Important: Your should write your solutions in the space given. If you have to write your solution outside the space provided, you must indicated clearly where your solutions are. Failing to do so may result in losing credit points as grader will ignore solutions that are not written in the given space.

PART 1. This portion of the test consists of five Fill in the Blank questions. Write your answers neatly and legibly in the spaces provided. Some partial credit may be given.

1. (3 points) Given that \( \lim_{x \to 2} f(x) = 4 \) and \( \lim_{x \to 2} g(x) = 16 \), then \( \lim_{x \to 2} g(x) - 2f(x) \) is _____.

2. (3 points) Is the identity \( \sin(4x) = 4 \sin(x) \) true or false? ____.

3. (3 points) Given functions \( f(x) = x^2 + 4 \) and \( g(x) = \frac{1}{x-1} \) the domain of \( f \circ g \) is _____.

4. (3 points) The value of \( \lim_{x \to 2} \frac{4x - 1}{x^2 - 7} \) is _____.

5. (3 points) If \( f(x) = \begin{cases} 4x - 1 & \text{if } x < 1 \\ 3x + 2 & \text{if } x \geq 1 \end{cases} \), then \( \lim_{x \to 1^+} f(x) \) is _____.

PART 2: This portion of the test consists of two multiple choice problems. No partial credit is given in this section, so work very carefully. Value: 3 points each.

6. The limit \( \lim_{x \to 2} (x^2 - 2)(x^2 + x) \) is equal to

(A) 2  (B) 6  (C) 12  
(D) 16  (E) 0  (F) None of These.
7. The equation \( x^3 - 5x + 1 = 0 \) has a solution in the interval:

(A) \([-1, 0]\]  (B) \([-1, -2]\]  (C) \([1, 2]\]

(D) \([0, 1]\]  (E) \([3, 4]\]  (F) None of these.

8. Let \( f(x) = 6 + x^2 \). Then \( f(x+h) \) equals

(A) \( 6 + x^2 + h \)  (B) \((6 + h) + (x + h)^2\)  (C) \( 6 + x + h \)

(D) \( 6 + x^2 + 2xh + h^2 \)  (E) \( 6 + x + h^2 \)  (F) \( 6x + h \)

(G) \( 6 + x^2 + h^2 \)  (H) None of these.

9. The limit \( \lim_{x \to 2} \frac{4(x^2 - x - 2)}{4 - x^2} \) equals:

(A) \( -\frac{3}{4} \)  (B) \(-3 \)  (C) DNE  (D) \( \frac{3}{4} \)

(E) \( 2 \)  (F) \( 4 \)  (G) \( 3 \)  (H) None of these.

10. Given the function

\[
f(x) = \begin{cases} 
  3x - 1 & \text{if } x < 1 \\
  x^2 + 1 & \text{if } x > 1 
\end{cases}
\]

which of the following statements is correct?

(A) \( f(x) \) is continuous at \( x = 1 \).

(B) The discontinuity of \( f(x) \) at \( x = 1 \) can be removed by defining \( f(1) = 2 \).

(C) \( f(x) \) has a non removable discontinuity at \( x = 1 \).

(D) The discontinuity of \( f(x) \) at \( x = 1 \) can be removed by defining \( f(1) = 3 \).

(E) None of above is correct.
PART 3: This portion of the exam will be graded on a partial credit basis. **Answers without supporting work shown on the paper will receive NO credit.**

11. **(10 points)** Let \( f(x) = \sqrt{x - 6} \) and \( g(x) = x^2 + 6 \). Find the functions \( f \circ g \) and \( g \circ f \) and determine their domains.

12. **(5 points each)** Compute each of the limit below.

   (a) \( \lim_{x \to 0} \frac{\tan(5x)}{\sin(2x)} \).

   (b) \( \lim_{x \to \infty} \frac{\sin(7x)}{x} \).
13. (5 points each) Compute each of the limit below.

(a) \[ \lim_{x \to 2^-} \frac{|x - 2|}{x^2 - 4}. \]

(b) \[ \lim_{x \to 3} \frac{x^2 - 2x - 3}{x - 3}. \]

14. (10 points) Given the function \( f(x) = \sqrt{x} \), first evaluate the difference quotient \[ \frac{f(4 + h) - f(4)}{h} \] and then compute the limit \[ \lim_{h \to 0} \frac{f(4 + h) - f(4)}{h} \].
15. (10 points) Find the constant $c$ that makes $g(x)$ continuous on $(-\infty, \infty)$.

$$g(x) = \begin{cases} 
4x^2 - c^2 & \text{if } x < 2 \\
3cx + 25 & \text{if } x \geq 2.
\end{cases}$$

16. (10 points) If for all $x > 7$,

$$\frac{3x - 7}{x} < f(x) < \frac{3x^3 + 7x}{x^3},$$

find $\lim_{x \to \infty} f(x)$. (Solutions with answer only and without procedure showing how the answer is obtained will have little credit).
17. (5 points each) Sketch graphs for functions with specific properties.

(a) Sketch the graph of a function \( f(x) \) with domain \([0, 2)\) that satisfies each of the following conditions: \( f(0) = 1, \) \( \lim_{x \to 1^+} f(x) = 2, \) \( \lim_{x \to 1^-} f(x) = 3, \) \( \lim_{x \to 2^-} f(x) = 0, \) and \( f(x) \) is continuous in both \([0, 1)\) and \((1, 2)\).

(b) Sketch the graph of a continuous function \( f(x) \) with \((-\infty, 0) \cup (0, 1) \cup (1, \infty)\) that satisfies each of the following conditions:

\[
\lim_{x \to 0^+} f(x) = \lim_{x \to 0^-} f(x) = \infty, \quad \lim_{x \to 1^-} f(x) = \lim_{x \to 1^+} f(x) = -\infty, \quad \lim_{x \to \infty} f(x) = \lim_{x \to -\infty} f(x) = 1.
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