1. Evaluate the logarithm to three decimal places. \( \log_3(21) \)
   
   (a) 0.361
   (b) 0.845
   (c) 2.771
   (d) 7.000

   Solution: c

2. Consider the function \( f \circ g \), where \( f(x) = \frac{1}{x} \) and \( g(x) = \sqrt{x + 1} \). What is the domain of \( f \circ g \)?
   
   (a) \( \{ x | x = -1 \} \)
   (b) \( \{ x | x > -1 \} \)
   (c) \( \{ x | x \geq -1 \} \)
   (d) \( \{ x : x \neq -1 \} \)

   Solution: b

3. The function \( f(x) = |x| \) is stretched by a factor of 2, shifted 1 unit right and 3 units down. What is the equation of the new function?
   
   (a) \( f(x) = 2|x - 1| - 3 \)
   (b) \( f(x) = 2|x + 1| - 3 \)
   (c) \( f(x) = |2x + 1| - 3 \)
   (d) \( f(x) = |2x - 1| - 3 \)

   Solution: a

4. Find the composition \( f \circ g(x) \) when
   \[
   f(x) = x - 1 \quad \text{and} \quad g(x) = \sqrt{2x + 1}.
   \]
   
   (a) \( f \circ g(x) = \sqrt{2x} \)
   (b) \( f \circ g(x) = \sqrt{2x + 1} - 1 \)
   (c) \( f \circ g(x) = \sqrt{2x - 1} \)
   (d) \( f \circ g(x) = \sqrt{2x + 1} \)

   Solution: b
5. Find the total amount of money accumulated at the end of 8 years if $3,000 is invested at 5% interest, compounded four times a year.

(a) $4,432.37 \\
(b) $4,475.47 \\
(c) $3,313.46 \\
(d) $4,464.39 \\
Solution: d

6. Express this logarithm as the sum, difference, and/or product of simpler logarithmic quantities. Assume all variables represent positive real numbers.

\[
\log \left( \frac{\sqrt{x + y}}{z^3} \right)
\]

(a) \( \log \left( \frac{1}{2} (x + y) - 3z \right) \) \\
(b) \( \frac{1}{2} \log(x) \log(y) - 3 \log z \) \\
(c) \( \frac{1}{2} \log(x + y) - 3 \log z \) \\
(d) \( \log \sqrt{x} + \log \sqrt{y} - 3 \log z \) \\
Solution: c

7. Consider the function \( f(x) = 1 - x^2 \).

(a) Is this function one-to-one? Why or why not? \\
Solution: no, because its graph does not pass the Horizontal Line Test \\
(b) Does this function have an inverse? If so, find it. \\
Solution: no, because it is not one-to-one \\
(c) Now consider the function \( f(x) = 1 - x^2 \) with domain \( \{x : x \geq 0\} \). Find \( f^{-1}(x) \). \\
Solution: \( f^{-1}(x) = \sqrt{1 - x} \) \\
(d) What is the domain of \( f^{-1} \)? What is the range? \\
Solution: \\
domain: \( \{x : x \leq 1\} \) \\
range: \( \{y : y \geq 0\} \)
8. Consider the function \( f(x) = \frac{1}{3}x(x^2 - 4)^2 \).

(a) Find the roots of \( f(x) \), and express them as ordered pairs.
Solution: \((0, 0), (2, 0), (-2, 0)\)

(b) Find the \( y \)-intercepts of \( f(x) \), and express them as ordered pairs.
Solution: \((0, 0)\)

(c) Find the intervals where \( f(x) > 0 \) and the intervals where \( f(x) < 0 \).
Solution:
\[ f(x) > 0 \text{ on } (0, 2) \cup (2, \infty) \]
\[ f(x) < 0 \text{ on } (-\infty, -2) \cup (-2, 0) \]

(d) Graph the function \( f(x) \). Label axes and intercepts.
Solution: The graph is a degree-five graph satisfying the information from parts (a), (b), and (c).

9. Solve the equation. \( 16^{2x-1} = \left(\frac{1}{2}\right)^x - 3 \)
Solution: \( x = \frac{7}{9} \)

10. Solve the equation. \( \log(10x^2 - 50) - \log(-4x) = 1 \)
Solution: \( x = -5 \)

11. Consider the function \( f(x) = \log_2(x + 1) \).

(a) What basic exponential or logarithmic curve can you use to help you graph this function?

\[ y = \quad \]

Solution: \( y = \log_2(x) \)

(b) Graph the basic curve in (a). Label both axes, the intercept, and one other point.
Solution: The graph has the shape of the general logarithmic graph. Its intercept is \((1, 0)\), and one other point on the graph is \((2, 1)\).

(c) Graph \( f(x) \). Label both axes, the intercept, and one other point.
Solution: The graph is the graph from part (b), shifted left by one unit. Its intercept is \((0, 0)\), and one other point on the graph is \((1, 1)\).
12. The number of bacteria present in a certain culture after \( t \) hours is given by the equation
\[
Q = Q_0 e^{0.34t},
\]
where \( Q_0 \) is the initial number of bacteria. How long will it take 300 bacteria to double? Round your solution to the nearest hundredth of an hour.

Solution: approximately 2.04 hours