Name: _____ Date: _____ Block: _____

Class Examples: Exponential Functions **Honors PreCalculus**

Identify the parent functions and describe the transformations.

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

$f(x) = 4^x$

right 2

up 3

2. $f(x) = -2 \cdot \left(\frac{1}{4}\right)^x - 1$

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

reflect over x-axis

vertical stretch of 2

down 1

3. $f(x) = 3 + 4^{-x/2}$

$f(x) = 4^x$

reflect over y-axis

horizontal stretch of 2

up 3

Graph the following Exponential Functions using Transformations. State the domain, range, Identify the Horizontal Asymptote, and describe the End Behavior of the graph.

4. $y = 3(2)^x - 1$

vertical stretch of 3

down 1

$y = 2^x$

x	y
-2	1/4
-1	1/2
0	1
1	2
2	4

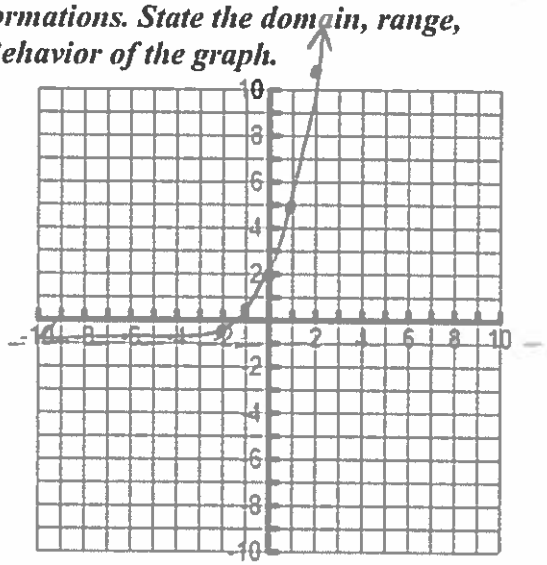
$3y - 1$

x	y
-2	-11/4
-1	1/2
0	2
1	5
2	11

HA: $y = -1$

D: $(-\infty, \infty)$

R: $(-1, \infty)$



5. $f(x) = \frac{1}{2} \cdot (3)^x + 2$

vertical shrink of $\frac{1}{2}$
up 2

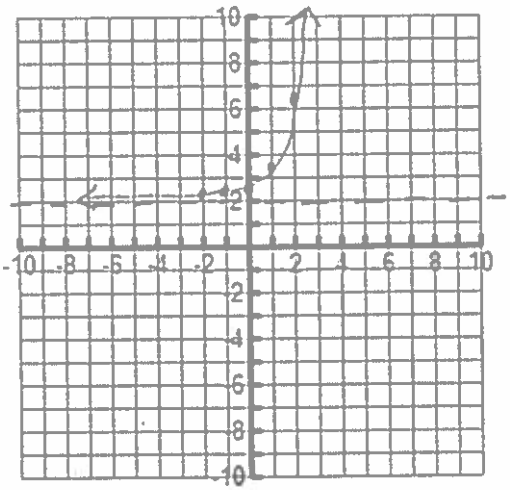
$y = 3^x$

X	Y
-2	1/9
-1	1/3
0	1
1	3
2	9

$\frac{1}{2}y + 2$

X	Y
-2	$37/18 \approx 2.06$
-1	$13/6 \approx 2.17$
0	2.5
1	3.5
2	6.5

HA: $y = 2$
D: $(-\infty, \infty)$
R: $(2, \infty)$



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

reflect over X-axis
vertical stretch of 2
right 2

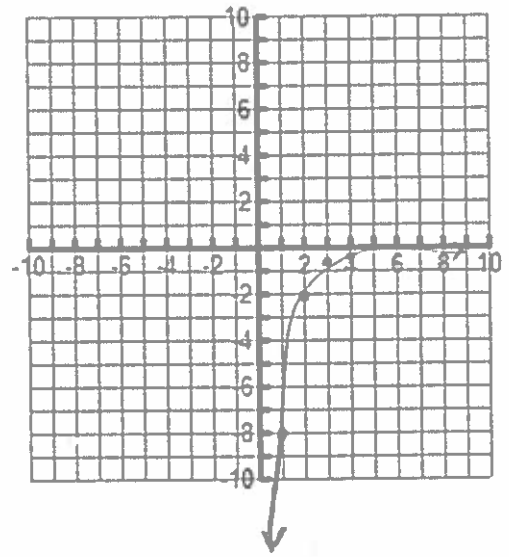
$y = \frac{1}{4}^x$

X	Y
-2	16
-1	4
0	1
1	1/4
2	1/16

$x+2 \quad -2y$

X	Y
0	-32
1	-8
2	-2
3	-1/2
4	-1/8

HA: $y = 0$
D: $(-\infty, \infty)$
R: $(-\infty, 0)$



7. $f(x) = 2e^{x-1} + 1$

vertical stretch of 2
right 1
up 1

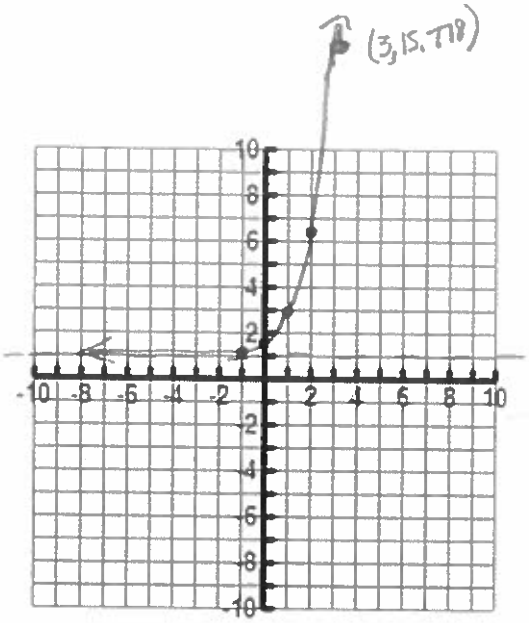
HA: $y=1$
D: $(-\infty, \infty)$
R: $(1, \infty)$

$y = e^x$

x	y
-2	.135
-1	.368
0	1
1	2.718
2	7.389

$x+1 \quad 2y+1$

x	y
-1	1.27
0	1.736
1	3
2	6.436
3	15.778



8. $f(x) = -e^x + 3$

reflect over x-axis
up 3

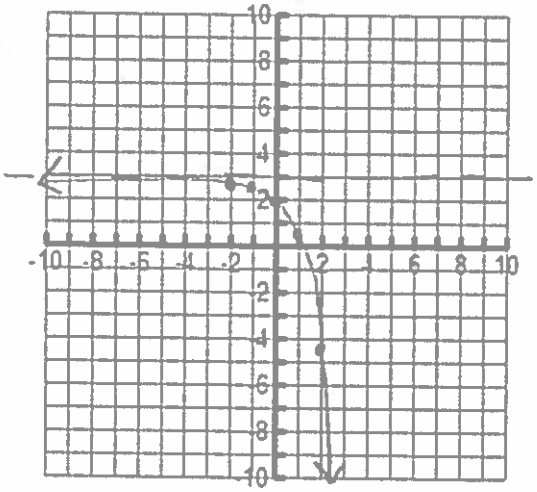
HA: $y=3$
D: $(-\infty, \infty)$
R: $(-\infty, 3)$

$y = e^x$

x	y
-2	.135
-1	.368
0	1
1	2.718
2	7.389

$-y+3$

x	y
-2	2.865
-1	2.632
0	2
1	.282
2	-4.389



Create an exponential model $y = ab^x$ for each situation.

9. $(0, -3)$ *and* $(4, -1875)$

$-3 = ab^0$ $\quad -1875 = ab^4$

$-3 = a$ $\quad -1875 = -3b^4$

$625 = b^4$

$\sqrt[4]{625} = b$

$5 = b$

$y = -3(5)^x$

10. $\left(2, \frac{2}{9}\right)$ *and* $\left(4, \frac{2}{81}\right)$

$\frac{2}{9} = ab^2$ $\quad \frac{2}{81} = ab^4$

$\frac{2}{9b^2} = a$ $\quad \frac{2}{81} = \frac{2}{9b^2}b^4$

$\frac{2}{9(\frac{1}{3})^2} = a$ $\quad 9.\ \frac{2}{81} = \frac{2b^2}{9}$

$2 = a$ $\quad \frac{2}{9} = 2b^2$

$y = 2(\frac{1}{3})^x$ $\quad \sqrt{\frac{1}{9}} = \sqrt{b^2}$ $\quad b = \frac{1}{3}$

11. $f(1) = 18$ *and* $f(5) = \frac{2}{9}$

$18 = ab^1$ $\quad \frac{2}{9} = ab^5$

$\frac{18}{b} = a$ $\quad \frac{2}{9} = \frac{18}{b} \cdot b^5$

$\frac{18}{\frac{1}{3}} = a$ $\quad \frac{2}{9} = 18b^4$

$54 = a$ $\quad \frac{1}{81} = b^4$

$\sqrt[4]{\frac{1}{81}} = b$

$\frac{1}{3} = b$

$y = 54(\frac{1}{3})^x$

12. $\left(3, \frac{1}{2}\right)$ *and* $(-4, 64)$

$\frac{1}{2} = ab^3$ $\quad 64 = ab^{-4}$

$\frac{1}{2b^3} = a$ $\quad 64 = \frac{1}{2b^3} \cdot b^{-4}$

$\frac{1}{2(\frac{1}{2})^3} = a$ $\quad 64 = \frac{1}{2b^7} \cdot 2b^7$

$4 = a$ $\quad 2b^7$

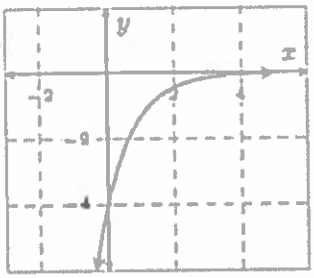
$y = 4(\frac{1}{2})^x$ $\quad 128b^7 = 1$

$b^7 = \frac{1}{128}$

$b = \sqrt[7]{\frac{1}{128}}$

$b = \frac{1}{2}$

13.



(d): $k(3) = -\frac{4}{27}$

$(0, -4)$ $\quad (3, -\frac{4}{27})$

$-4 = ab^0$ $\quad -\frac{4}{27} = ab^3$

$-4 = a$ $\quad -\frac{4}{27} = -4b^3$

$\frac{1}{27} = b^3$

$\sqrt[3]{\frac{1}{27}} = b$

$\frac{1}{3} = b$

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

14. A club's membership has been growing exponentially since the club was founded. The club had

12 members 3 months after it was founded, and 36 members 6 months after it was founded. Find an exponential function that models the club's membership, and determine how many members the club had at the start.

$(3,12)$ $(6,36)$

$12 = ab^3$ $36 = ab^6$

$\frac{12}{b^3} = a$ $36 = \left(\frac{12}{b^3}\right)b^6$

$36 = 12b^3$

$\frac{12}{(\sqrt[3]{3})^3} = a$ $3 = b^3$

$\sqrt[3]{3} = b$

$\frac{12}{3} = a$ $1.442 = b$

$4 = a$

$y = 4(1.442)^x$

When the club was founded, there were 4 members.

Partner Activity:

Estimates of the amounts (in billions of dollars) of U.S. online advertising spending from 2007-2011 are shown in the table. Use your *STAT-EDIT* menu on your calculator to create a list for these points. Then use the *STAT-CALC* menu to create an *EXPREG* model for this data in the form $y = ab^x$. Graph your model in your equation editor and use the *TRACE* feature on your calculator to determine when the Advertising spending will reach 40 billion dollars

Year	Advertising spending
2007	21.1
2008	23.6
2009	25.7
2010	28.5
2011	32.0

$y = 1.908(1.108)^x$

$y = 21.12(1.108)^x$

$y = 21.12(1.108)^x$

During the 6th year since 2007 or 2013