

Announcements

- MMC tonight!
- WHZ due tomorrow
- Herndon TuTh 12:00, Addams 303 → BSB 215

Today: exponentials.

#1. It's a function Ca^x , a is a positive real number.
(the base)

e.g. $7 \cdot 2^x$,

$-\frac{13}{4} \cdot \pi^x$.

C is nonzero

x is the variable

Domain: all real #'s.

What to do if x isn't integer:

ex $2^{10/17} = (2^{10})^{1/17} = \sqrt[17]{2^{10}}$

to do 2^π , try: 2^3

$2^{3.1}$

$2^{3.14}$

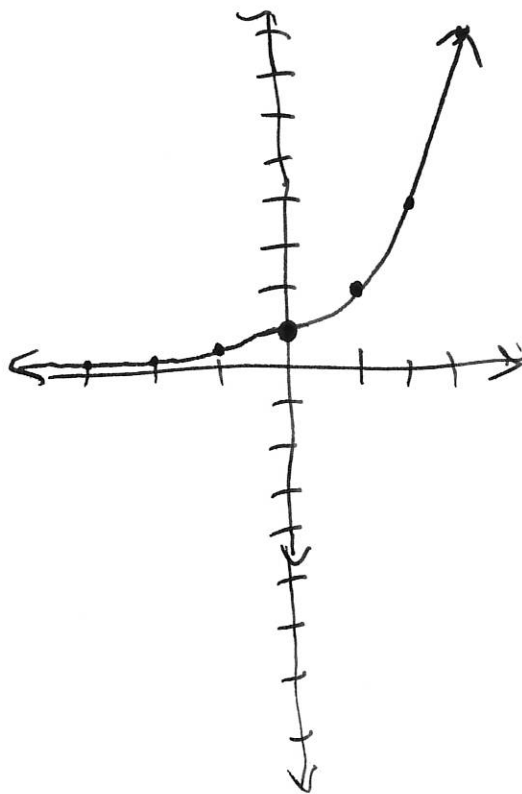
$2^{3.141}$

...

these get closer
and closer to 2^π .

2. 2^x

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

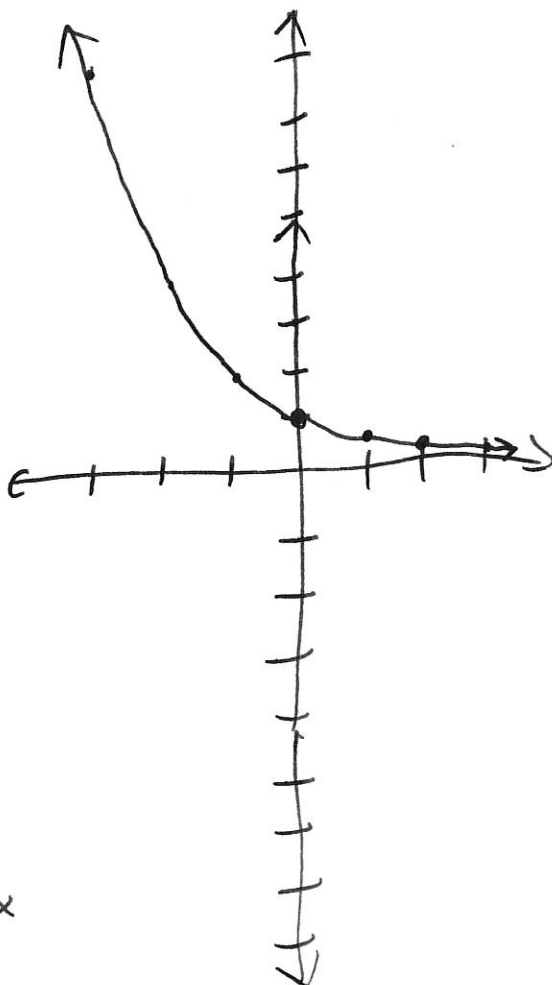


$x \rightarrow \infty$
 $2^x \rightarrow \infty$

 $x \rightarrow -\infty$
 $2^x \rightarrow 0$
 (but never crosses $y=0$!)

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

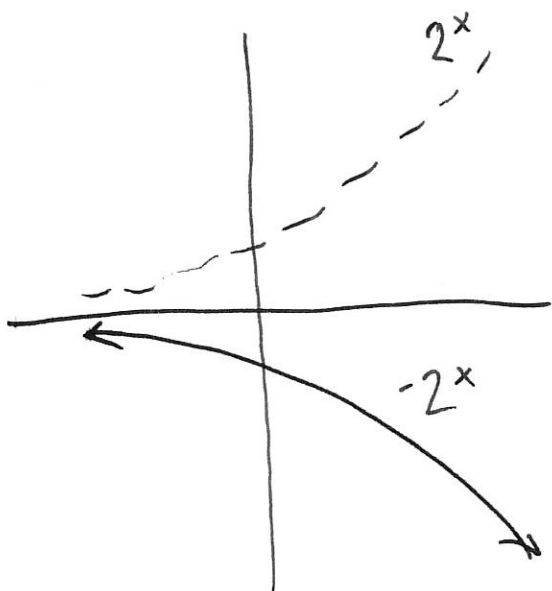
x	$\left(\frac{1}{2}\right)^x$
-3	8
-2	4
-1	2
0	1
1	$\frac{1}{2}$
2	$\frac{1}{4}$
3	$\frac{1}{8}$



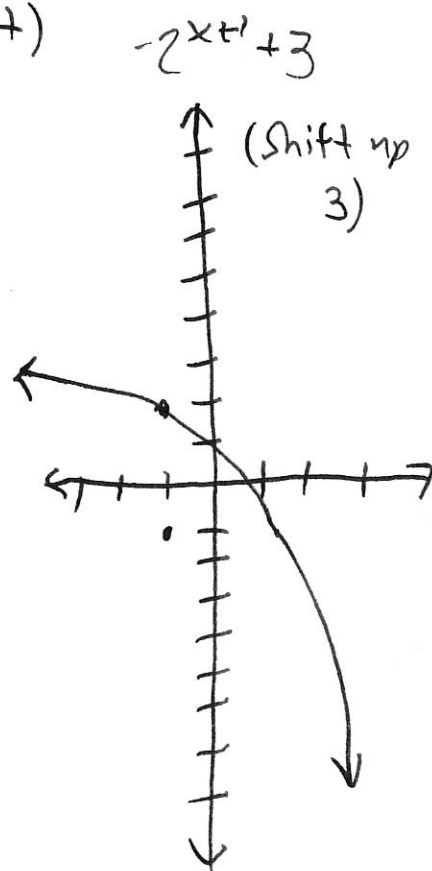
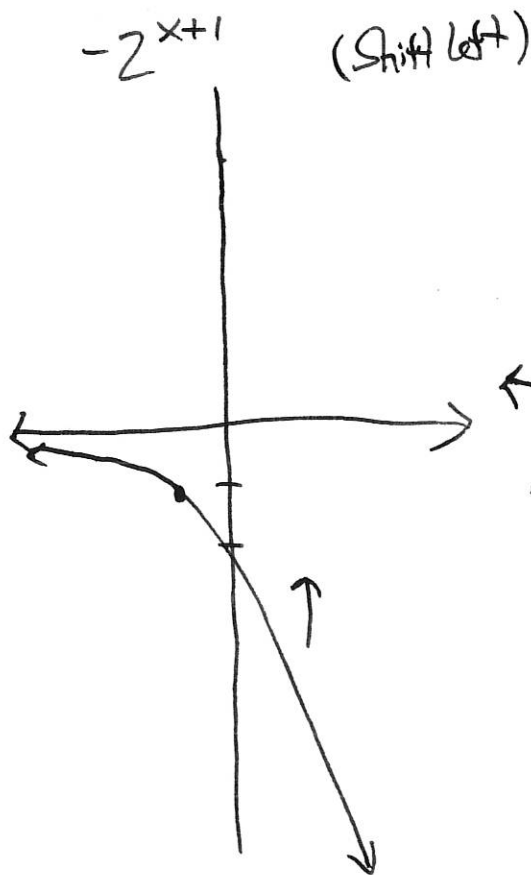
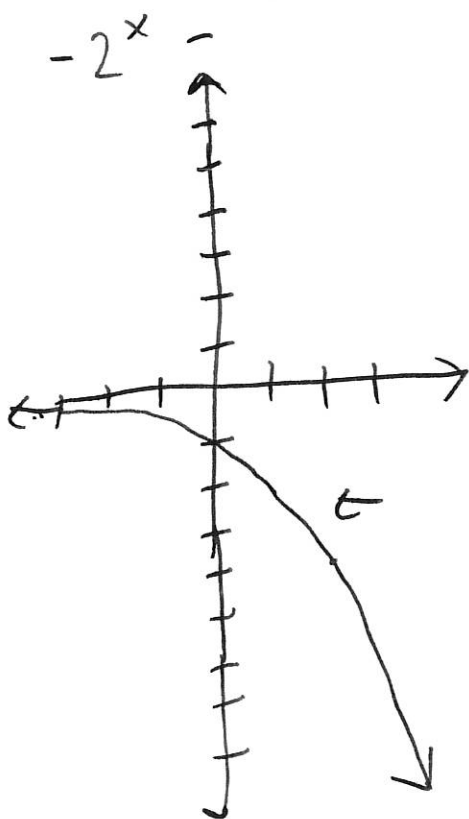
$$\left(\frac{1}{2}\right)^x = (2^{-1})^x = 2^{-x} = \frac{1}{2^x}$$

$$\left(\frac{1}{2}\right)^{-3} = 2^{-(-3)} = 2^3 = 8$$

$$-2^x = (-1) \cdot 2^x$$

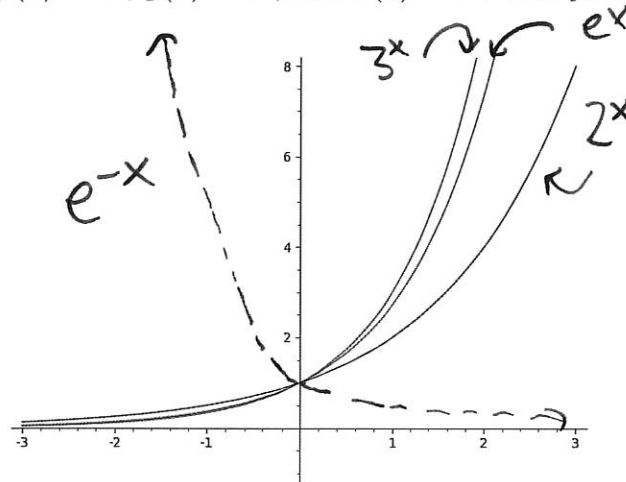


$$F(x) = 3 - 2^{x+1} = -2^{x+1} + 3$$



5. e is in many ways a number like π . It's irrational, so we express it using a symbol: however, don't forget that it isn't a variable! We can still graph exponential functions with e as the base.

Here are the graphs of $f(x) = 2^x$, $g(x) = e^x$, and $h(x) = 3^x$. Can you tell which is which?



Sketch the graph of $y = e^{-x}$ on the same axes.

6. How different are exponential and linear growth? Let's check by making a table of values for the following functions:

$$f(x) = 2x + 1, \quad g(x) = 3^x$$

7. Now let's consider some exponential equations, and how to solve them.

$$2^{2x} = 16, \quad 3^{x+4} = \frac{1}{27}, \quad 8^{-x+14} = 16^x, \quad e^{x^2} = e^{3x} \cdot e^{-2}.$$

x	2 ^{x+1}
-3	-5
-2	-3
-1	-1
0	1
1	3
2	5
3	7
4	9
5	11

x	3 ^x
-3	1/27
-2	1/9
-1	1/3
0	1
1	3
2	9
3	27
4	81
5	243

???

x	x!

(grows much faster)

even faster!

$$2^{2x} = 16$$

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

$$2x = 4$$

$$\boxed{x=2}$$

$$3^{x+4} = \frac{1}{27}$$

$$3^{x+4} = 3^{-3}$$

$$x+4 = -3$$

$$\boxed{x=-7}$$

$$8^{-x+14} = 16^x$$

$$(2^3)^{-x+14} = (2^4)^x$$

$$2^{3(-x+14)} = 2^{4x}$$

$$3(-x+14) = 4x$$

$$-3x + 42 = 4x$$

$$42 = 7x$$

$$\boxed{x=6}$$

$$e^{x^2} = e^{3x} \cdot e^{-2}$$

$$e^{x^2} = e^{3x-2}$$

$$x^2 = 3x - 2$$

$$x^2 - 3x + 2 = 0$$

$$(x-1)(x-2) = 0$$

$$\boxed{\begin{matrix} x_1=1 \\ x=2 \end{matrix}}$$