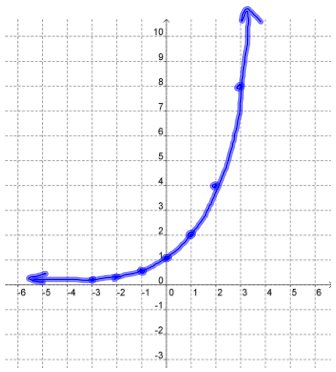
$y = 2^x$

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



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

R: $\{y \mid y \in \mathbb{R}, y > 0\}$

x-int: does not exist

y-int: $y = 1$

VA: none

HA: $y = 0$

Behaviour: as $x \uparrow$, $y \uparrow$

increasing

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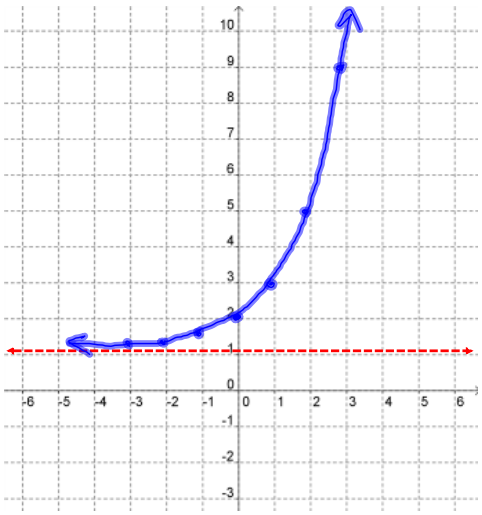
$y = 2^x + 1$

vertical shift up by 1

x	y
-2	1.25
-1	1.5
0	2
1	3
2	5
3	9



HA: $y = 1$

Key features:

HA: $y = 1$

y-int: $y = 2$

R: $\{y \mid y \in \mathbb{R}, y > 1\}$

$y = f(x) + 1$

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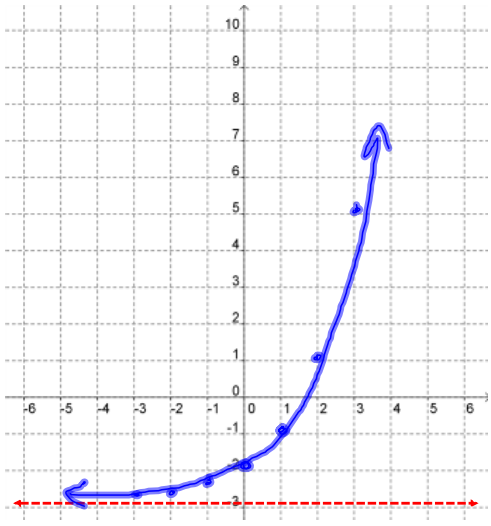
$y = 2^x - 3$

x	y
-2	-2.75
-1	-2.5
0	-2
1	-1
2	1
3	5



Vertical shift down by 3.

Key features: HA: $y=-3$

y-int: -2

$y = f(x) - 3$ $R: \{y \mid y \in \mathbb{R}, y > -3\}$

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$y = 2^x + q$

vertical shift by q: up for $q > 0$
down for $q < 0$

HA: $y = 0 + q$

$y = q$

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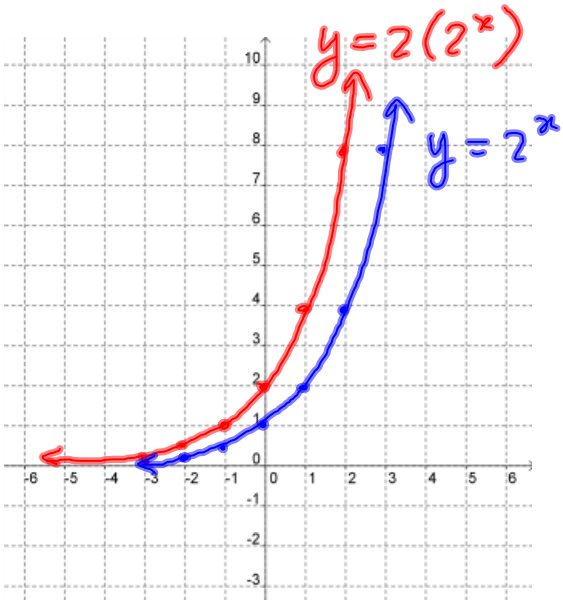
$y = 2(2^x)$

x	y
-2	0.25 → 0.5
-1	0.5 → 1
0	1 → 2
1	2 → 4
2	4 → 8
3	8 → 16



Vertical stretch by 2

$y = 2f(x)$

Key features:
y-int : 2 (doubled)

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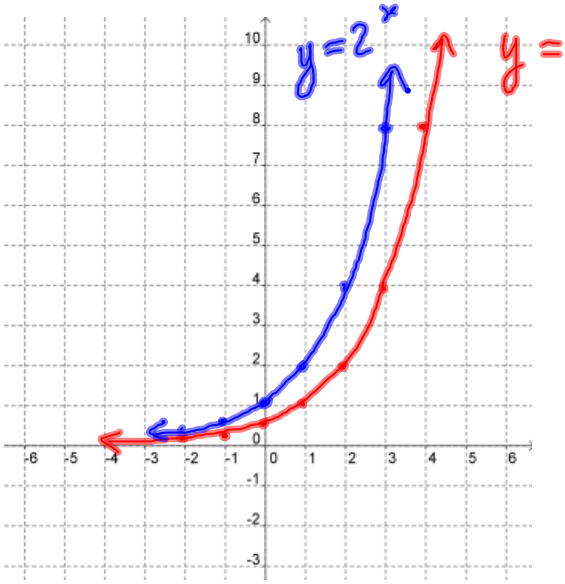
$y = \frac{1}{2}(2^x)$

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



4 8

V. scaling by $\frac{1}{2}$

V. Compression by 2

Key features:
y-int: $\frac{1}{2}$ (compressed by 2)

$y = \frac{1}{2}f(x)$

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$y = a(2^x), a > 1$

v. scaling or v. stretch by a

y-int : moved from $y = 1$ to $y = a(1)$

$y = a$

$y = a(2^x), 0 < a < 1$

v. scaling of a

v. compression of $\frac{1}{a}$

y-int : $y = a$

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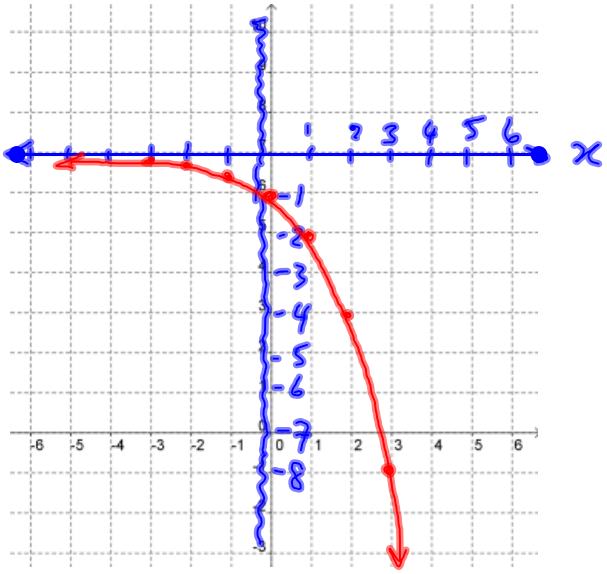
$y = -(2^x)$

v. reflect

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



Key features: y-int : $y = -1$

Range: $\{y \mid y \in \mathbb{R}, y < 0\}$

$y = -f(x)$

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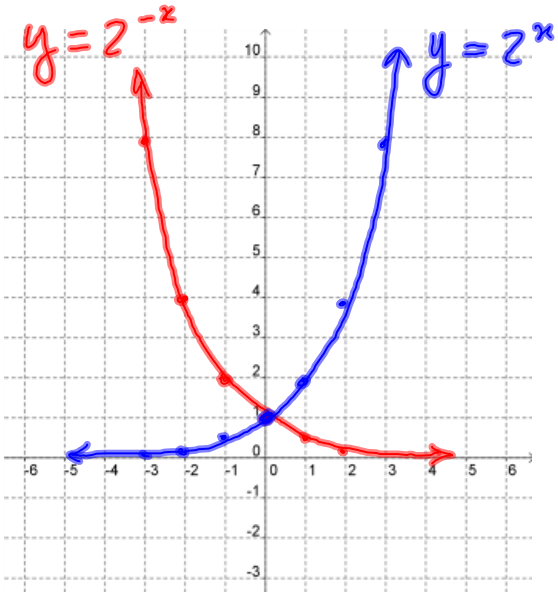
$y = 2^{-x}$

h. reflection

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



Key features: no changes.

$y = f(-x)$

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$y = a(2^x)$ v. reflection

y-int: $y = 1 \rightarrow y = -1$

$y = 2^{kx}$ h. reflection

no changes to key features.

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

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Part C:

$y = 2(2^x) + 1$

$y = 2^{x+1} + 1$

v. stretch by 2

v. shift up by 1.

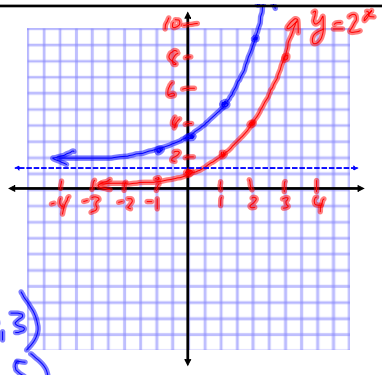
$(0,1) \to (0,2) \to (0,3)$

$(1,2) \to (1,4) \to (1,5)$

$(2,4) \to (2,8) \to (2,9)$

$(-1,0.5) \to (-1,1) \to (-1,2)$

* v. scaling is equivalent to h. shift



$y = 3(2^x)$

$y = 2^{1.585}(2^x)$

$y = 2^{x+1.585}$

$3^a = 2$

$a = 1.585$

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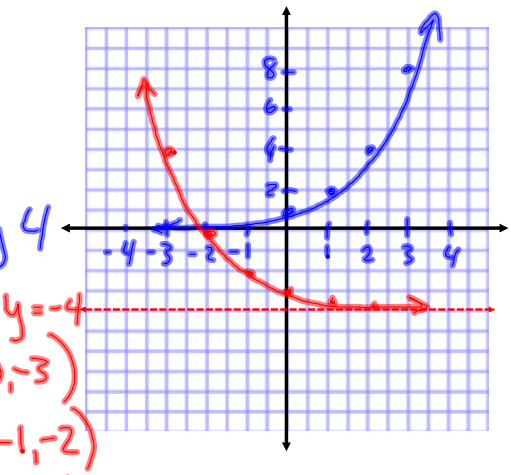
$y = 2^{-x} - 4$

h. reflect

v. shift down by 4



$(0,1) \to (0,1) \to (0,-3)$

$(1,2) \to (-1,2) \to (-1,-2)$

$(2,4) \to (-2,4) \to (-2,0)$

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

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

$y = 2^{-x} - 4$

$y = \frac{1}{2^x} - 4$

$y = \left(\frac{1}{2}\right)^x - 4$, only v. transformations after changing base

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