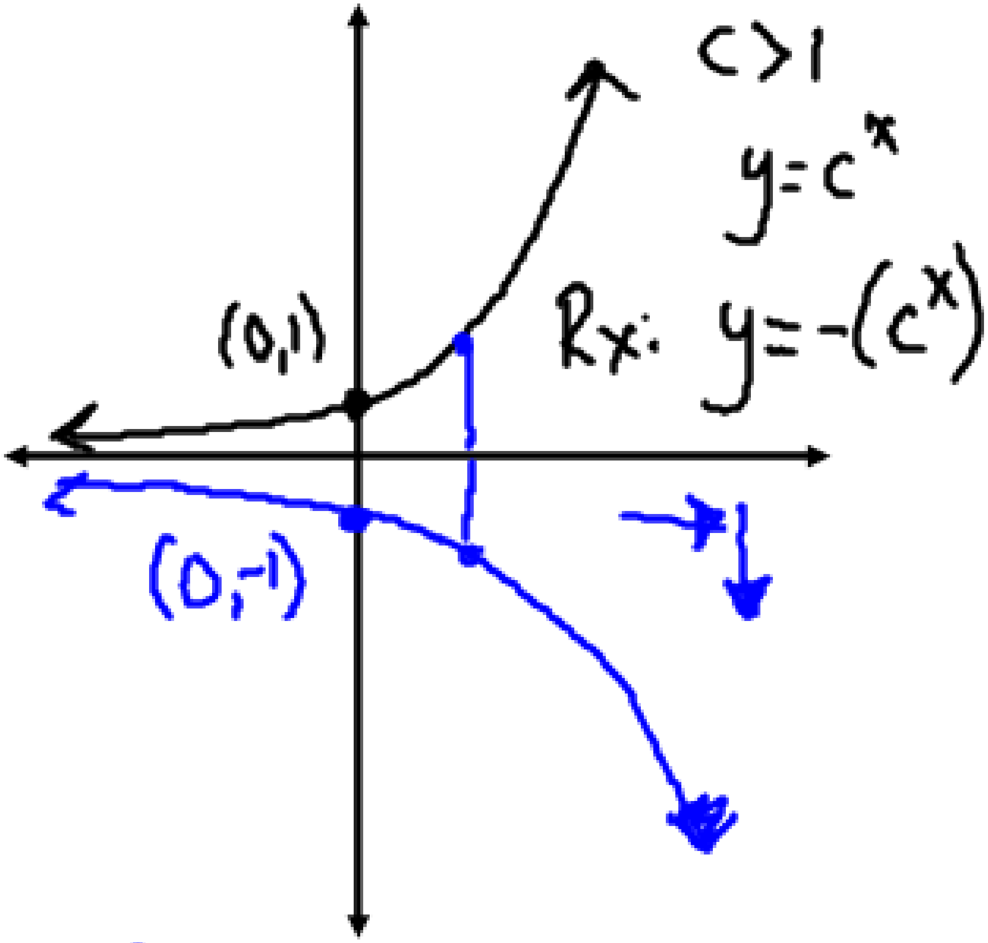
$y = \left(\frac{1}{2}\right)$

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

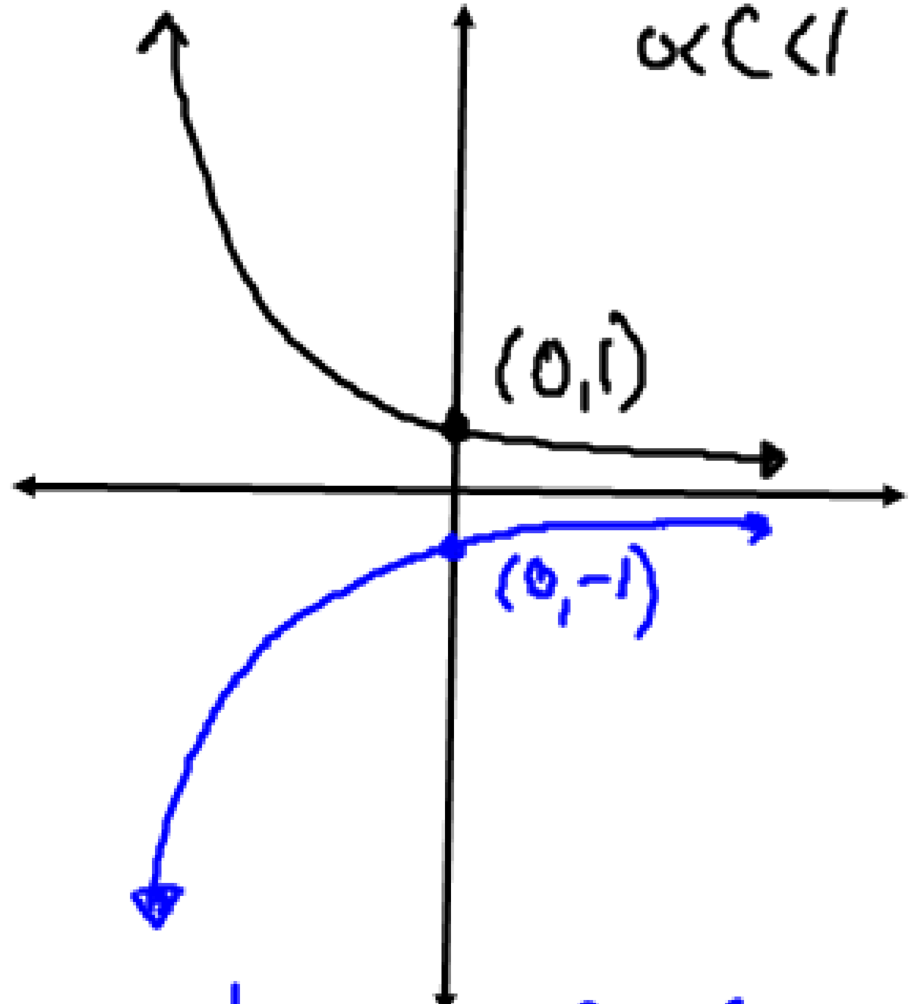
the decreasing curve becomes an increasing curve

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

Reflections in the x- axis



an increasing curve becomes decreasing



a decreasing curve becomes increasing

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

R_x

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

Mapping Rule:

the transformed exponential $y = a(c)^{b(x-h)} + k$ would be

$$(x, y) \rightarrow \left((-)\frac{1}{b}x + h, (-)ay + k \right)$$

common ratio

needs to be in factored form

$-(x+3)$

Examples: graph the following $y = 2(3)^{-x-3} + 1$

List transformations:

VS 2 HS 1

VT 1 HT -3

R_x No R_y Yes

Mapping Rule:

$(x,y) \rightarrow (-x-3, 2y+1)$

function without any transformations

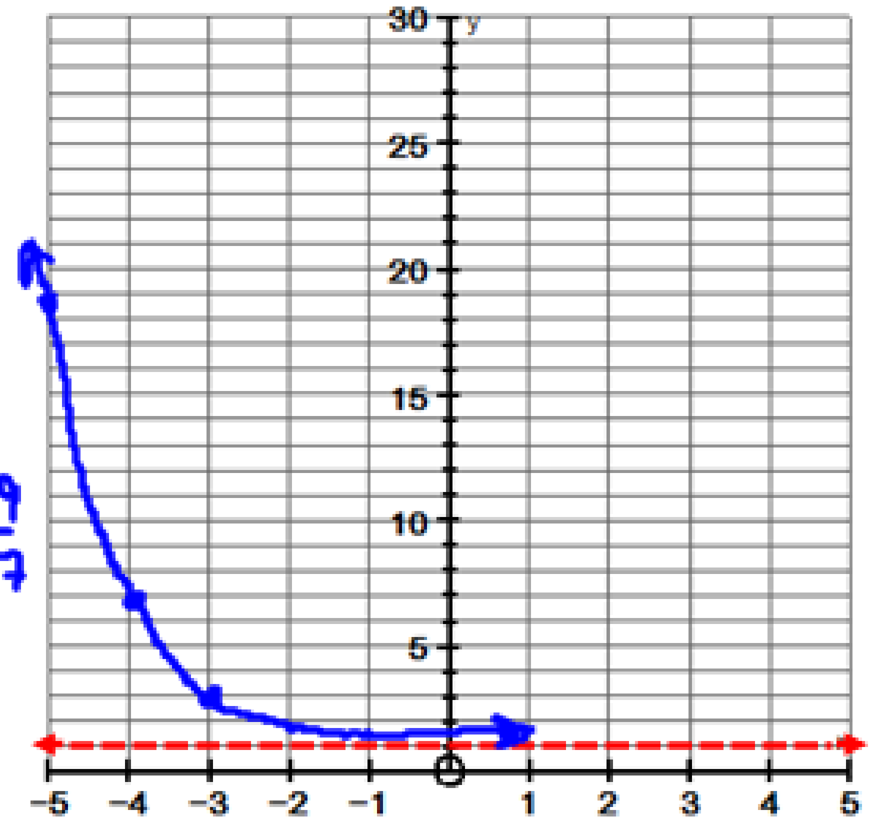
$y = 3^x$

Table of values…

$y = 3^x$

x	y
-3	$3^{-3} = \frac{1}{3^3} = \frac{1}{27}$
-2	$3^{-2} = \frac{1}{3^2} = \frac{1}{9}$
-1	$3^{-1} = \frac{1}{3}$
0	$3^0 = 1$
1	$3^1 = 3$
2	$3^2 = 9$
3	$3^3 = 27$

$-x-3$	$2y+1$
0	$\frac{2}{27} + \frac{27}{27} = \frac{29}{27}$
-1	$\frac{2}{9} + \frac{9}{9} = \frac{11}{9}$
-2	$\frac{2}{3} + \frac{3}{3} = \frac{5}{3}$
-3	3
-4	7
-5	19
-6	55



HA: $y = 1$

y-int: $\left(0, \frac{29}{27}\right)$

x-int: NONE

range: $\{y \mid y > 1\}$

Apply

pg 355 ch7.2

7. Describe the transformations that must be applied to the graph of each exponential function $f(x)$ to obtain the transformed function. Write each transformed function in the form $y = a(c)^{b(x-h)} + k$.

a) $f(x) = \left(\frac{1}{2}\right)^x$, $y = f(x - 2) + 1$

VT 1 HT +2

$c = \frac{1}{2}$

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

d) $f(x) = 4^x$, $y = 2f\left(-\frac{1}{3}(x-1)\right) - 5$

VS 2 HS 3
VT -5 HT 1
R_x NO R_y Yes

$$y = 2(4)^{-\frac{1}{3}(x-1)} - 5$$

c = 4

HW:
pg 343 # 1-5
pg 354 # 1-5