1. Consider the function \( f \) defined by:

\[
    f(x) = \begin{cases} 
        |x + 2| & \text{if } x \leq 0 \\
        5 - x^2 & \text{if } x > 0 
    \end{cases}
\]

Find the three solutions to \( f(x) = 1 \) and compute their sum.

(A) \(-4\)  (B) \(-2\)  (C) \(0\)  (D) \(2\)  (E) \(6\)

2. Let \( f(x) = \frac{1}{x} \). What is the value of \( \frac{f(x + 2) - f(x)}{2} \)?

(A) \(-\frac{1}{x(x + 2)}\)  (B) \(\frac{1}{x(x + 2)}\)  (C) \(\frac{x}{x + 2}\)  (D) \(-\frac{x}{x + 2}\)  (E) \(x + 2\)

3. Let \( f(x) = \sqrt{2x} \). What is the value of \( f(x + 1) - f(x) \) in terms of \( x \)?

(A) \(\frac{2}{\sqrt{2x + 2} + \sqrt{2x}}\)  (B) \(\frac{2}{\sqrt{2x + 1} + \sqrt{2x}}\)  (C) \(\frac{1}{\sqrt{2x + 1}}\)

(D) \(\sqrt{2x + 2}\)  (E) \(\sqrt{2x + 2} - x\)

4. Suppose the point \((2, 5)\) belongs to the graph of a function \(g\) and \(g'(2) = 4\). What is the \(y\)-intercept of the line tangent to the graph of \(g\) at the point \((2, 5)\)?

(A) \(-8\)  (B) \(-3\)  (C) \(3\)  (D) \(8\)  (E) \(13\)

5. The line tangent to the graph of a function \(h\) at the point \((3, 7)\) has a \(y\)-intercept of 10. What is \(h'(3)\)?

(A) \(-7\)  (B) \(-4\)  (C) \(-1\)  (D) \(1\)  (E) \(17/3\)
Math 1120  Calculus  Test 2

On all the following questions, show your work.

6. (20 points) Let

\[ f(x) = \begin{cases} 2x - 3 & \text{if } x \leq 4 \\ 6 - x & \text{if } x > 4 \end{cases} \]

and let \( g(x) = 2x \).

(a) Compute each of the following

i. \( f \circ g(1) \)

ii. \( f \circ g(2) \)

iii. \( f \circ g(3) \)

iv. \( f \circ g(3.5) \)

(b) Find a symbolic representation of the composition \( f \circ g(x) \), and simplify the representation.
7. (25 points) Compute the limits requested.

(a) \( \lim_{h \to 0} \frac{\sqrt{2 + h} - \sqrt{2}}{h} \)

(b) \( \lim_{x \to 3} \frac{x - 3}{x^3 - 27} \)

(c) \( \lim_{h \to 0} \frac{\frac{1}{3 + h} - \frac{1}{3}}{h} \)

(d) \( \lim_{x \to \infty} \frac{2x^3 - 2x^2 + 7}{4x^3 - 10x^2 + x - 27} \)

(e) \( \lim_{x \to -\infty} \frac{|x| - 3}{3x + 5} \)
8. (25 points) Find the following derivatives.

(a) \( \frac{d}{dx} \sqrt{2x^3 - 5x + 7} \)

(b) \( \frac{d}{dx} (2x - 1) \cdot (3x^2 + 4x) \)

(c) \( \frac{d}{dx} \frac{2x^2 - 1}{3x + 2} \)

(d) \( \frac{d}{dx} \sqrt{x^2 - 2x + 1} \)

(e) \( \frac{d}{dx} (x^3 + 3x^2 + 3x + 1)^{1/3} \)
9. (20 points) Let $f(x) = \frac{1}{x} + x$.

(a) Compute $f(3.1)$

(b) Compute $f(3 + h)$

(c) Compute $\frac{f(3+h) - f(3)}{h}$ and simplify, assuming $h \neq 0$.

(d) Take the limit of the expression in (c) as $h$ approaches 0 to find $f'(3)$.

(e) What is the slope of the line tangent to $f$ at the point $(3, 3\frac{1}{3})$.

(f) Find an equation for the line tangent to the graph of $f$ at the point $(3, 3\frac{1}{3})$. 