1. Make up 2 functions, f and g, and then show how to find the composition of these functions \((f \circ g)(x)\). Use no more than one linear function.

\[
\begin{align*}
f(x) &= 2x + 1 \\
g(x) &= x^2 - 3
\end{align*}
\]

\[
(f \circ g)(x) = f(g(x)) = f(x^2 - 3) = \ldots
\]

A function is one-to-one if each \(x\) value in the domain is paired with one value in the range (function definition) and each \(y\) value in the range is paired with \(\ldots\) value in the domain (one-to-one).

If every \(\ldots\) (horizontal or vertical) line intersects the graph of a function \(f\) in at most one point, then the function \(f\) is one-to-one.

Sketch 2 graphs, one which is a function but isn’t one-to-one and one which is a one-to-one function.

(1) Not one-to-one

(2) One-to-one function

2. Complete the 3 main steps for finding the inverse of a function, \(y = f(x)\). Also, complete the example in the box, and use this function and its inverse for the graphs (next page).

(1) From \(y = f(x)\) form, the main idea is to ________________.

(2) Then, if possible, solve for \(y\) in terms of \(x\).

(3) Then write \(y = f^{-1}(x)\).

You can check your result by showing that ________________.

\[
\begin{align*}
\text{Let } y &= f(x) = \sqrt{x - 4} \\
x &= \sqrt{y - 4} \\
\ldots &= y - 4 \\
y &= \ldots \\
f^{-1}(x) &= x^2 + 4
\end{align*}
\]
Show the graphs and tables for the specific function, \( f \), and its inverse, \( f^{-1} \).

\[
f(x) = \sqrt{x - 4}
\]

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
<th>( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>13</td>
<td>3</td>
<td>3</td>
<td>13</td>
</tr>
</tbody>
</table>

Also give the domains and ranges of these 2 one-to-one functions. Use interval notation.

**Domain of \( f \):** \([4, \infty)\)  
**Range of \( f \):** \([0, \infty)\)

**Domain of \( f^{-1} \):** __________  
**Range of \( f^{-1} \):** __________

3. The general form for an exponential function is __________ with \( a > 0 \) and \( a \neq 1 \).

The general form for a logarithmic function is __________ with \( a > 0 \) and \( a \neq 1 \).

The other form of a logarithm is __________.

Label the following graphs with the following 3 equations:

\[ y = 2^x, \ y = x, \ y = \log_2 x \]

What is the relationship between the exponential function \( y = 2^x \) and the logarithmic function \( y = \log_2 x \)?
4. Draw rough sketches of the graphs of 2 exponential functions of the form \( y = a^x \) under the following conditions. Include any asymptotes and intercepts on your graphs. You may choose a specific value for the base, a.

(a) \( a > 1 \)  
(b) \( 0 < a < 1 \)

![Graphs of exponential functions with different bases](image)

Both graphs have y-intercept __________ and horizontal asymptote __________.

5. The compound interest formula for the accumulated amount of an investment is given by the formula,

\[
A = P \left(1 + \frac{r}{n}\right)^{nt},
\]

where \( P \) is the principal, \( r \) is the ________________, and \( t \) is the ________________.

Common numbers of compoundings \((n)\) for a year include 1 for annually, 2 for semiannually, 4 for quarterly, 12 for _______________, 52 for weekly, and 360 for daily.

If interest is compounded “continuously”, we use a new formula, _______________ , where \( P \) is the principal, \( r \) is the annual interest rate, and \( t \) is the time in years.

The number \( e \) is (like \( \pi \)) a transcendental number and is approximately ________________.

The number \( e \) is defined to be what the expression \( \left(1 + \frac{1}{n}\right)^n \) approaches as \( n \) approaches infinity (\( \infty \)).

This formula is part of the general exponential growth (or decay) category of applications.
6. There are several exponential and logarithmic equation solving principles. Complete the following statements.

(a) If \( \log_a u = v \), then _______________ .

(b) If \( a^u = a^v \), then _______________ .

(c) If \( \log_a u = \log_a v \), then _______________ .

Show the proper use of two of these principles in the problems below.

\[ \log_2(x^2 - 1) = 3 \quad \log_2(x^2 - 1) = \log_23 \]

7. Complete the following chart of logarithm rules, with their rationale.

<table>
<thead>
<tr>
<th>Rule</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>( \log_a a = 1 ) because __________</td>
<td>For example, ( \log 10 = ) _____ and ( \ln e = 1 ).</td>
</tr>
<tr>
<td>2.</td>
<td>__________ because ( a^0 = 1 )</td>
<td>For example, ( \log 1 = 0 ) and ( \ln 1 = ) _____ .</td>
</tr>
<tr>
<td>3.</td>
<td>( \log_a a^r = ) __________</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>( a^{\log_a M} = ) __________</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>( \log_a MN = \log_a M + \log_a N ) since ( a^M \cdot a^N = ) __________</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>( \log_a \frac{M}{N} = \log_a M - \log_a N )</td>
<td>since ( \frac{a^M}{a^N} = ) __________ .</td>
</tr>
<tr>
<td>7.</td>
<td>( \log_a M^r = r \cdot ) __________</td>
<td></td>
</tr>
</tbody>
</table>
| 8.  | \( \log_a M = \) __________ | This is the “Change-of-Base Formula”.


8. The common logarithm is base 10, and the inverse of $y = \log x$ is _______________.

The natural logarithm is base $e$, and the inverse of $y = \ln x$ is _______________.

These are the two typical calculator keys (\text{log} and \text{ln}).

Perform the following computations. Round to 4 decimal places.

(a) $\log 23 \approx 1.3617$
(b) $\ln 100$ _______________ = _______________
(c) $\log 10 + \ln e$ _______________ = _______________

Describe 2 practical applications of exponential functions or logarithmic functions. Include the specific formula related to the application.

(1) U.S Population Growth (Census Years, 1900-Present) $y = 81.2253 \cdot 1.0126^x$
(2) the pH scale _______________ pH = _______________

9. Complete the chart below involving the 3 cases for systems of 2 linear equations.

<table>
<thead>
<tr>
<th>Drawing:</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometric relationship:</td>
<td>(x*, y*)</td>
<td>Parallel lines</td>
<td>Coinciding lines</td>
</tr>
<tr>
<td>Solution Set:</td>
<td>${(x, y) }$</td>
<td>${(x, y) }$</td>
<td>${(x, y) }$</td>
</tr>
</tbody>
</table>

Show your work for each method of solving linear systems.

(a) Graphing (Write each linear equation near the corresponding line on your graph.)

$$\begin{cases} x + y = 5 \\ 3x - 2y = 0 \end{cases}$$

The solution appears to be ___________.

$$x + y = 5 \quad 3x - 2y = 0$$
9. (b) Substitution

\[ y = 5 - x \]
\[ 3x - 2(5 - x) = 0 \]

(c) Elimination or Addition

\[ 2(x + y) = 2(5) \]
\[ 2x + 2y = 10 \]
\[ 3x - 2y = 0 \]

10. Write a few sentences describing something you learned that was new for you in class this unit. You may include a favorite activity, an interesting application, a teaching and learning technique, or a specific concept that you better understand as a result of this unit.

Do your best! Live and learn! Rise to the challenge!