* Exponential Function

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

* base: $y = b^x$

* $y = af(k(x-d)) + c$ (same as other functions)

① Draw the base $y = b^x$

② Follow the order from a effect, k effect, d effec and c effect.

* a effects (= multiply by "a" only to y coordinates)

① If $a < 0$, reflect in the x axis.

② If $0 < a < 1$, compress vertically by a

③ If $a > 1$, stretch vertically by a

* k effects (= multiply by "$\frac{1}{k}$" only to x coordinates)

① If $k < 0$, reflect in the y axis

② If $0 < k < 1$, stretch horizontally by $\frac{1}{k}$

③ If $k > 1$, compress horizontally by $\frac{1}{k}$

* d effects and c effects (add or subtract x (d effects))
(" " " y (c effects))

① If $d > 0$, shift (or translate) right by d

② If $d < 0$, " left "

③ If $c > 0$, " up by c

④ If $c < 0$ " down by c

* Note $y = 2^{4x}$ is same as $y = 16^x$

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MCR3U
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Transformations of Exponential Functions

In Unit 2: $y = af(k(x-d)) + c$

The general equation for an exponential function is:

$$y = ab^{[k(x-d)]} + c$$

List the transformations that must be applied to $y = 2^x$ to graph $y = -2^{2(x-3)} + 5$

1. Reflect it in x axis.
2. Horizontal compression by $\frac{1}{2}$
3. Shift right 3 units and up 5 units.

adding $\ominus$ to y coordinates

multiplied by $\frac{1}{2}$ only to x values

$y = 2^x$

x	y
-1	$\frac{1}{2}$
0	1
1	2
2	4
3	8

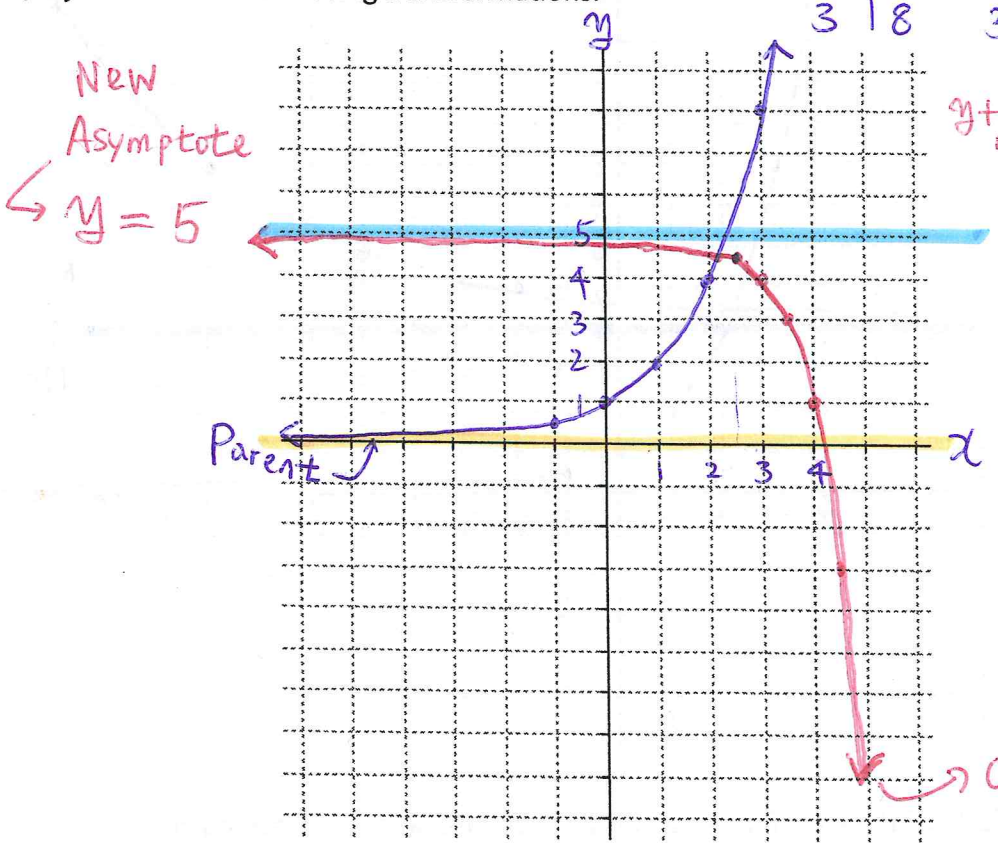
S1

x	y
-1	$-\frac{1}{2}$
0	-1
1	-2
2	-4
3	-8

S2

x	y
$-\frac{1}{2}$	$-\frac{1}{2}$
0	-1
$\frac{1}{2}$	-2
1	-4
$\frac{3}{2}$	-8

Graph $y = -2^{2(x-3)} + 5$ using transformations.



$y+5$ → S3 → $x+3$ and

x	y
2.5	4.5
3	4
3.5	3
4	1
4.5	-3

Describe the effects of the transformation on the domain, range, and asymptote.

$D = \{x \in \mathbb{R}\}$

New asymptote: $y = 5$

$R = \{y \in \mathbb{R}, y < 5\}$

List the transformations that must be applied to $y = \left(\frac{1}{2}\right)^x$ to graph $y = \left(\frac{1}{2}\right)^{-\frac{1}{3}x+\frac{2}{3}} + 4$.

① Reflect it on y axis.

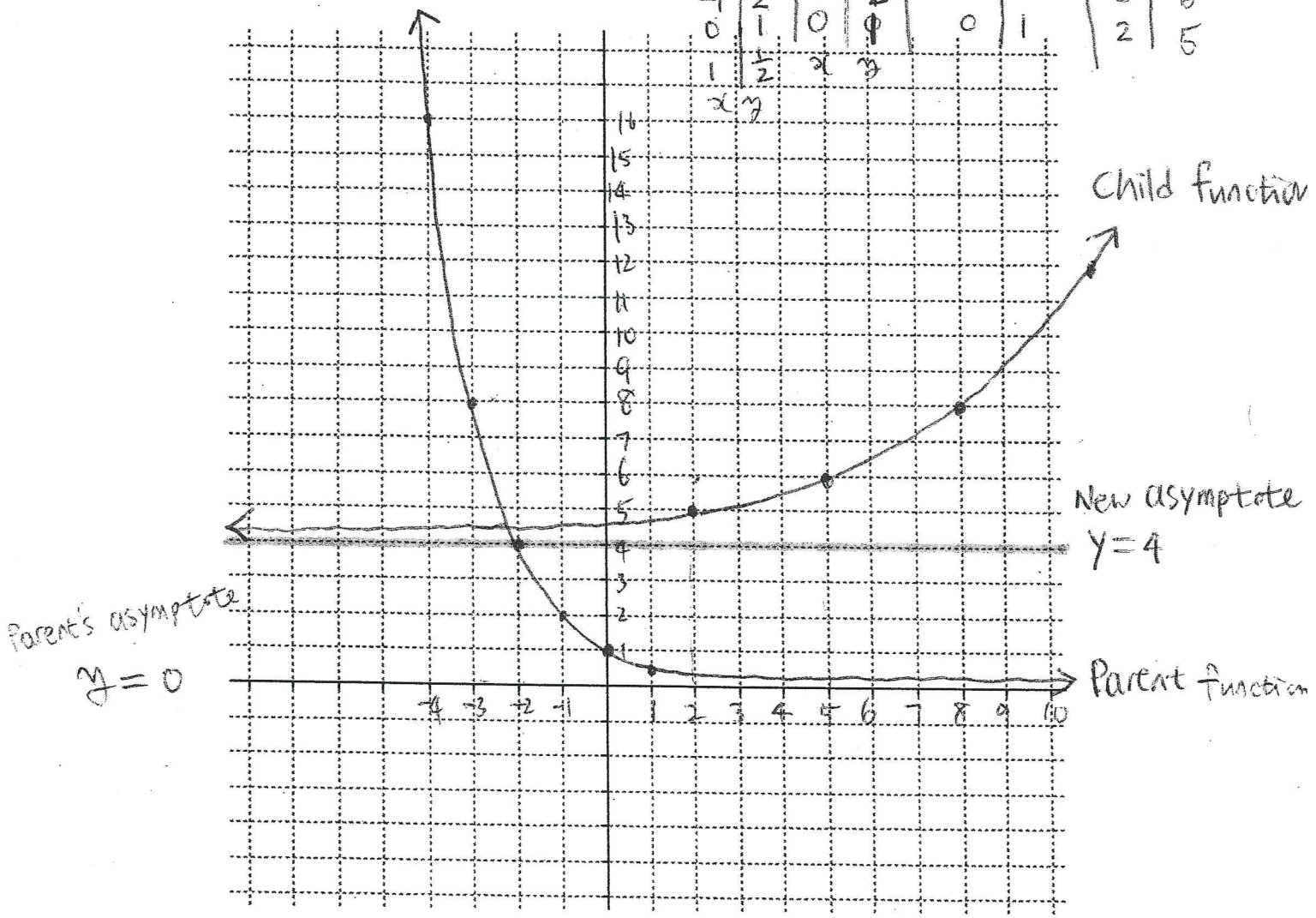
② Horizontal stretch by 3.

③ Shift 2 units to the right and 4 units up.

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

Graph $y = \left(\frac{1}{2}\right)^{-\frac{1}{3}x+\frac{2}{3}} + 4$ using transformations.

		S1		S2		S3	
				x	y		
−4	16	4	16	12	16	14	20
−3	8	3	8	9	8	11	12
−2	4	2	4	6	4	8	8
−1	2	1	2	3	2	5	6
0	1	0	1	0	1	2	5
1	$\frac{1}{2}$	x	y				
x	y						



Describe the effects of the transformation on the domain, range, and asymptote.

$D = \{x \in \mathbb{R}\}$

New asymptote: $y = 4$

$R = \{y \in \mathbb{R},\ y > 4\}$

Homework: Pg. 196 #1-5, 7, 8-12 ~~TIPS #24, 25~~

* Don't worry about word problems.

April 17 HW

#9. c) $9^{\frac{y}{5}} = 27$

$(3^2)^{\frac{y}{5}} = 3^3$

$3^{2 \times \frac{y}{5}} = 3^3$

$5 \times \frac{2y}{5} = 3 \times 5$

$2y = 15$

$y = \frac{15}{2}$

e) $4^{\frac{x}{4}} = \frac{1}{8}$

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

$2^{\frac{2x}{4}} = 2^{-3}$

$2 \times \frac{2x}{4} = -3 \times 2$

$x = -6$

#9 f) $\left(\frac{3}{2}\right)^{\frac{m}{2}} = \frac{4}{9}$

$\frac{3^{\frac{m}{2}}}{2^{\frac{m}{2}}} = \frac{2^2}{3^2}$

$\frac{3^{\frac{m}{2}}}{2^{\frac{m}{2}}} = \frac{3^{-2}}{2^{-2}}$

$2 \times \frac{m}{2} = -2 \times 2$

$m = -4$

#2 g) $4^{x-1} = 1$

$4^{x-1} = 4^0$

$x - 1 = 0$

$x = 1$

#2 i) $(-1)^{2x} = 1$

$(-1)^{2x} = (-1)^0$

$\frac{2x}{2} = \frac{0}{2}$

$x = 0$