

4.3A – Investigating $f(x) = b^x$

The following table investigates various exponential functions.

Same as 1st column but reflect vertically (-y)

Even and odd exponents will change the sign.

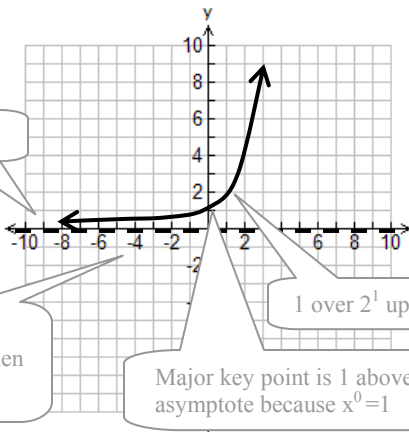
$x^0 = 1$
So this will always be 1 away from asymptote

Also try these on calculator

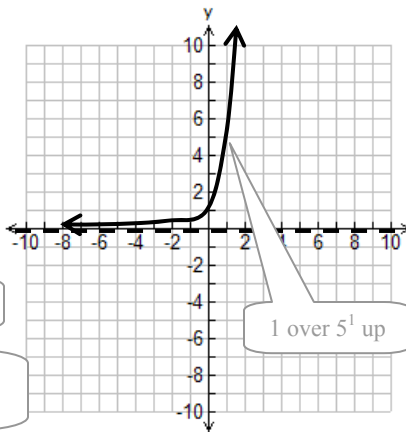
x	$f(x) = 2^x$	$f(x) = 5^x$	$f(x) = (\frac{1}{2})^x$	$f(x) = (\frac{1}{4})^x$	$f(x) = -2^x$	$f(x) = (-2)^x$
-10	1/1024	0.000000102	1024	1048576	- small #	small #
-2	$\frac{1}{4} = 0.25$	0.04	4	16	-0.25	+0.25
-1	$\frac{1}{2} = 0.5$	0.2	2	4	-0.5	-0.5
0	1	1	1	1	-1	+1
1	2	5	0.5	$\frac{1}{4} = 0.25$	-2	-2
2	4	25	0.25	0.0625	-4	+4
10	1024	9765625	0.000977	small #	-1024	1024

Graphing the functions using the table values one can compare features of the various exponential functions to come up with some generalization about its shape and key points.

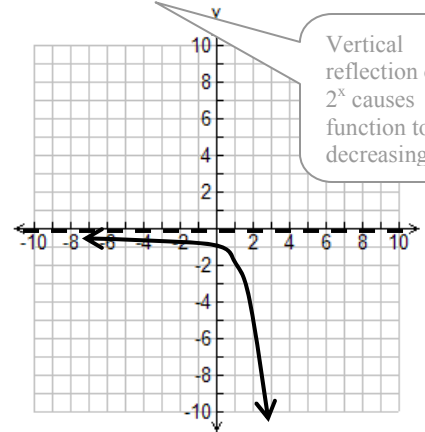
a) $f(x) = 2^x$



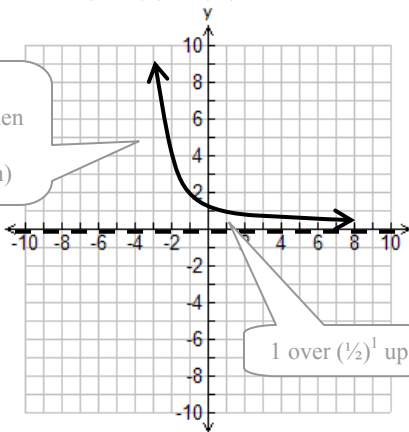
b) $f(x) = 5^x$



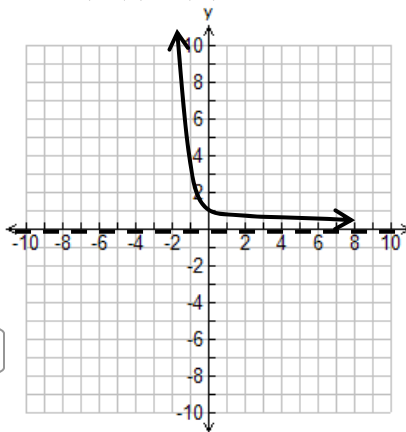
c) $f(x) = -2^x$



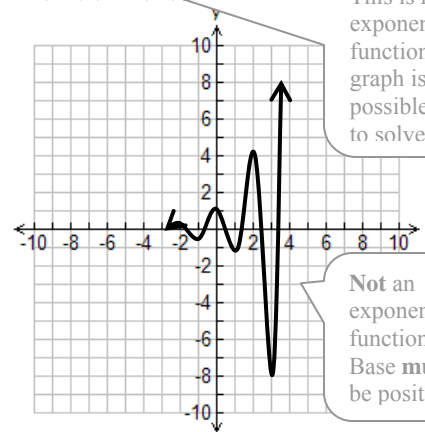
d) $f(x) = (\frac{1}{2})^x$



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



f) $f(x) = (-2)^x$



In general for function $y = b^x$

function is only defined when $b > 0$ (i.e. positive bases) and $b \neq 1$
horizontal asymptote along x-axis ($y = 0$)

intercepts: $y = 1$ (when no translations or reflection)

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

Range: $y > 0$ (increases if $b > 1$ & decreases if $0 < b < 1$)

What does this mean?

4.3A – Investigating $f(x) = b^x$ Practice Questions

1. Complete the following table

x	$f(x) = 3^x$	$f(x) = 4^x$	$f(x) = -4^x$	$f(x) = (1/3)^x$	$f(x) = -(1/3)^x$	$f(x) = (1/5)^x$	$f(x) = (1/2)^{-x}$
-5							
-3							
-2							
-1							
0							
1							
2							
3							
5							

2. Sketch the functions $y = 2^x$, $y = 5^x$ and $y = 7^x$ on the same grid

- What parts of the curve are similar? What parts of the curve are different?
- Describe the domain and range of each curve

Is using calculator, select different line styles for each function

3. Sketch the functions $y = 3^x$ and $y = (1/3)^x$ on the same grid

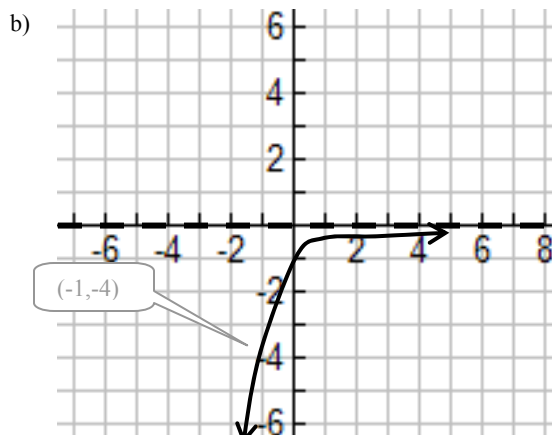
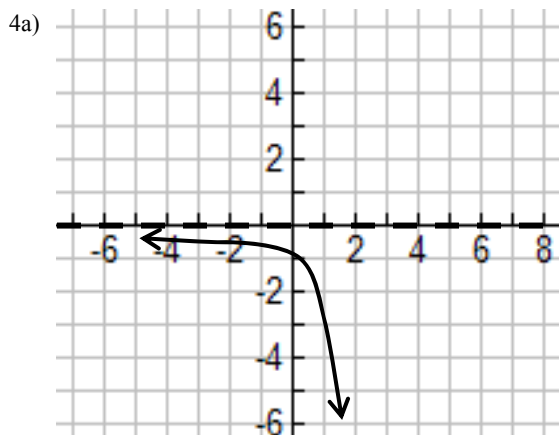
- What parts of the curve are similar? What parts of the curve are different?
- Describe the domain and range of each curve

4. Sketch the following exponential functions, clearly indicate asymptote, and the two key points on either side of y-axis.

- | | | |
|---------------------|----------------------|------------------------|
| a) $f(x) = -3^x$ | b) $g(x) = -(1/4)^x$ | c) $y = 7^x$ |
| d) $m(x) = (1/6)^x$ | e) $y = 2^{-x}$ | f) $h(x) = (1/2)^{-x}$ |
| g) $y = 4^x$ | h) $y = -1^x$ | i) $y = 2^x + 1$ |

5. How are the functions $y = 2^x$ and $y = (1/2)^{-x}$ related. Show this algebraically.

Answers 2. **a)** all have horizontal asymptote $y=0$, y-intercept of $(0,1)$, and increase over their domain. As the base gets larger the function stretches vertically **b)** all have $D:x \in \mathbb{R}$ and $R:y > 0$ **3. a)** both have horizontal asymptote $y=0$, both have y-intercept of $(0,1)$, $y=3^x$ increases while $y=(1/3)^x$ decreases. They are horizontal reflections of each other **b)** both have $D:x \in \mathbb{R}$ and $R:y > 0$ **4.** some graphs shown below, check others on graphing calculator **5.** They are the same functions, negative exponent flips the fraction to make it into $y=2^x$



4.3A - Sketching Practice Sheets

