Problem 1. Find the domain of \( f(x) = \sqrt{\frac{x^2 - 8x + 15}{x^2 - 1}} \).

Problem 2. Evaluate each of the following limits, or state explicitly why it does not exist.

i. \( \lim_{x \to 2} \frac{x^4 - 2x^3 + 3x^2 - 15x + 18}{x^3 - 8} \)

ii. \( \lim_{x \to 3} \frac{\sqrt{7 - x} - 2}{\sqrt{4 - x} - 1} \)

iii. \( \lim_{t \to \infty} \frac{\sin(t^2 + 1)}{1 - t} \)

iv. \( \lim_{x \to \infty} \left( \frac{x^2}{x + 2} - \frac{x^3}{x^2 + 3} \right) \)

v. \( \lim_{x \to 5} \frac{x^2 - 25}{|x - 5|} \)

Problem 3. Find all horizontal asymptotes of the graph of \( r(t) = \frac{6t^3 + 5t - 7}{\sqrt{625t^2 + 2t^5 - 10}} \).

Problem 4. Use the definition of the derivative to find \( g'(3) \) if \( g(x) = \frac{x}{\sqrt{x + 1}} \).

Problem 5. Find all points on the graph of \( f(x) = 2x^3 + 3x^2 - 12x + 1 \) where the tangent line is horizontal.
Problem 6. In each of the following, compute the desired value or function.

i. Find $h'(0)$ if $h(q) = \frac{(e^{q^2+q} - 2)^8}{\sin^2(q) + 3}$.

ii. Find $f'(0)$ if $f(x) = (x^2 + 4x + 1)^2(x^3 - 1)^{10}e^{2x}$.

iii. Find $y'(t)$ if $y(t) = \tan^3(\cos(t - \frac{1}{t}))$.

iv. Find $f''(x)$ if $f(x) = \ln(\ln(x + 1))$.

Problem 7. Find an equation of the line tangent to the graph of $x(t) = \sqrt{t^2 + 3t + 6}$ at the point $(2, 2)$.

Problem 8. A ball is thrown vertically upward at time $t = 0$ with an initial velocity of 80 ft/sec at an initial height of 96 feet. This gives that during the time of flight, the ball’s height at time $t$ is $h(t) = -16t^2 + 80t + 96$.

i. Find the maximum height of the ball.

ii. Find the velocity of the ball when it hits the ground.

Problem 9. The ellipse defined by $x^2 + 4y^2 = 36$ has two tangent lines that pass through the point $(12, 3)$. Find the equations of both of these lines.