Warmup:

$$y = -3(2)^{x-1} + 4$$

horiz. shift (opp.)

asy. vert. shift

Graph the following ~~exponential~~ function:

$y = -3(2)^x$

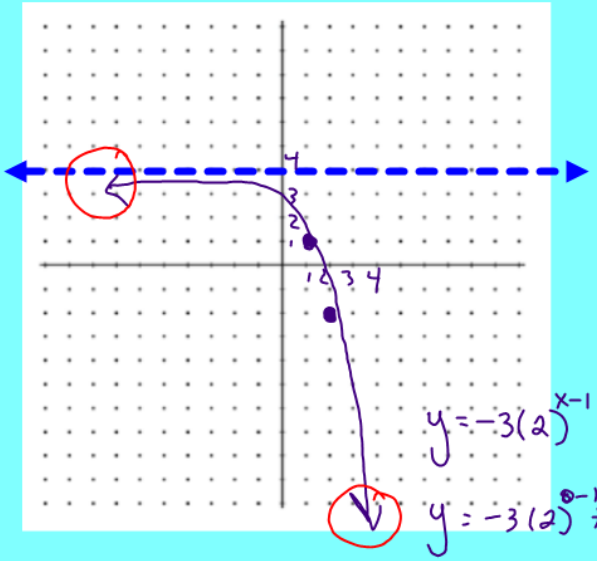
(0, -3) (0, a)

(1, -6) (1, ab)

y = 0

Right 1 (1 , 1)

Up 4 (2 , -2) y = 4



$y = -3(2)^{x-1} + 4$

$y = -3(2)^{0-1} + 4$

Domain

$(-\infty, \infty)$

Range

$(-\infty, 4)$

X-Int

(0, 2.5)

Inc/Dec $(-\infty, \infty)$

End Behavior

as $x \to \infty$ $y \to -\infty$

as $x \to -\infty$ $y \to 4$

$y = 3(2)^x$

(0,3)

~~(0,2)~~

~~(1,2)~~

(1,6)

$y = 3^x$

(0,1)

(1,3)

What if your money doubled every 3 weeks.
Suppose that currently, you have $10 in the bank. How much money will you have in 6 months, assuming that there are four weeks each month? $2,560
How long will it take for there to be $10,240 in your account? 30 weeks.

weeks	x	# y
0 months	0	10
3 wks	1	20
6 wks	2	40
9	3	80
12	4	160
15	5	320
18	6	640
21	7	1280
24	8	2560
27	9	5120
30	10	10,240

y-int

$y = a b^x$

$y = 10(2)^x$

24 weeks in 6 months

double 8 times

$y = 10(2)^8 = 2560$

$\frac{10,240}{10} = \frac{10(2)^x}{10}$

$(1024) = 2^x$

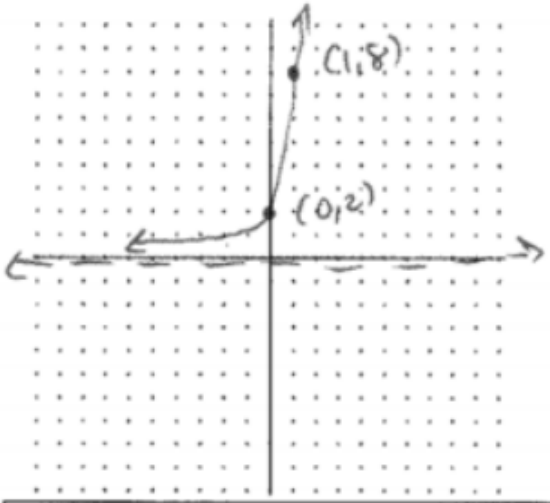
$2^{10} = 2^x$

$x = 10$

$2^7 = 128$
$2^8 = 256$
$2^9 = 512$
$2^{10} = 1024$
$2^{11} = 2048$

$2^{2nd} = 4$
$2^3 = 8$
$2^4 = 16$
$2^5 = 32$
$2^6 = 64$

1. $y = 2(4)^x$



Critical Points: (0,2) (1,8)

Asymptote: y=0

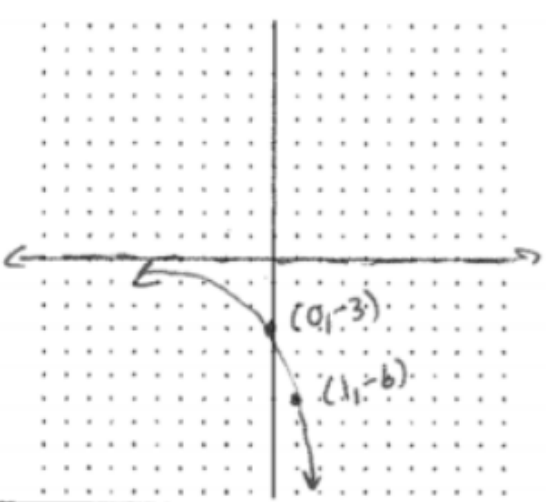
y – intercept: (0,2)

Domain: (-∞,∞) Range: (0,∞)

End Behavior: $x \to \infty, y \to \infty$

$x \to -\infty, y \to 0$

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



Critical Points: (0,-3) (1,-6)

Asymptote: y=0

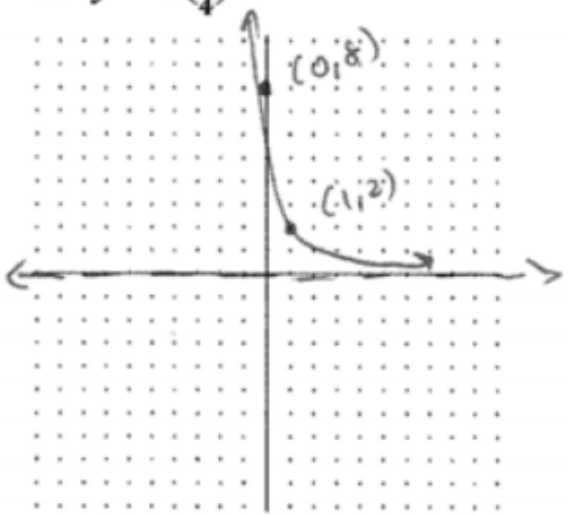
y – intercept: (0,-3)

Domain: (-∞,∞) Range: (-∞,0)

End Behavior: $x \to \infty, y \to -\infty$

$x \to -\infty, y \to 0$

3. $y = 8(\frac{1}{4})^x$



Critical Points: (0,8) (1,2)

Asymptote: y=0

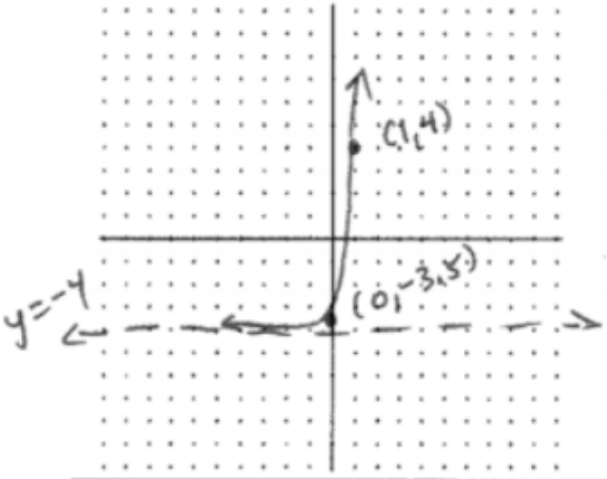
y – intercept: (0,8)

Domain: (-∞,∞) Range: (0,∞)

End Behavior: $x \to \infty, y \to 0$

$x \to -\infty, y \to \infty$

4. $y = \frac{1}{2}(16)^x - 4$



Critical Points: (0,-3.5) (1,4)

Asymptote: y = -4

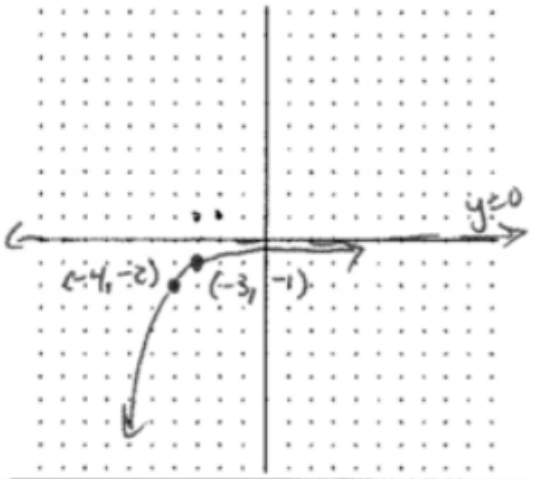
y – intercept: (0,-3.5)

Domain: (-∞,∞) Range: (-4,∞)

End Behavior: $x \to \infty$, $y \to \infty$

$x \to -\infty$, $y \to -4$

5. $y = -2(\frac{1}{2})^{x+4}$



Critical Points: (-4,-2) (-3,-1)

Asymptote: y = 0

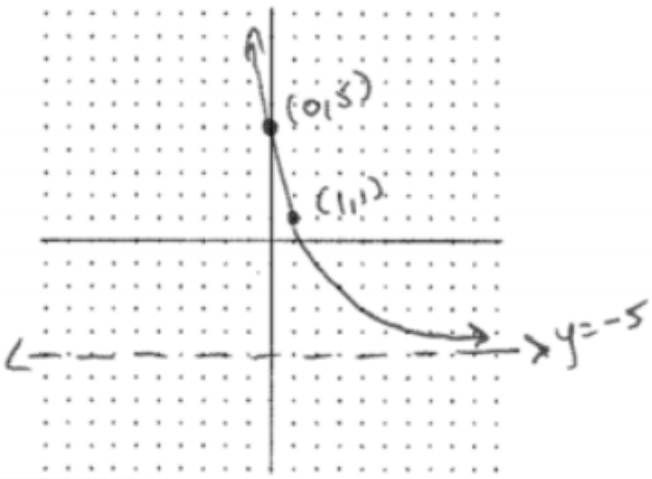
y – intercept: (0,-.125)

Domain: (-∞,∞) Range: (-∞,0)

End Behavior: $x \to \infty$, $y \to 0$

$x \to -\infty$, $y \to -\infty$

6. $y = 10(\frac{3}{5})^x - 5$



Critical Points: (0,5) (1,1)

Asymptote: y = -5

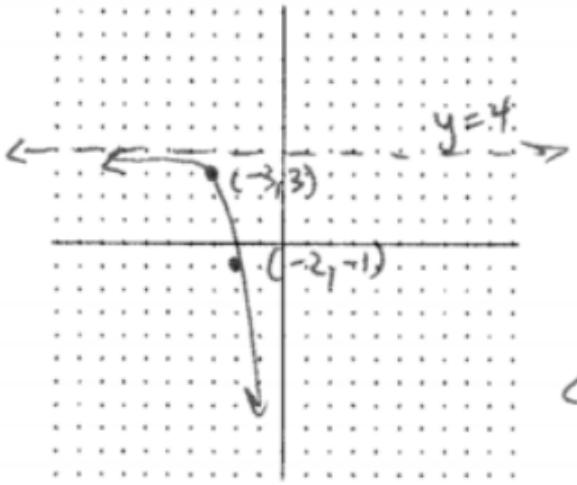
y – intercept: (0,5)

Domain: (-∞,∞) Range: (-5,∞)

End Behavior: $x \to \infty$, $y \to -5$

$x \to -\infty$, $y \to \infty$

7. $y = -(5)^{x+3} + 4$



Critical Points: (-3,3) (-2,-1)

Asymptote: y=4

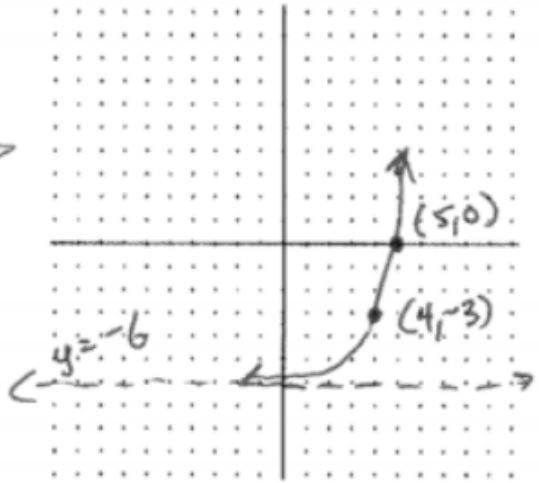
y – intercept: (0,-121)

Domain: (-∞,∞) Range: (-∞,4)

End Behavior: $x \to \infty$, $y \to -\infty$

$x \to -\infty$, $y \to 4$

8. $y = 3(2)^{x-4} - 6$



Critical Points: (4,-3) (5,0)

Asymptote: y=-6

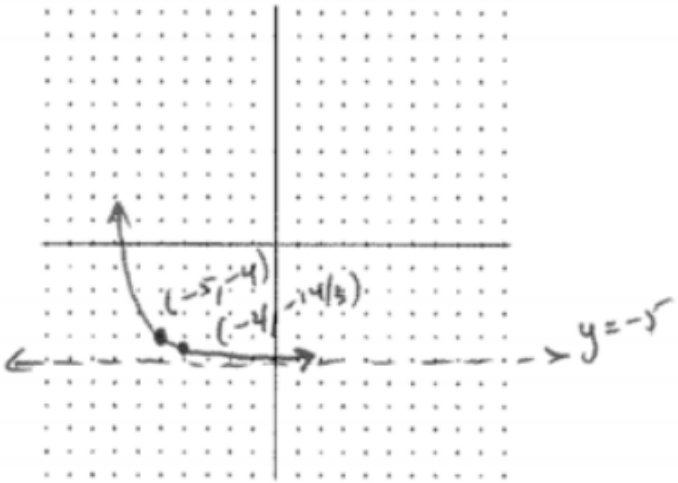
y – intercept: (0,-5.81)

Domain: (-∞,∞) Range: (-6,∞)

End Behavior: $x \to \infty$, $y \to \infty$

$x \to -\infty$, $y \to -6$

9. $y = (\frac{1}{3})^{x+5} - 5$



Critical Points: (-5,-4) (-4,-14/3)

Asymptote: y=-5

y – intercept: (0,-4.99)

Domain: (-∞,∞) Range: (-5,∞)

End Behavior: $x \to \infty$, $y \to -5$

$x \to -\infty$, $y \to \infty$

E.Q.:

How do we solve exponential equations?

Powers of Numbers:

- In order to solve exponential equations, it is beneficial to be familiar with the different powers of some common numbers.

	2^0	2^1	2^2	2^3	2^4	2^5	2^6	2^7	2^8	2^9	2^{10}
Powers of 2:	1	2	4	8	16	32	64	128	256	512	1024
Powers of 3:	1	3	9	27	81	243	729				
Powers of 4:	1	4	16	64	256	1024					
Powers of 5:	1	5	25	125	625						
Powers of 6:	1	6	36	216							
Powers of 7:	1	7	49	343							

Property of Equality of Exponential Functions:

If b is a positive number other than 1, then $b^x = b^y$ if and only if $x = y$. In other words, if the bases are the same, then the exponents must be equal.

$2^x = 1024$

$2^x = 2^{10}$

$x = 10$

$3^x = 9$ $\quad$ $3^x = 27$

$3^x = 3^2$ $\quad$ $3^x = 3^3$

$x = 2$ $\quad$ $x = 3$

$3^{2.75} = 20.5$

$3^{2.73} = 20.06$

$3^x = 20$

$3^{2.2} = 11.2$

$3^{2.5} = 15.6$

$3^{2.7} = 19.41$

$3^{2.8} = 21.67$

Example 1: Solve for x

$$12^{1} = 12^{x}$$

Example 2: Solve for x

$$8^{(x-3)} = 8^4$$

x = 7

$x - 3 = 4$

$+3 \quad +3$

$x = 7$

You try:
Solve each of the following equations

$100^6 = 100^x$

$x = 6$

$5^{2x} = 5^3$

$\frac{2x}{2} = \frac{3}{2}$

$x = \frac{3}{2}$

$x = 1.5$

2^{-10} ✓

2^{-9-1}

$2^{y-1} = 2^{-10}$

$y - 1 = -10$

$+1 \quad +1$

$y = -9$

Example 3: Solve for x

$$5^x = 25$$

$5^x = 5^2$

$x = 2$

$x = 2$

-In order to solve exponential equations:

1) Get the same bases for the exponential equation.

2) Set the exponents = to each other.

3) Solve for the variable.

Example 4: Solve for x

$$3^{4x} = 27$$

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

$\frac{4x}{4} = \frac{3}{4}$

$x = \frac{3}{4}$ or .75

You try:

Solve each of the following equations

$2^x = 8$

$2^x = 2^3$

$x = 3$

$4^{x+1} = 64$

$4^{x+1} = 4^3$

$x + 1 = 3$

$x = 2$

$8^{2x} = 64$

$8^{2x} = 8^2$

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

$x = 1$

Example 5: Solve for y

$$9^{3y} = 27$$

$$(9)^{3y} = 3^3$$

$$(3^2)^{3y} = 3^3$$

$$3^{6y} = 3^3$$

$$\frac{6y}{6} = \frac{3}{6}$$

$y = \frac{1}{2}$ or .5

Example 6: Solve for x

$$32 = 4^{x-3}$$

$2(x-3)$

$2^5 = (2^2)^{x-3}$

$2^5 = 2^{2x-6}$

$5 = 2x - 6$

$11 = 2x$

5.5 or $11/2 = x$

You try:

Solve each of the following equations

$8 = 16^x$

$2^3 = (2^4)^x$

$2^3 = 2^{4x}$

$3 = 4x$

$x = 3/4$

$125 = 25^{6y}$

$5^3 = (5^2)^{6y}$

$5^3 = 5^{12y}$

$3 = 12y$

$y = \frac{3}{12} = \frac{1}{4}$

$9^{x-1} = 27$

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

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

$2x - 2 = 3$

$2x = 5$

$x = 5/2$

HW #4

Solving Exponential Equations