1. (16 points total) For the graph of the function illustrated in below determine the following:

\[ y = f(x) \]

(a) \( \lim_{x \to -8^-} f(x) \)
(b) \( \lim_{x \to -8^+} f(x) \)
(c) \( \lim_{x \to 0^-} f(x) \)
(d) \( \lim_{x \to 0^+} f(x) \)
(e) \( \lim_{x \to -\infty} f(x) \)
(f) \( \lim_{x \to +\infty} f(x) \)
(g) \( f(0) \)
(h) At which points is \( y = f(x) \) discontinuous?
(i) List the \( x \)-coordinates of all the critical points.

2. Compute the following limits. Give justifications for your answers. (4 points each)

(a) \( \lim_{x \to \infty} \frac{2x^3}{5x^4 + 2x^3 - 2} \)
(b) \( \lim_{x \to -3} \frac{x^2 - 9}{x + 3} \)
(c) \( \lim_{x \to 0} \frac{\sqrt{x + 1} - 1}{x} \)
(d) \( \lim_{x \to 1} \frac{3x^2 - 2x + 4}{x} \)

3. (8 points) Prove by induction,

\[ 1 + 3 + \cdots + (2N - 1) = N^2. \]
4. *(10 points)* For a function \( y = f(x) \) give the algebraic expression for the Newton quotient at the point \( x = a \).

5. *(10 points)* Compute the derivative \( f'(x) \) by computing the limit of the Newton quotient:

\[
f(x) = \frac{1}{x + 2}
\]

6. *(10 points total)* The following expressions are the derivatives of a function \( y = g(x) \) at a point \( x = b \) for various functions. In each case identify \( g(x) \) and the point \( b \). DO NOT COMPUTE THE LIMITS.

   (a) \[
   \lim_{h \to 0} \frac{\ln (2 + h) - \ln (2)}{h}
   \]

   (b) \[
   \lim_{h \to 0} \frac{\cos \left( \frac{\pi}{3} + h \right) - 1/2}{h}
   \]

7. *(30 points total)* Consider the graphs of \( y = f(x) \) and \( y = g(x) \) that are depicted on the left and right below, respectively. Answer the questions that follow with complete sentences or grammatically correct notation.

(a) ¿How many critical points does \( y = f(x) \) have?
(b) ¿How many critical points does \( y = g(x) \) have?
(c) ¿On what intervals is \( y = f(x) \) increasing? Decreasing?
(d) ¿On what intervals is \( y = g(x) \) increasing? Decreasing?
(e) ¿For which values of \( x \) is the derivative, \( f'(x) \) positive? Negative?
(f) ¿For which values of \( x \) is the derivative, \( y = g(x) \) positive? Negative?
(g) ¿For which values of \( x \) is it true that \( 0 < g(x) \)?
(h) ¿For which values of \( x \) is it true that \( 0 < f(x) \)?
(i) True or False: \( f(x) = g'(x) \)?