INSTRUCTIONS:

1. Answer all nine (9) questions.
2. Your work must justify the answer you give.
3. Point values are as shown.
4. No calculators, lecture notes and/or books are permitted.
5. This is the first of ten (10) pages.

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Problem 1: (10 Points)

Find the domain and sketch the graph of the function \( H(t) = \frac{4 - t^2}{2 - t} \).
Problem 2: (10 Points)
Determine whether each statement is true or false. If it is true, explain why. If it is false, explain why or give an example that disproves the statement.

1. If \( f \) is a function, then \( f(s + t) = f(s) + f(t) \).

2. If \( x_1 < x_2 \) and \( f \) is a decreasing function, then \( f(x_1) > f(x_2) \).

3. You can always divide by \( e^x \).

4. If \( 0 < a < b \), then \( \ln(a) < \ln(b) \).

5. If \( x \) is any real number, then \( \sqrt{x^2} = x \).
Problem 3: (10 Points)
Let \( f(x) = \sqrt{x} \) and \( g(x) = \sqrt{1-x} \). Find the functions \( g \circ f \) and \( f \circ g \) and state their domains.
Problem 4: (10 Points)  
Suppose that the graph of \( f \) is given. Describe how the graphs of the following functions can be obtained from the graph of \( f \).

(a) \( y = f(x) + 8 \)
(b) \( y = f(x + 8) \)
(c) \( y = 1 + 2f(x) \)
(d) \( y = f(x - 2) - 2 \)
(e) \( y = -f(x) \)
Problem 5: (10 Points)
Find the exact value of each expression.

(a) \( e^{2\ln 3} \)

(b) \( \log_{10} 25 + \log_{10} 4 \)

(c) \( \tan \left( \arcsin \frac{1}{2} \right) \)

(d) \( \sin \left( \arccos \frac{4}{5} \right) \)
Problem 6: (10 Points)
(a) What is wrong with the following equation?

\[ \frac{x^2 + x - 6}{x - 2} = x + 3 \]

(b) In view of part (a), explain why the equation

\[ \lim_{x \to 2} \frac{x^2 + x - 6}{x - 2} = \lim_{x \to 2} (x + 3) \]

is correct.
Problem 7: (10 Points)
Evaluate the limit if it exists. If the limit does not exist, explain why.

(a) \( \lim_{x \to -4} \frac{\sqrt{x^2 + 9} - 5}{x + 4} \)

(b) \( \lim_{x \to +\infty} \frac{\sin^2(x)}{x^2 + 1} \) [Hint: Use the Squeeze Theorem]
Problem 8: (10 Points)
Use the Intermediate Value Theorem to show that there is a root of the equation
\[ x^5 - x^3 + 3x - 5 = 0 \]
in the interval (1, 2).
Problem 9: (20 Points)

Let

\[ g(x) = \begin{cases} 
2x - x^2 & \text{if } 0 \leq x \leq 2 \\
2 - x & \text{if } 2 < x \leq 3 \\
x - 4 & \text{if } 3 < x < 4 \\
\pi & \text{if } x \geq 4 
\end{cases} \]

(a) For each of the numbers 2, 3, and 4, discover whether \( g \) is continuous from the left, continuous from the right, or continuous at the number.

(b) Sketch the graph of \( g \).