Math 3
Unit 2 Day 7 Notes – Graphing Exp. and Log. Functions

Name: Key
Date:

Part I: Determine which functions are exponential functions. For those that are not, explain why they are not exponential functions.

(a) $f(x) = 2^x + 7$ — Yes No

(b) $g(x) = x^2$ — Yes No — it is a quadratic function

(c) $h(x) = 1^x$ — Yes No — can't have a one as the base

(d) $f(x) = x^x$ — Yes No — base has to have a #

(e) $h(x) = 3 \cdot 10^{-x}$ — Yes No

(f) $f(x) = -3^{x+1} + 5$ — Yes No

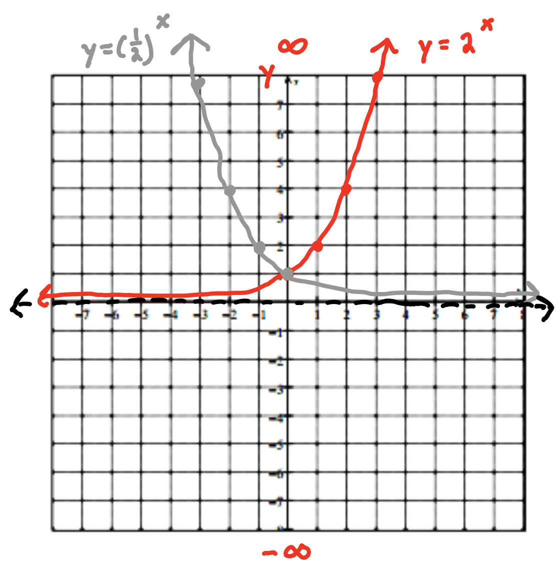
(g) $g(x) = (-3)^{x+1} + 5$ — Yes No

(h) $h(x) = 2x - 1$ — Yes No — it is a linear function

Part 2: Graph each of the following and find the domain and range for each function.

(a) $f(x) = 2^x$ growth — domain: $(-\infty, \infty)$ — range: $(0, \infty)$

(b) $g(x) = \left(\frac{1}{2}\right)^x$ decay — domain: $(-\infty, \infty)$ — range: $(0, \infty)$



Horizontal Asymptote: an "invisible" line that the graph of a function never crosses.

Identify the horizontal asymptote of (a):

$y = 0$

Identify the horizontal asymptote of (b):

$y = 0$

Identify the y-intercept of (a):

$(0, 1)$

Identify the y-intercept of (b):

$(0, 1)$

End behavior:

$\to -\infty \quad f(x) \to 0$

$\to +\infty \quad f(x) \to \infty$

End Behavior:

$x \to -\infty \quad g(x) \to \infty$

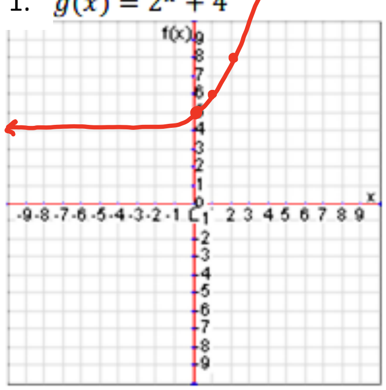
$x \to +\infty \quad g(x) \to 0$

Transforming Exponential Functions:

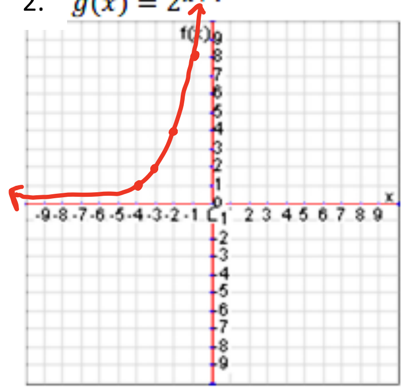
Translate left or right:	$g(x) = b^{x+c}$ (graph moves c units left) $g(x) = b^{x-c}$ (graph moves c units right)
Vertical stretch or compression:	$g(x) = cb^x$ (graph stretches if $c > 1$) (graph shrinks if $0 < c < 1$)
Horizontal stretch or compression:	$g(x) = b^{cx}$ (graph shrinks if $c > 1$) (graph stretches if $0 < c < 1$)
Reflections:	$g(x) = -b^x$ (graph reflects over the x-axis) $g(x) = b^{-x}$ (graph reflects over the y-axis)
Translate up or down:	$g(x) = b^x + c$ (graph moves up c units) $g(x) = b^x - c$ (graph moves down c units)

Part 3: Describe the transformation using the function f(x) = 2^x as the parent function. Then graph the function. For each, identify the domain, range, y-intercept, the asymptote, and the end behavior as x→ ∞ and -∞. horizontal asymptote.

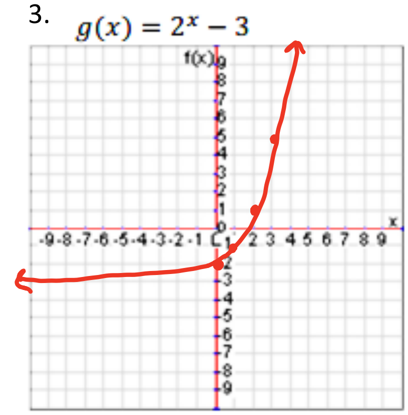
1. $g(x) = 2^x + 4$



2. $g(x) = 2^{x+4}$



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

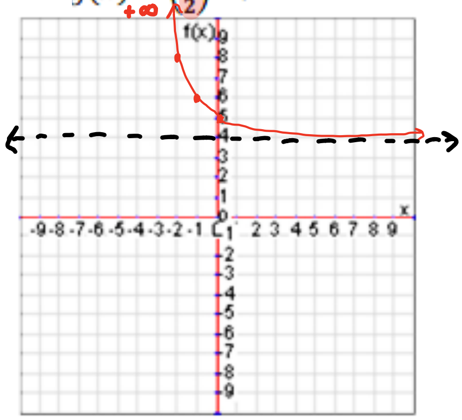


1.
Domain: $(-\infty, \infty)$
Range: $(4, \infty)$
Y-Intercept: $(0, 5)$
Asymptote: $y = 4$
End Behavior: $x \to -$ $y \to 4$
$x \to +\infty$ $\to \infty$

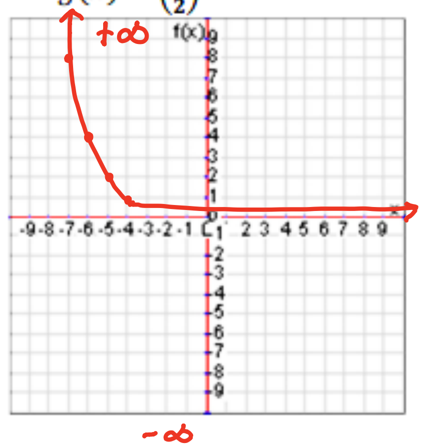
2.
Domain: $(-\infty, \infty)$
Range: $(0, \infty)$
Y-Intercept: $(0, 16)$
Asymptote: $y = 0$
End Behavior: $x \to -\infty$ $y \to 0$
$x \to +\infty$ $y \to \infty$

3.
Domain: $(-\infty, \infty)$
Range: $(-3, \infty)$
Y-Intercept: $y = -3$
Asymptote: $(0, -2)$
End Behavior: $x \to -\infty$ $y \to -3$
$x \to +\infty$ $y \to \infty$

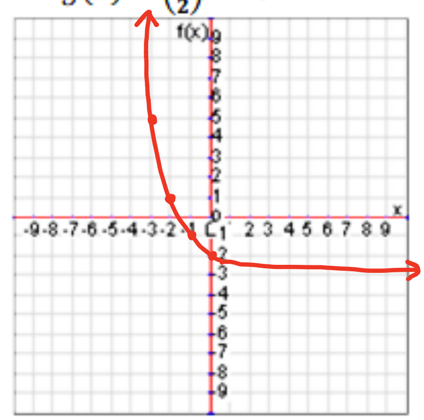
4. $g(x) = \left(\frac{1}{2}\right)^x + 4$



5. $g(x) = \left(\frac{1}{2}\right)^{(x+4)}$



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



Domain: $(-\infty, \infty)$
Range: $(4, \infty)$
Y-Intercept: $(0, 5)$
Asymptote: $y = 4$
End Behavior: $x \to -\infty$ $y \to \infty$
$x \to \infty$ $y \to 4$

Domain: $(-\infty, \infty)$
Range: $(0, \infty)$
Y-Intercept: $(0, 0.0625)$
Asymptote: $y = 0$
End Behavior: $x \to -\infty$ $y \to \infty$
$x \to \infty$ $y \to 0$

Domain: $(-\infty, \infty)$
Range: $(-3, \infty)$
Y-Intercept: $(0, -2)$
Asymptote: $y = -3$
End Behavior: $x \to -\infty$ $y \to \infty$
$x \to \infty$ $y \to -3$

Graphing and Transforming Logarithmic Functions:

The logarithmic function is the inverse of the exponential function.

- $\log_a x = y$ is read "log base a of x equals y."
- It is equivalent to $a^y = x$

$$\log_a x = y \qquad a^y = x$$

Practice: Change to the other form:

Exponential Form	$2^3 = 8$	$2^{-3} = \frac{1}{8}$	$7^m = x$	$10^3 = 1000$
Logarithmic Form	$\log_2 8 = 3$	$\log_2\left(\frac{1}{8}\right) = -3$	$\log_7 x = m$	$\log_{10} 1000 = 3$

Now let's use $f(x) = 10^x$ to explore its inverse, $f^{-1}(x) = \log_{10} x$

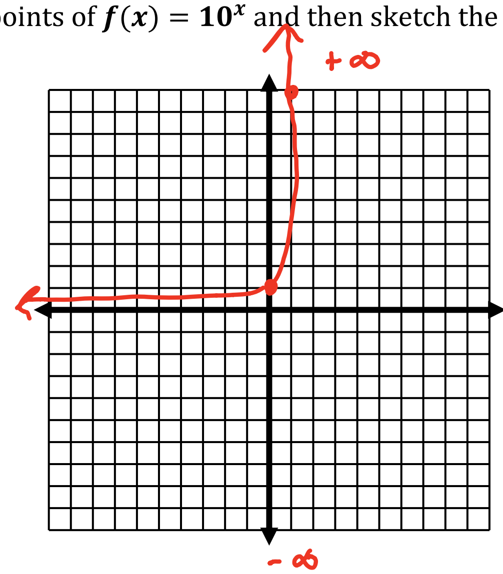
1. Complete the table to get the characteristic points of $\boldsymbol{f(x) = 10^x}$ and then sketch the graph.

x	$f(x) = 10^x$
–1	.1
0	1
1	10
2	100

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

Range: $(0, \infty)$

Asymptote: $y = 0$



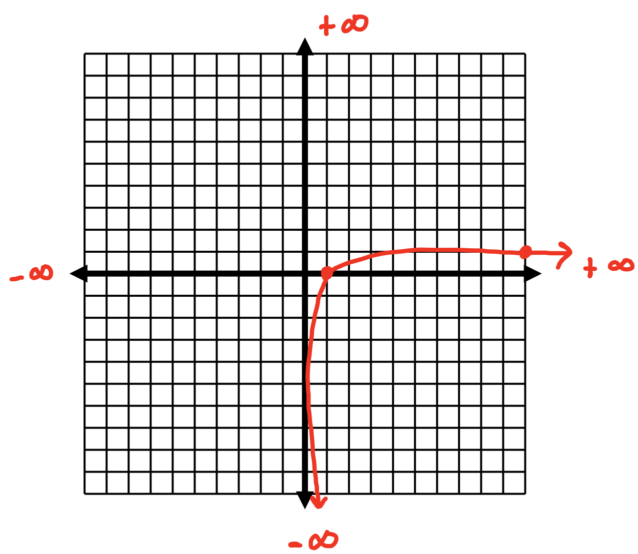
2. Complete the table to get the characteristic points of $\boldsymbol{f^{-1}(x) = \log_{10} x}$ and then sketch the graph.

x	$f^{-1}(x) = \log_{10} x$
.1	–1
1	0
10	1
100	2

Domain: $(0, \infty)$

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

Asymptote: $x = 0$

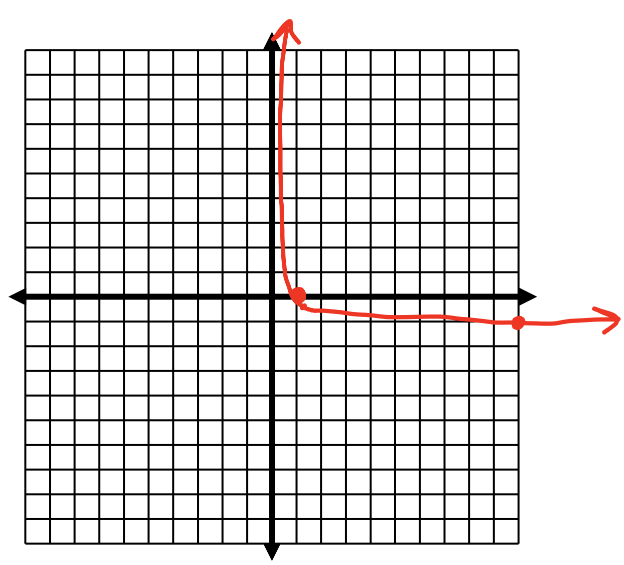


3. Graph $f(x) = -\log_{10} x$

Domain: $(0, \infty)$

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

Asymptote: $x = 0$

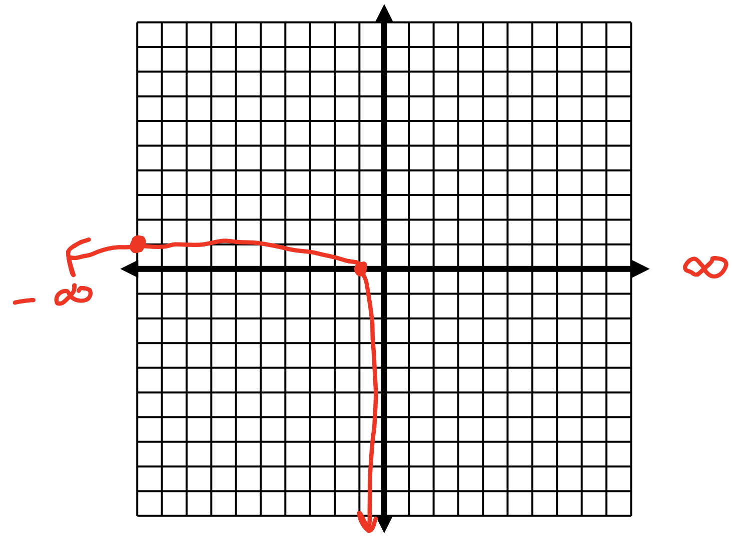


4. Graph $g(x) = \log_{10}(-x)$

Domain: $(-\infty, 0)$

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

Asymptote: $x = 0$

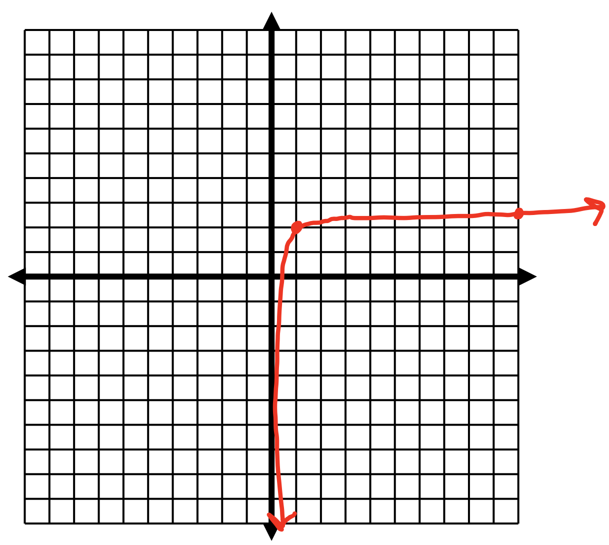


5. Graph $f(x) = \overset{.5}{\left(\frac{1}{2}\right)} \log_{10}(x) + 2$

Domain: $(0, \infty)$

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

Asymptote: $x = 0$



6. Graph $f(x) = \log_{10}(x+4) - 2$

Domain: $(-4, \infty)$

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

Asymptote: $X = -4$