F.IF.C.7: Graphing Logarithmic Functions

1 The graph of \( y = \log x \) lies in Quadrant(s)
   1) I and II  2) II and III  3) III and IV  4) I and IV

2 Which statement about the graph of \( c(x) = \log_6 x \) is false?
   1) The asymptote has equation \( y = 0 \).
   2) The graph has no \( y \)-intercept.
   3) The domain is the set of positive reals.
   4) The range is the set of all real numbers.

3 If \( f(x) = \log_3 x \) and \( g(x) \) is the image of \( f(x) \) after a translation five units to the left, which equation represents \( g(x) \)?
   1) \( g(x) = \log_3 (x + 5) \)  2) \( g(x) = \log_3 x + 5 \)
   3) \( g(x) = \log_3 (x - 5) \)  4) \( g(x) = \log_3 x - 5 \)

4 The graph of \( y = \log_2 x \) is translated to the right 1 unit and down 1 unit. The coordinates of the \( x \)-intercept of the translated graph are
   1) \((0,0)\)  2) \((1,0)\)  3) \((2,0)\)  4) \((3,0)\)

5 Which sketch shows the inverse of \( y = a^x \), where \( a > 1 \)?

[Sketches of functions showing the inverse relationship]
6. The cells of a particular organism increase logarithmically. If \( g \) represents cell growth and \( h \) represents time, in hours, which graph best represents the growth pattern of the cells of this organism?

1) \hspace{1cm} 2) \hspace{1cm} 3) \hspace{1cm} 4)

7. Which graph represents the function \( \log_2 x = y \)?

1) \hspace{1cm} 2) \hspace{1cm} 3) \hspace{1cm} 4)
8 Sketch and label the graph of \( y = 2^x \).

The graph of \( y = 2^x \) is subject to each of these transformations:

1. reflection in the \( y \)-axis
2. reflection in the line \( y = x \)
3. translation: \( (x, y) \rightarrow (x, y + 1) \)

Next to the appropriate numeral below, write the letter of the equation, chosen from the list below, that best described the image of \( y = 2^x \) under each of the numbered transformations.

*Equations*

(a) \( y = \log_2 x \)
(b) \( y = -2^x \)
(c) \( y = 2^{-x} \)
(d) \( y = 2^x + 1 \)

(1)
(2)
(3)
9 Which sketch best represents the graph of \( x = 3^y \)?

1) \[
\begin{array}{c}
\text{y} \\
\text{x}
\end{array}
\]

2) \[
\begin{array}{c}
\text{y} \\
\text{x}
\end{array}
\]

3) \[
\begin{array}{c}
\text{y} \\
\text{x}
\end{array}
\]

4) \[
\begin{array}{c}
\text{y} \\
\text{x}
\end{array}
\]

10 Sketch the graph of the functions \( f(x) = 3^x \) and \( g(x) = \log_3 x \). Considering the graphs, describe the relationship between \( f(x) \) and \( g(x) \). Specify the domain and the range of \( g \).
11 If a function is defined by the equation \( f(x) = 4^x \), which graph represents the inverse of this function?

1)  

2)  

3)  

4)  

12 Sketch below the graph of \( y = 4^x \). On the same set of axes, sketch the graph of \( y = \log_4 x \).
13 Sketch and label the graph of the equation \( y = \log x \) for all values of \( x \) in the interval \( 0.1 \leq x \leq 10 \). On the same set of axes, reflect the graph drawn in the line \( y = x \), and label it \( c \). What is the equation of \( c \)?

14 Graph \( f(x) = \log_2(x + 6) \) on the set of axes below.
15 On the grid below, graph the function \( y = \log_2(x - 3) + 1 \)

16 Graph \( y = \log_2(x + 3) - 5 \) on the set of axes below. Use an appropriate scale to include both intercepts.

Describe the behavior of the given function as \( x \) approaches \(-3\) and as \( x \) approaches positive infinity.
17  Graph the following function on the axes below.

\[ f(x) = \log_3(2 - x) \]

State the domain of \( f \). State the equation of the asymptote.

18  A hotel finds that its total annual revenue and the number of rooms occupied daily by guests can best be modeled by the function \( R = 3 \log(n^2 + 10n), n > 0 \), where \( R \) is the total annual revenue, in millions of dollars, and \( n \) is the number of rooms occupied daily by guests. The hotel needs an annual revenue of $12 million to be profitable. Graph the function on the accompanying grid over the interval \( 0 < n \leq 100 \). Calculate the minimum number of rooms that must be occupied daily to be profitable.
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Answer Section

1 ANS: 4 REF: 018535siii
2 ANS: 1

3 ANS: 1 REF: 011902aii
4 ANS: 4
\[ \log_2(x - 1) - 1 = 0 \]
\[ \log_2(x - 1) = 1 \]
\[ x - 1 = 2^1 \]
\[ x = 3 \]

5 ANS: 3 REF: 011422a2
6 ANS: 3 REF: 010420b
7 ANS: 1 REF: 061211a2
8 ANS:
c, a, d

REF: 088539siii
9 ANS: 2 REF: 081816aii
f(x) and g(x) are inverses of each other. The domain of g is the positive reals and the range of g is the reals.

REF: fall9927b

11 ANS: 2

\[ f^{-1}(x) = \log_4 x \]

REF: fall0916a2

12 ANS:

REF: 069039siii

13 ANS:

\[ y = 10^x \]

REF: 019442siii
As $x \to -3$, $y \to -\infty$. As $x \to \infty$, $y \to \infty$. 

REF: 061735aaii
17 ANS:

Domain: \( x < 2 \), Asymptote \( x = 2 \)

REF: 012034aii

18 ANS:

\[
\begin{align*}
3\log(x^2 + 10x) &= 12 \\
\log(x^2 + 10x) &= 4 \\
x^2 + 10x &= 10^4 \\
x^2 + 10x - 10000 &= 0
\end{align*}
\]

\[
x = \frac{-10 \pm \sqrt{10^2 - 4(-10000)}}{2}
\]

\[
x = \frac{-10 + \sqrt{40000}}{2} \approx 95.1
\]

96 rooms must be occupied. The other root is negative.

REF: 080530b