1. Let \( f(x) = \begin{cases} 
3-x & \text{if } x < 3 \\
\sqrt{x-3} & \text{if } x \geq 3
\end{cases} \)

a. (4 pt.) Evaluate: \( f(-1) = \) \( f(7) = \) 

b. (6 pt.) Sketch the graph of \( f(x) \).

2. Given \( f(x) = \frac{1}{\sqrt{x+3}} \) and \( g(x) = x^2 + 3 \),

a.) (5 pt.) Find the domain of \( f(x) \).

b.) (5 pt.) Find \( (g \circ f)(x) \).

3. (10 pt.) Given \( f(x) = x^2 + 3, \ x \geq 0 \), find the inverse function \( f^{-1}(x) \).
4. (10 pt.) The graph of the function \( y = |x| \) is shown below.

![Graph of \( y = |x| \)](image)

Graph the function \( y = |x + 2| - 5 \) in the axes below. Label three points on the graph.

![Axes for graphing \( y = |x + 2| - 5 \)](image)

5. Given the polynomial function \( P(x) = 5x^3 - 12x^2 + x + 6 \)

   a. (3 pt.) Use the factor theorem to show that \( x - 2 \) is a factor of \( P(x) \).

   b. (3 pt.) Find a complete factorization of \( P(x) \) into linear factors.
6. Given the rational function \( r(x) = \frac{3x^2}{x^2 - 4} \)

   a. (2 pt.) Find the equations of the vertical asymptotes of the graph of \( r(x) \).

   b. (4 pt.) Find \( x \) and \( y \) intercepts of the graph of \( r(x) \).

   c. (2 pt.) Find the equation of the horizontal asymptote of the graph of \( r(x) \).

   d. (5 pt.) Sketch the graph of \( r(x) \). Label the vertical and horizontal asymptotes, as well as the intercepts on the graph.

7. (8 pt.) Find the exact solution to the following equation:

   \[ 9^{x+2} = 27^x \]

8. (8 pt.) Evaluate \( \log_3 \left( \frac{1}{\sqrt{3}} \right) \) without using a calculator, showing your work.

9. (10 pt.) Find the exact solution to the following equation. Check for extraneous solutions.

   \[ \log_5 x + \log_5 (4x - 1) = 1 \]

10. (10 pt.) Use the laws of logarithms to expand \( \log_2 \left( \frac{x^3 y^2}{64} \right) \), writing powers as factors. Where possible, evaluate logarithmic expressions without using a calculator.

11. (10 pt.) Xanax is a tranquilizer used in the short-term relief of symptoms of anxiety. Its half-life in the bloodstream is 36 hours. Use the formula \( A = A_0 e^{kt} \) to find how long it will take for Xanax to decay to 90% of the original dose. Round your final answer to two decimal places.
12. (10 pt.) A circle has a radius of 40 cm. Find the length in centimeters of the arc intercepted by a central angle of \(36^\circ\). Round your answer to two decimal places.

13. Given the trigonometric function

\[ f(x) = 2 \sin \left( \frac{\pi}{2} x + \pi \right) \]

a. (3 pt.) Determine the amplitude of \(f(x)\).

b. (3 pt.) Determine the period of \(f(x)\).

c. (3 pt.) Determine the phase shift of \(f(x)\).

d. (6 pt.) Sketch one period of the graph of \(f(x)\). Label the end points and \(x\) and \(y\) intercepts of the period.

14. (10 pt.) Suppose \(\theta\) is an angle such that \(\tan \theta = \frac{3}{4}\) and \(\cos \theta < 0\). Find the exact value of \(\sec \theta\), showing your work.

15. Find the **exact** value of the following expressions

a. (5 pt.) \(\tan \left( \sin^{-1} \left( -\frac{3}{5} \right) \right) \)

b. (5 pt.) \(\cos^{-1} \left( \cos \left( \frac{\pi}{3} \right) \right) \)
16. (10 pt.) A helicopter hovers 1125 feet above a small island. The following figures shows that the angle of depression from the helicopter to point P on the coast is 35°. How far off the coast to the nearest foot, is the island?

17. (10 pt.) Verify the following trigonometric identity.

\[
\frac{\sin t}{\tan t} + \frac{\cos t}{\cot t} = \sin t + \cos t
\]

18. Use the following figure for an angle \( \theta \) in quadrant I to find the exact values of the following.

\[
\text{a. (5 pt.) } \sin(2\theta)
\]

\[
\text{b. (5 pt.) } \sin\left(\frac{\theta}{2}\right)
\]
19. (10 pt.) Find all solutions of the following equation in the interval $[0, 2\pi]$. Leave your answers in exact form.

$$8 \sin x + 1 = 6 \sin x$$

20. (10 pt.) Find the lengths $b$, $c$ and the angle $C$ in the following triangle. Round your answers to the nearest tenth, when appropriate.
Addition and Subtraction Formulas:

1.) \( \cos(s + t) = \cos(s) \cos(t) - \sin(s) \sin(t) \)
2.) \( \cos(s - t) = \cos(s) \cos(t) + \sin(s) \sin(t) \)
3.) \( \sin(s + t) = \sin(s) \cos(t) + \cos(s) \sin(t) \)
4.) \( \sin(s - t) = \sin(s) \cos(t) - \cos(s) \sin(t) \)
5.) \( \tan(s + t) = \frac{\tan(s) + \tan(t)}{1 - \tan(s) \tan(t)} \)
6.) \( \tan(s - t) = \frac{\tan(s) - \tan(t)}{1 + \tan(s) \tan(t)} \)

Double Angle Formulas:

7.) \( \sin(2s) = 2 \sin(s) \cos(s) \)
8.) \( \cos(2s) = \cos^2(s) - \sin^2(s) \)
9.) \( \cos(2s) = 2 \cos^2(s) - 1 \)
10.) \( \cos(2s) = 1 - 2 \sin^2(s) \)
11.) \( \tan(2s) = \frac{2 \tan(s)}{1 - \tan^2(s)} \)

Half-Angle Formulas:

12.) \( \sin \left( \frac{u}{2} \right) = \pm \sqrt{\frac{1 - \cos(u)}{2}} \) (\( \pm \) depends on Quadrant)
13.) \( \cos \left( \frac{u}{2} \right) = \pm \sqrt{\frac{1 + \cos(u)}{2}} \) (\( \pm \) depends on Quadrant)
14.) \( \tan \left( \frac{u}{2} \right) = \frac{1 - \cos(u)}{\sin(u)} = \frac{\sin(u)}{1 + \cos(u)} \)

Law of Sines
\[ \frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}, \] where \( a, b, c \) are lengths of sides and \( A, B, C \) are the opposite angles.

Law of Cosines
\[ a^2 = b^2 + c^2 - 2bc \cos A, \] where \( a, b, c \) are lengths of sides and \( A \) is the angle opposite side \( a \).

Arc Length and Area formulas
\[ s = r \theta \quad A = \frac{1}{2} r^2 \theta \]