

3.5 - Transformations for Exponential Functions

Today we will INVESTIGATE:

$$y = a(b)^{k(x-d)} + c$$

Base Functions vary for exponential. Ex. $y = 2^x$, $y = 3^x$ etc.

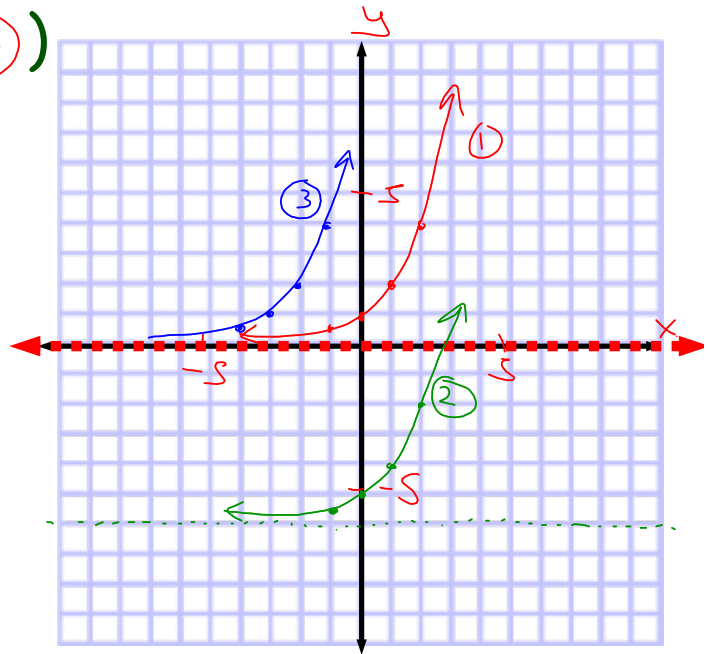
Ex.1 An asymptote: a line in which a curve approaches but never touches it!

a) Graph $y = 2^x$ (Base Function)

x	y
-1	$\frac{1}{2}$
0	1
1	2
2	4

KEY POINTS and Asymptote

$$y = 0$$



b) On the same grid graph the following and indicate the transformations.

i) $y = 2^x - 6$

DOWN 6

ii) $y = 2^{x+3}$

LEFT 3

c)

	$y = 2^x$ (Base)	$y = 2^x - 6$	$y = 2^{x+3}$
Asymptote	$y = 0$	$y = -6$	$y = 0$
Domain	$\{x \in \mathbb{R}\}$	$\{x \in \mathbb{R}\}$	$\{x \in \mathbb{R}\}$
Range	$\{y \in \mathbb{R} \mid y > 0\}$	$\{y \in \mathbb{R} \mid y > -6\}$	$\{y \in \mathbb{R} \mid y > 0\}$

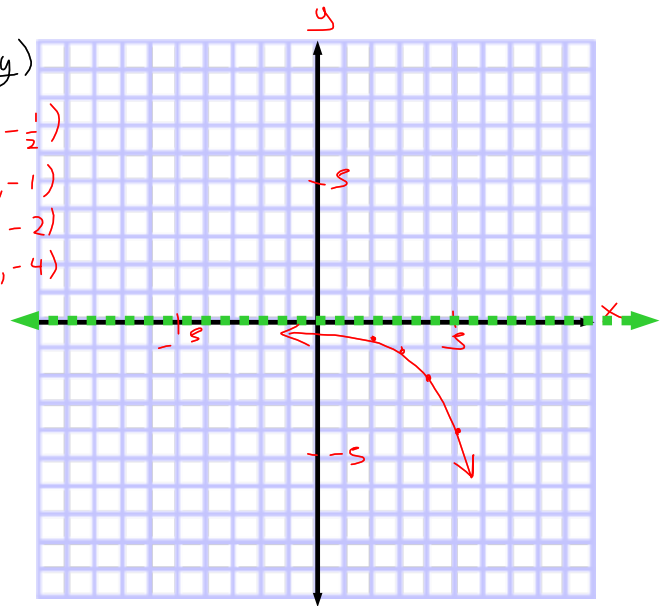
Ex.2 $y = -2^{x-3}$ $(x,y) \rightarrow (x+3, -y)$

a) List the transformations

- Vertical Reflection
- Right 3

$(-1, \frac{1}{2}) \rightarrow (2, -\frac{1}{2})$
 $(0, 1) \rightarrow (3, -1)$
 $(1, 2) \rightarrow (4, -2)$
 $(2, 4) \rightarrow (5, -4)$

b) Graph



Ex.3

a) Graph $y=3^x$ (Base Function)

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

KEY POINTS and Asymptote

$y=0$

b) On the same grid graph the following and indicate the transformations.

② i) $y=3^{2x}$

-Horz. Comp. by 2

ii) $y=-2(3^x)$

- V. Refl.
- V.S. by 2

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

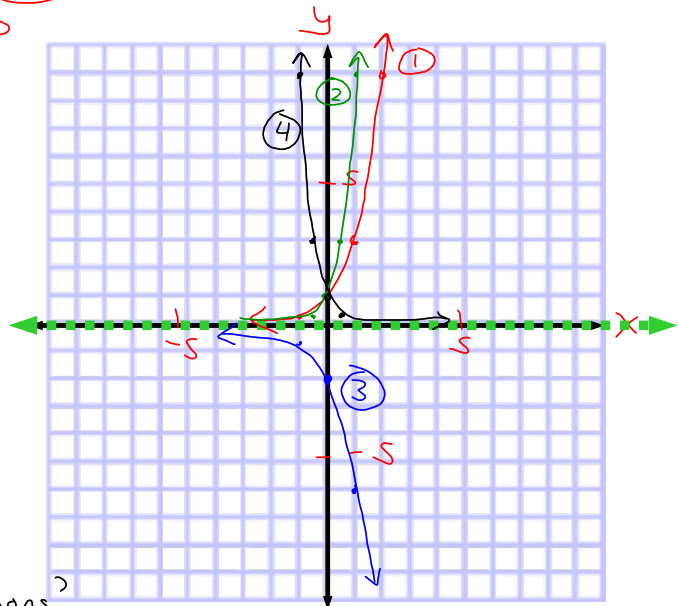
OR

$y = (3^{-1})^{2x}$
 $= 3^{-2x}$

Note: Can be rewritten

Transformations?
 - H.C. by 2

- H.C. by 2
- H. Refl



Ex. 4 Graph $y = 2^{-3x-6} + 3$

$$y = 2^{-3(x+2)} + 3$$

ALWAYS
FACTOR!

- H.C. by 3
- H. Refl.
- Left 2
- UP 3

$$(x, y) \rightarrow \left(-\frac{x}{3} - 2, y + 3\right)$$

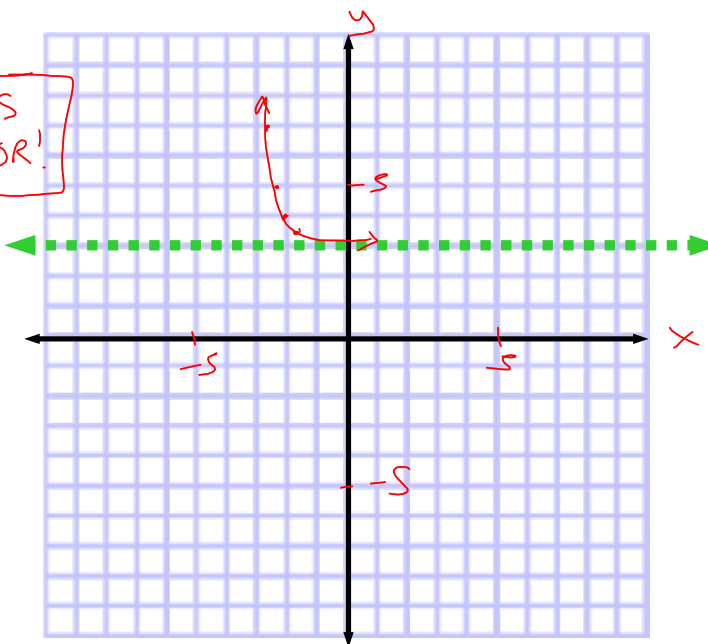
Base $y = 2^x$

$$\left(-1, \frac{1}{2}\right) \rightarrow (-1.6, 3.5)$$

$$(0, 1) \rightarrow (-2, 4)$$

$$(1, 2) \rightarrow (-2.3, 5)$$

$$(2, 4) \rightarrow (-2.6, 7)$$



Ex. 5

a) Name another function that is equivalent to $f(x) = 3^{2+x}$

$$f(x) = 3^2 \cdot 3^x \\ = 9 \cdot 3^x$$

OR

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

b) What are the transformations that occur in each to give the same final function?

Instead
of shift
left 2

↓
V.S. by 9

Decay instead of growth

- Horiz. Refl

- Shift left 2

Ex. 6

a) Write several transformed equations with a base of 2 that passes through the point (0,2).

① $y = 2 \cdot 2^x$

③ $y = 2^{x+1}$

② $y = 2^x + 1$

b) Prove algebraically, if any of the above equations give the same graph.

① & ③

$$y = 2 \cdot 2^x \\ = 2^{x+1} \quad \underline{\text{SAME}}$$

Pg. 251 # 1, 2, 5, 9, 13

Homework: ~~Pg 195 C1, C2, 1, 4, 6-8, 10, 12, 13~~