Problem 1: (4 points) Find the limit if it exists.

(a) \( \lim_{{x \to \pi/4}} \frac{\sin x - \cos x}{\cos 2x} \)

(b) \( \lim_{{x \to 0}} \frac{\sin 2x}{x + 2\tan 2x} \)

Problem 2: (5 points)

(a) If \( f(x) = \sqrt{x} e^{x+1} + \pi^3 \) find \( f'(1) \)

(b) Find equations of both lines through the point \((1,-3)\) that are tangent to the parabola \( y = x^2 \).

Problem 3: (3 points) A ball is thrown straight up from the ground. Its distance from the ground at time \( t \) is \( s(t) = 5 + 36t - 6t^2 + \frac{t^3}{3} \).

(a) Find the maximum height that the point can reach.

(b) Find the velocity of the ball when it hits the ground.

Problem 4: (4 points) Find \( y' \). DO NOT SIMPLIFY.

(a) \( y = \left( \frac{\sqrt{x}}{x^2 - x} \right)^2 \)

(b) \( y = \sec^3(\sin x) \)

(c) \( y = 2^x + \tan x \)

(d) \( y = \csc^2 x^3 \)

Problem 5: (4 points) If \( f(3) = 2, f'(3) = 1, g(3) = 3 \) and \( g'(3) = 4 \), find

1. \( \frac{d}{dx} \left( f(x^2 - 2x) \right)_{x=3} \)

2. \( \frac{d}{dx} \left( e^x g \right)_{x=3} \)
Problem 1: (4 points) Find the limit if it exists. $\lim_{{x \to 0}} \frac{\sin 2x}{x + 2 \tan 2x}$

Problem 2: (6 points)
(a) If $f(x) = \sqrt{x} e^{x+1} + \pi^3$ find $f'(1)$

(b) Find equations of both lines through the point (1,-3) that are tangent to the parabola $y = x^2$.

Problem 3: (4 points) A ball is thrown straight up from the ground. Its distance from the ground at time $t$ is $s(t) = 8 + 36t - 6t^2 + \frac{t^3}{3}$.

(a) Find the maximum height that the point can reach.

(b) Find the velocity of the ball when it hits the ground.

Problem 4: (8 points) Find $y'$. DO NOT SIMPLIFY.
(a) $y = \left(\frac{\sqrt{x}}{x^2 - x}\right)^2$

(b) $y = \sec^3(\cot x)$

(c) $y = 2^{x + \tan x}$

(d) $y = \csc^2 x^3$

Problem 5: (3 points) If $f(3) = 2$, $f'(3) = 1$, $g(3) = 3$ and $g'(3) = 4$, find $\frac{d}{dx} \left( \frac{g(x^2 - 2x)}{f(x)} \right)_{x=3}$
**Problem 1:** (4 points) Find the limit if it exists. \[ \lim_{x \to \pi/4} \frac{\sin x - \cos x}{\cos 2x} \]

**Problem 2:** (6 points)
(a) If \( f(x) = \sqrt{x} \ e^{x^{-1}} - \pi^3 \) find \( f'(1) \)

(b) Find equations of both lines through the point (1,3) that are tangent to the parabola \( y = -x^2 \).

**Problem 3:** (4 points) A ball is thrown straight up from the ground. Its distance from the ground at time \( t \) is \( s(t) = 5 + 36t - 6t^2 + \frac{t^3}{3} \).

(a) Find the maximum height that the point can reach.

(b) Find the velocity of the ball when it hits the ground.

**Problem 4:** (8 points) Find \( \frac{dy}{dx} \). DO NOT SIMPLIFY.
(a) \( y = \left( \frac{\sqrt{x}}{x^2 + 1} \right)^3 \)

(b) \( y = \sec^4(\cos x) \)

c) \( y = 2^{x + \cos x} \)

d) \( y = \csc^2 x^3 \)

**Problem 4:** (3 points) If \( f(3) = 2, \ f'(3) = 1, \ g(2) = 3 \) and \( g'(2) = 4 \), find \( \frac{d}{dx} \left( \frac{f(x^2 - 2x)}{g(x)} \right) \) at \( x = 3 \)