

Welcome Back.

1) SAT questions

2) Do the Math Lab to learn how to graph an Exponential Functions.

3) Notes

4) Homework

Name:

Period:

Date:

Math Lab: Graphing Exponential Functions

Exponential functions are ones in which the variable is in the exponent. As with other types of functions, there is a parent graph for exponential functions ($y = b^x$ where b is the base) and we can create other similarly shaped graphs using transformations.

Complete the tables of ordered pairs below for each of the following **parent graphs**, then use the points to sketch each graph on the coordinate plane below in the given colors.

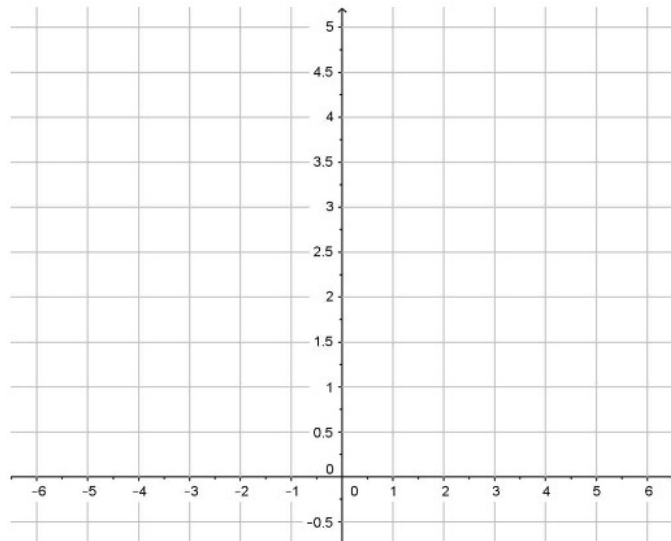
$y = 2^x$ (BLACK)	
-2	
-1	
0	
1	
2	
3	

$y = 3^x$ (RED)	
-2	
-1	
0	
1	
2	
3	

$y = 4^x$ (BLUE)	
-2	
-1	
0	
1	
2	
3	

Is there ever any value of x that will make $y = 0$?

Is there ever any value of x that will make y negative?



Find the domain and range for each parent graph.

$y = 2^x$ (BLACK)

$y = 3^x$ (RED)

$y = 4^x$ (BLUE)

Domain:

Domain:

Domain:

Range:

Range:

Range:

Horizontal Asymptote at:

Horizontal Asymptote at:

Horizontal Asymptote at:

What 2 points did all 3 graphs have in common?

What if the base was a number between 0 and 1? What do you think would happen?

Ex: $f(x) = (1/2)^x$

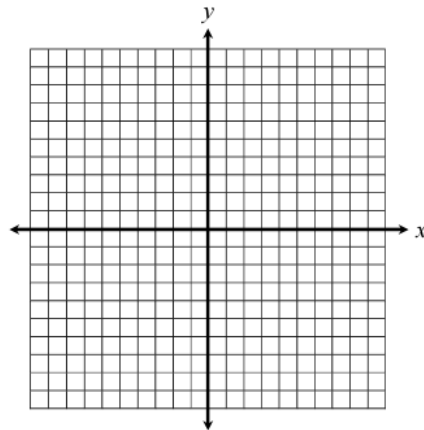
Name:	Date:
Topic:	Class:

Main Ideas/Questions	Notes/Examples
<p style="text-align: center;">EXPONENTIAL <i>Parent Function</i></p> <div style="border: 1px solid black; width: 100px; height: 20px; margin: 10px auto;"></div>	<ul style="list-style-type: none"> • If $b > 1$, the function is an _____ and is _____. • If $b < 1$, the function is an _____ and is _____.

ASYMPTOTE	
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Directions: Classify as an exponential growth or decay, graph, then identify its key characteristics.

1. $f(x) = 2^x$



Domain: _____

Range: _____

End Behavior:

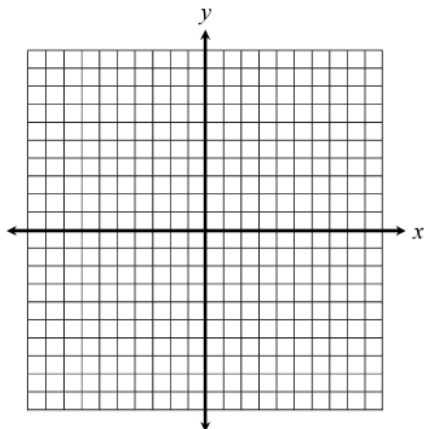
As $x \rightarrow \infty$, $f(x) \rightarrow$ _____

As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____

y-intercept: _____

Asymptote: _____

2. $f(x) = 3^x$



Domain: _____

Range: _____

End Behavior:

As $x \rightarrow \infty$, $f(x) \rightarrow$ _____

As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____

y-intercept: _____

Asymptote: _____

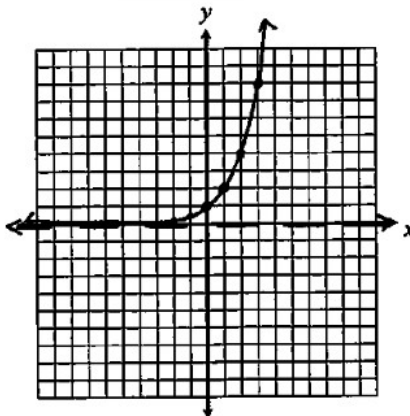
Name:	Date:
Topic:	Class:

Main Ideas/Questions	Notes/Examples
<p>EXPONENTIAL Parent Function</p> <p>$f(x) = b^x$</p>	<ul style="list-style-type: none"> If $b > 1$, the function is an <u>exponential growth</u> and is <u>increasing</u>. If $b < 1$, the function is an <u>exponential decay</u> and is <u>decreasing</u>.
ASYMPTOTE	A line which the graph gets close to but never crosses

Directions: Classify as an exponential growth or decay, graph, then identify the key characteristics.

1. $f(x) = 2^x$

X	y
-2	.25
-1	.5
0	1
1	2
2	4



Domain: \mathbb{R}

Range: $y > 0$

End Behavior:

As $x \rightarrow \infty$, $f(x) \rightarrow \infty$

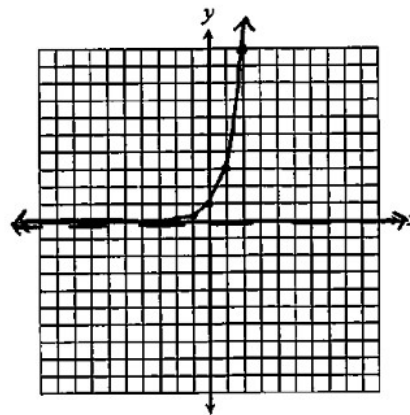
As $x \rightarrow -\infty$, $f(x) \rightarrow 0$

y-intercept: (0, 1)

Asymptote: $y = 0$

2. $f(x) = 3^x$

X	y
-2	. $\bar{3}$
-1	. $\bar{3}$
0	1
1	3
2	9



Domain: \mathbb{R}

Range: $y > 0$

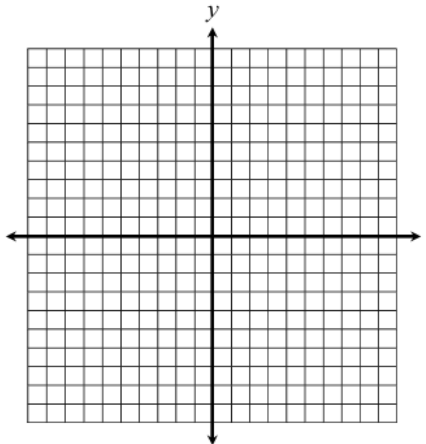
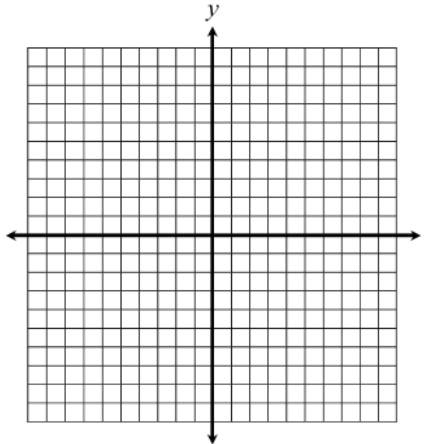
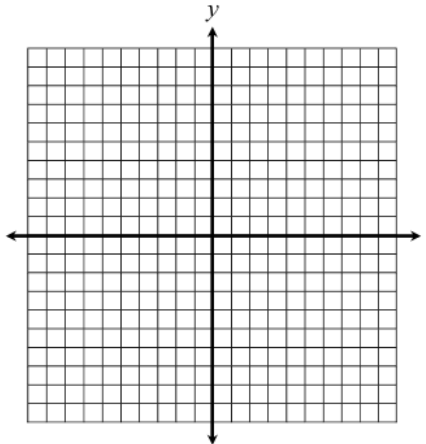
End Behavior:

As $x \rightarrow \infty$, $f(x) \rightarrow \infty$

As $x \rightarrow -\infty$, $f(x) \rightarrow 0$

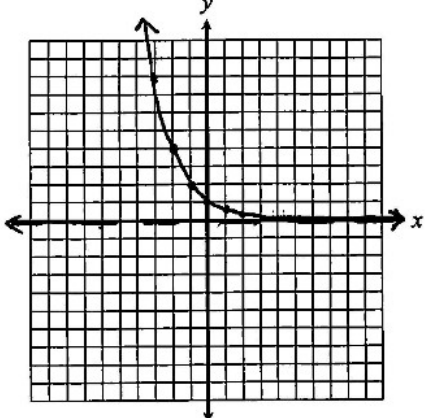
y-intercept: (0, 1)

Asymptote: $y = 0$

<p>3. $f(x) = \left(\frac{1}{2}\right)^x$</p>		<p>Domain: _____</p> <p>Range: _____</p> <p>End Behavior: As $x \rightarrow \infty$, $f(x) \rightarrow$ _____ As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____</p> <p>y-intercept: _____</p> <p>Asymptote: _____</p>
<p>4. $f(x) = \left(\frac{2}{3}\right)^x$</p>		<p>Domain: _____</p> <p>Range: _____</p> <p>End Behavior: As $x \rightarrow \infty$, $f(x) \rightarrow$ _____ As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____</p> <p>y-intercept: _____</p> <p>Asymptote: _____</p>
<p>5. $f(x) = \left(\frac{5}{2}\right)^x$</p>		<p>Domain: _____</p> <p>Range: _____</p> <p>End Behavior: As $x \rightarrow \infty$, $f(x) \rightarrow$ _____ As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____</p> <p>y-intercept: _____</p> <p>Asymptote: _____</p>

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

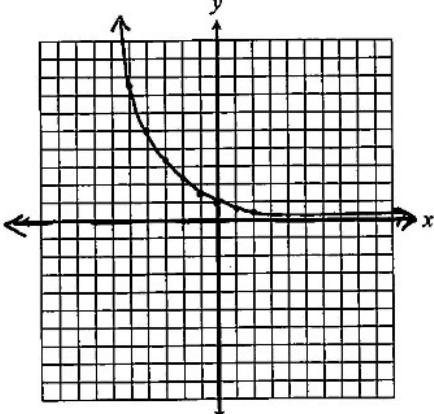
X	Y
-2	4
-1	2
0	1
1	.5
2	.25



Domain: \mathbb{R}
 Range: $y > 0$
 End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow 0$
 As $x \rightarrow -\infty$, $f(x) \rightarrow \infty$
 y-intercept: $(0, 1)$
 Asymptote: $y = 0$

4. $f(x) = \left(\frac{2}{3}\right)^x$

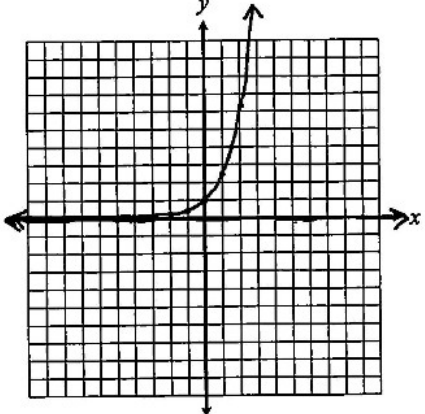
X	Y
-2	2.25
-1	1.5
0	1
1	0.6
2	0.4



Domain: \mathbb{R}
 Range: $y > 0$
 End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow 0$
 As $x \rightarrow -\infty$, $f(x) \rightarrow \infty$
 y-intercept: $(0, 1)$
 Asymptote: $y = 0$

5. $f(x) = \left(\frac{5}{2}\right)^x$

X	Y
-2	0.16
-1	0.4
0	1
1	2.5
2	6.25



Domain: \mathbb{R}
 Range: $y > 0$
 End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow \infty$
 As $x \rightarrow -\infty$, $f(x) \rightarrow 0$
 y-intercept: $(0, 1)$
 Asymptote: $y = 0$

Name:	Date:
Topic:	Class:

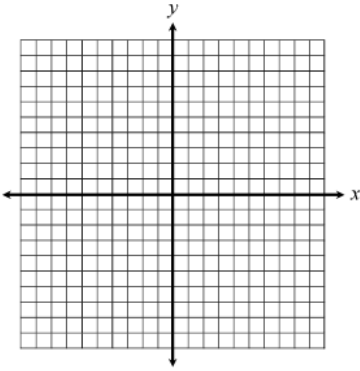
Main Ideas/Questions	Notes/Examples
<p>TRANSFORMATIONS of Exponential Functions</p> $f(x) = a \cdot b^{x-h} + k$	<ul style="list-style-type: none"> h is the _____ shift. (+ shifts _____, - shifts _____) k is the _____ shift. (+ shifts _____, - shifts _____) If a is negative, the function is _____ across the _____. $a > 1$ represents a vertical _____. $0 < a < 1$ represents a vertical _____.

Directions: (a) Identify the parent function, and (b) describe the transformations.

<p>1. $f(x) = 3^x + 5$</p>	<p>2. $f(x) = 2 \cdot \left(\frac{1}{4}\right)^{x-1}$</p>
<p>3. $f(x) = -\left(\frac{4}{3}\right)^{x+2} + 7$</p>	<p>4. $f(x) = \frac{1}{2} \cdot 5^{x-4} - 2$</p>

Directions: Graph each function and identify its key characteristics.

5. $f(x) = 2^{x+5}$



Domain: _____

Range: _____

End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow$ _____
 As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____

y-intercept: _____

Asymptote: _____

Name:	Date:
Topic:	Class:

Main Ideas/Questions	Notes/Examples
<p>TRANSFORMATIONS of Exponential Functions</p> <p>$f(x) = a \cdot b^{x-h} + k$</p>	<ul style="list-style-type: none"> h is the <u>horizontal</u> shift. (+ shifts <u>left</u> - shifts <u>right</u>) k is the <u>vertical</u> shift. (+ shifts <u>up</u> - shifts <u>down</u>) If a is negative, the function is <u>reflection</u> across the <u>x-axis</u> $a > 1$ represents a vertical <u>stretch</u>. $0 < a < 1$ represents a vertical <u>compression</u>.

Directions: (a) Identify the parent function, and (b) describe the transformations.

<p>1. $f(x) = 3^x + 5$</p> <p>a) $f(x) = 3^x$</p> <p>b) up 5</p>	<p>2. $f(x) = 2 \cdot \left(\frac{1}{4}\right)^{x-1}$</p> <p>a) $f(x) = \left(\frac{1}{4}\right)^x$</p> <p>b) vert. stretch x 2, right 1</p>
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<p>3. $f(x) = -\left(\frac{4}{3}\right)^{x+2} + 7$</p> <p>a) $f(x) = \left(\frac{4}{3}\right)^x$</p> <p>b) reflect over x, left 2, up 7</p>	<p>4. $f(x) = \frac{1}{2} \cdot 5^{x-4} - 2$</p> <p>a) $f(x) = 5^x$</p> <p>b) vert. compression by 1/2, right 4, down 2</p>
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Directions: Graph each function and identify its key characteristics.

5. $f(x) = 2^{x+5}$

X	Y	X	Y
-2	0.25	-7	0.25
-1	0.5	-6	0.5
0	1	-5	1
1	2	-4	2
2	4	-3	4

$f(x) = 2^x$ $f(x) = 2^{x+5}$

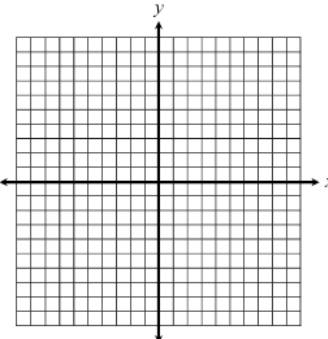
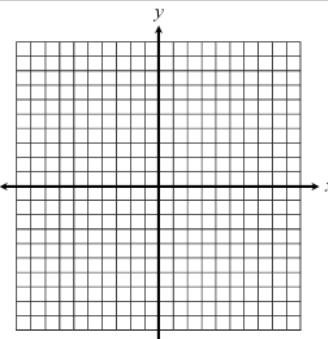
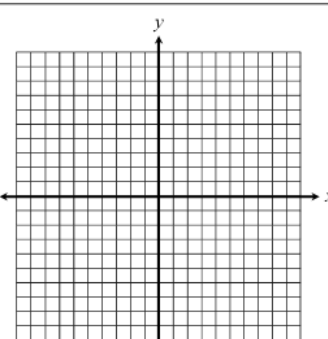
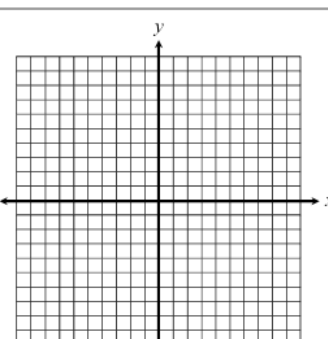
Domain: \mathbb{R}

Range: $y > 0$

End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow \infty$
 As $x \rightarrow -\infty$, $f(x) \rightarrow 0$

y-intercept: $2^{0+5} = 32$ (0,32)

Asymptote: $y = 0$

<p>6. $f(x) = \left(\frac{1}{3}\right)^x - 2$</p>		<p>Domain: _____</p> <p>Range: _____</p> <p>End Behavior:</p> <p>As $x \rightarrow \infty$, $f(x) \rightarrow$ _____</p> <p>As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____</p> <p>y-intercept: _____</p> <p>Asymptote: _____</p>
<p>7. $f(x) = \frac{1}{2} \cdot 3^x + 1$</p>		<p>Domain: _____</p> <p>Range: _____</p> <p>End Behavior:</p> <p>As $x \rightarrow \infty$, $f(x) \rightarrow$ _____</p> <p>As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____</p> <p>y-intercept: _____</p> <p>Asymptote: _____</p>
<p>8. $f(x) = \left(\frac{3}{2}\right)^{x-4} - 5$</p>		<p>Domain: _____</p> <p>Range: _____</p> <p>End Behavior:</p> <p>As $x \rightarrow \infty$, $f(x) \rightarrow$ _____</p> <p>As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____</p> <p>y-intercept: _____</p> <p>Asymptote: _____</p>
<p>9. $f(x) = -2 \cdot 4^{x-2}$</p>		<p>Domain: _____</p> <p>Range: _____</p> <p>End Behavior:</p> <p>As $x \rightarrow \infty$, $f(x) \rightarrow$ _____</p> <p>As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____</p> <p>y-intercept: _____</p> <p>Asymptote: _____</p>

6. $f(x) = \left(\frac{1}{3}\right)^x - 2$

X	y
-2	9
-1	3
0	1
1	0.3
2	0.1

X	y
-2	7
-1	1
0	-1
1	-1.6
2	-1.8

Domain: \mathbb{R}
 Range: $y > -2$
 End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow -2$
 As $x \rightarrow -\infty$, $f(x) \rightarrow \infty$
 y-intercept: $(0, -1)$
 Asymptote: $y = -2$

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

X	y
-2	0.1
-1	0.3
0	1
1	3
2	9

X	y
-2	1.05
-1	1.15
0	1.5
1	2.5
2	5.5

Domain: \mathbb{R}
 Range: $y > 1$
 End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow \infty$
 As $x \rightarrow -\infty$, $f(x) \rightarrow 1$
 y-intercept: $(0, 1.5)$
 Asymptote: $y = 1$

8. $f(x) = \left(\frac{3}{2}\right)^{x-4} - 5$

X	y
-2	0.4
-1	0.6
0	1
1	1.5
2	2.25

X	y
2	-4.5
3	-4.3
4	-4
5	-3.5
6	-2.15

Domain: \mathbb{R}
 Range: $y > -5$
 End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow \infty$
 As $x \rightarrow -\infty$, $f(x) \rightarrow -5$
 y-intercept: $(0, -4.802)$
 Asymptote: $y = -5$

9. $f(x) = -2 \cdot 4^{x-2}$

X	y
-2	.06
-1	.25
0	1
1	4
2	16

X	y
0	-.125
1	-.5
2	-2
3	-8
4	-32

Domain: \mathbb{R}
 Range: $y < 0$
 End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow -\infty$
 As $x \rightarrow -\infty$, $f(x) \rightarrow 0$
 y-intercept: $(0, -0.125)$
 Asymptote: $y = 0$

Do your homework!

Name: _____ Unit 7: Exponential & Logarithmic Functions

Date: _____ Bell: _____ Homework 1: Graphing Exponential Functions

**** This is a 2-page document! ****

Directions: Classify each function as an exponential growth or an exponential decay. Sketch the curve.

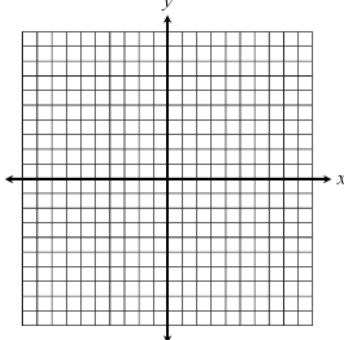
<p>1. $f(x) = \frac{1}{2} \cdot 5^x$</p>	<p>2. $f(x) = \left(\frac{6}{5}\right)^x$</p>	<p>3. $f(x) = 4 \cdot \left(\frac{3}{8}\right)^x$</p>
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Directions: (a) Identify the parent function and **(b)** describe the transformations.

<p>4. $f(x) = \left(\frac{4}{5}\right)^{x+2}$</p>	<p>5. $f(x) = -3 \cdot 2^{x-1} + 7$</p>
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Directions: Graph each function and identify its key characteristics.

6. $f(x) = 3^{x-2} - 7$



Domain: _____

Range: _____

End Behavior:

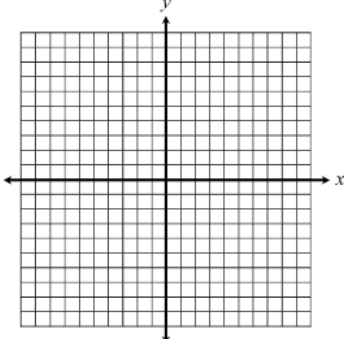
As $x \rightarrow \infty$, $f(x) \rightarrow$ _____

As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____

y-intercept: _____

Asymptote: _____

7. $f(x) = \left(\frac{1}{2}\right)^{x+4} - 3$



Domain: _____

Range: _____

End Behavior:

As $x \rightarrow \infty$, $f(x) \rightarrow$ _____

As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____

y-intercept: _____

Asymptote: _____

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Name: _____ Unit 7: Exponential & Logarithmic Functions

Date: _____ Bell: _____ Homework 1: Graphing Exponential Functions

**** This is a 2-page document! ****

Directions: Classify each function as an exponential growth or an exponential decay. Sketch the curve.

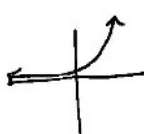
1. $f(x) = \frac{1}{2} \cdot 5^x$

growth



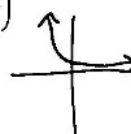
2. $f(x) = \left(\frac{6}{5}\right)^x$

growth



3. $f(x) = 4 \cdot \left(\frac{3}{8}\right)^x$

decay



Directions: (a) Identify the parent function and (b) describe the transformations.

4. $f(x) = \left(\frac{4}{5}\right)^{x+2}$

a) $f(x) = \left(\frac{4}{5}\right)^x$

b) left 2

5. $f(x) = -3 \cdot 2^{x-1} + 7$

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

b) reflected over x, right 1, vert. stretch by 3, up 7

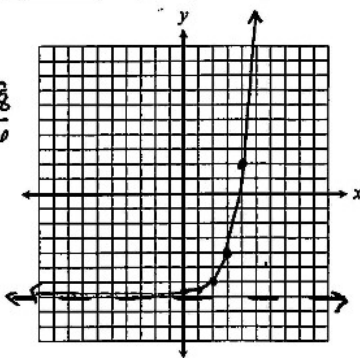
Directions: Graph each function and identify its key characteristics.

6. $f(x) = 3^{x-2} - 7$

X	y
-2	0.1
-1	0.3
0	1
1	3
2	9

→

X	y
0	-6.8
1	-6.6
2	-6
3	-4
4	2



Domain: \mathbb{R}

Range: $y > -7$

End Behavior:

As $x \rightarrow \infty$, $f(x) \rightarrow \infty$

As $x \rightarrow -\infty$, $f(x) \rightarrow -7$

y-intercept: $(0, -6.8)$

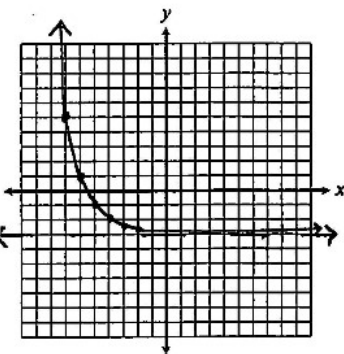
Asymptote: $y = -7$

7. $f(x) = \left(\frac{1}{2}\right)^{x+4} - 3$

X	y
-2	4
-1	2
0	1
1	.5
2	.25

→

X	y
-6	1
-5	-1
-4	-2
-3	-2.5
-2	-2.75



Domain: \mathbb{R}

Range: $y > -3$

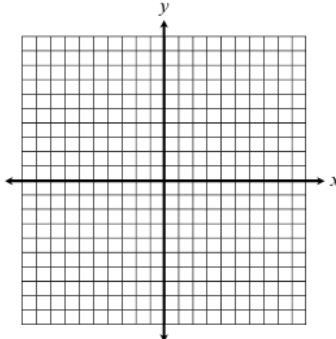
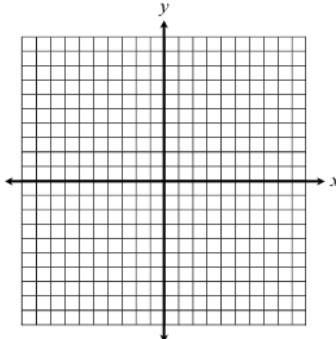
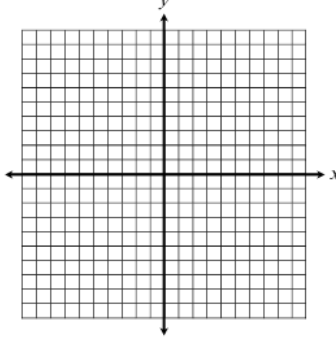
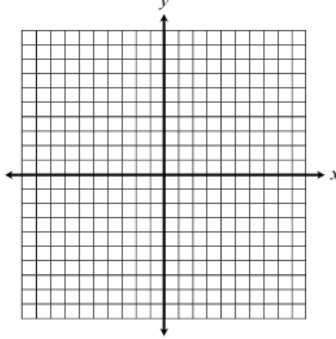
End Behavior:

As $x \rightarrow \infty$, $f(x) \rightarrow -3$

As $x \rightarrow -\infty$, $f(x) \rightarrow \infty$

y-intercept: $(0, -2.9375)$

Asymptote: $y = -3$

<p>8. $f(x) = \frac{1}{2} \cdot 2^x - 6$</p>		<p>Domain: _____</p> <p>Range: _____</p> <p>End Behavior:</p> <p>As $x \rightarrow \infty$, $f(x) \rightarrow$ _____</p> <p>As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____</p> <p>y-intercept: _____</p> <p>Asymptote: _____</p>
<p>9. $f(x) = \frac{1}{8} \cdot 4^{x+1}$</p>		<p>Domain: _____</p> <p>Range: _____</p> <p>End Behavior:</p> <p>As $x \rightarrow \infty$, $f(x) \rightarrow$ _____</p> <p>As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____</p> <p>y-intercept: _____</p> <p>Asymptote: _____</p>
<p>10. $f(x) = 4 \cdot \left(\frac{2}{3}\right)^x + 1$</p>		<p>Domain: _____</p> <p>Range: _____</p> <p>End Behavior:</p> <p>As $x \rightarrow \infty$, $f(x) \rightarrow$ _____</p> <p>As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____</p> <p>y-intercept: _____</p> <p>Asymptote: _____</p>
<p>11. $f(x) = -\frac{1}{3} \cdot 6^x + 5$</p>		<p>Domain: _____</p> <p>Range: _____</p> <p>End Behavior:</p> <p>As $x \rightarrow \infty$, $f(x) \rightarrow$ _____</p> <p>As $x \rightarrow -\infty$, $f(x) \rightarrow$ _____</p> <p>y-intercept: _____</p> <p>Asymptote: _____</p>

8. $f(x) = \frac{1}{2} \cdot 2^x - 6$

X	y
-2	.25
-1	.5
0	1
1	2
2	4

X	y
-2	-5.875
-1	-5.75
0	-5.5
1	-5
2	-4

Domain: \mathbb{R}
 Range: $y > -6$
 End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow \infty$
 As $x \rightarrow -\infty$, $f(x) \rightarrow -6$
 y-intercept: $(0, -5.5)$
 Asymptote: $y = -6$

9. $f(x) = \frac{1}{8} \cdot 4^{x+1}$

X	y
-2	.0625
-1	.25
0	1
1	4
2	16

X	y
-3	.008
-2	.03125
-1	.125
0	.5
1	2

Domain: \mathbb{R}
 Range: $y > 0$
 End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow \infty$
 As $x \rightarrow -\infty$, $f(x) \rightarrow 0$
 y-intercept: $(0, 1/2)$
 Asymptote: $y = 0$

10. $f(x) = 4 \cdot \left(\frac{2}{3}\right)^x + 1$

X	y
-2	2.25
-1	1.5
0	1
1	0.6
2	0.4

X	y
-2	10
-1	7
0	5
1	3.6
2	2.7

Domain: \mathbb{R}
 Range: $y > 1$
 End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow 1$
 As $x \rightarrow -\infty$, $f(x) \rightarrow \infty$
 y-intercept: $(0, 5)$
 Asymptote: $y = 1$

11. $f(x) = -\frac{1}{3} \cdot 6^x + 5$

X	y
-2	.027
-1	.16
0	1
1	6
2	36

X	y
-2	4.9907
-1	4.94
0	4.6
1	3
2	-1

Domain: \mathbb{R}
 Range: $y < 5$
 End Behavior:
 As $x \rightarrow \infty$, $f(x) \rightarrow -\infty$
 As $x \rightarrow -\infty$, $f(x) \rightarrow 5$
 y-intercept: $(0, 4.6)$
 Asymptote: $y = 5$

