1. (10 points) Find the domain for the function

\[ f(x) = \frac{x}{4 - x^2} \]

2. (10 points) 1. People are willing to pay \( 100 - \sqrt{x} \) dollars for a limited edition etching, where \( x \) is the number sold. What is the domain of \( x \)?

3. (15 points) Find

(a) \[ \lim_{x \to \infty} \frac{x + 3}{x^2 - 9} \]

(b) \[ \lim_{x \to 7} \frac{x - 7}{x^2 - 49} \]

(c) \[ \lim_{x \to 3} \frac{x^3 - 8}{x - 3} \]

4. (10 points) Let \( f(x) = x^2(x + 1) \). Find the equation of the line tangent to the curve \( f(x) \) at \( x = 1 \) without using the rules of differentiation.
5. (10 points) Determine all values of x, if any, for which \( f(x) \) is discontinuous.

\[
f(x) = \begin{cases} 
  x + 1, & x \leq 1 \\
  -x^2 + 4x - 1, & x > 1 
\end{cases}
\]

6. (15 points) The graph of a function \( f \) is sketched below

(i) Find the points at which \( f \) has no limit; explain your reasoning.

(ii) Find the points at which \( f \) is not continuous; explain your reasoning.

(iii) Find the points at which \( f \) has no derivative; explain your reasoning.
7. (10 points) If the price of a product per item is given by \( p(x) = x^2 + 2x + 4 \) and the total cost function is given by \( C(x) = 8 + x \) where \( x \) is the number of items produced and sold. Find the profit function \( P(x) \). What is the profit when the production and sales are \( x = 6 \)?

8. (10 points) Suppose an egg is thrown straight upward from the ground with initial velocity 96 feet/second and the egg’s height at time \( t \) is given by the function \( s(t) = 96t - 16t^2 \). Find the velocity at any time \( t \) without using the rules of differentiation. What is the velocity of the egg when \( t = 3 \) seconds?

9. (10 points) The monthly demand and supply functions for the Luminar desk lamp are given by \( p = d(x) = -1.1x^2 + x + 40 \) and \( p = s(x) = 0.1x^2 + 15 \) respectively, where \( p \) is measured in dollars and \( x \) in units of a thousand. Find the equilibrium quantity and price.