1. Let \( f \) be a continuous function. Find
\[
\lim_{x \to \infty} f \left( (1 - \frac{1}{x})^x \right).
\]

2. Consider the equation \( x + e^x = 0 \). Is there a solution to this equation? Why or why not.

3. Find the derivative of the function
\[
e^{2\tan(\sqrt{x})}.
\]

4. Consider the function
\[
f(x) = \begin{cases} 
\frac{\sin x}{x} & x < 0 \\
x^3 + 2x + 1 & x \geq 0
\end{cases}
\]

At which points is \( f \) continuous? At which points is it differentiable?

5. Let \( f(x) = x \ln \left( 1 + e^{x^2} \right) \). Find \( f'(5) \).

6. Show that the curves
\[
e^{x^2-y^2} \cos(2xy) = 1 \quad \text{and} \quad e^{x^2-y^2} \sin(2xy) = 0
\]
meet orthogonally at the point \((\sqrt{\pi}, \sqrt{\pi})\).

7. Find the derivative of the function
\[
f(x) = \frac{(\sin x)^2 (\tan x)^2}{(x^2 + 1)^2}.
\]

8. Find an equation for the tangent line to the curve
\[
x^2 + y^2 = (2x^2 + 2y^2 - x)^2 = 0
\]
through the point \((0, 0.5)\).

9. If \( f(x) = e^x/(x + 1)^3 \), find \( f'(x) \) and \( f''(x) \).

10. Find the limit
\[
\lim_{x \to 1} \frac{x^\pi - 1}{x^e - 1}.
\]

11. Show that \( e^x \geq 1 + x \) for \( x \geq 0 \). (Hint: Consider the function \( f(x) = e^x - 1 - x \).)
12. A particle is moving along the curve \( y = x^2 \). As it passes through the point \((2, 4)\), its \( y \) coordinate changes at a rate of 5 m/sec. What is the rate of change of the particle’s distance to the origin at this instant?

13. Find the absolute maximum and absolute minimum values of the function

\[ f(x) = x^2 - \ln x^2 \]

on the interval \([1/4, 4]\).

14. Find

\[ \lim_{x \to \frac{\pi}{2}} \tan(7x)\cos(4x). \]

15. A woman wants to get from a point \( A \) on the shore of a circular lake to a point \( C \) diametrically opposite \( A \) in the shortest possible time. She can walk at a speed of 4 \( \text{mi/hr} \) and row at a speed of 2 \( \text{mi/hr} \). How should she proceed?

16. Consider the function

\[ f(x) = x^3 - 7x^2 + 9x - \pi. \]

(i) Find all the critical points of \( f \), and the values of \( f \) at those points. State weather these points are local maxima, local minima or neither.

(ii) Find all the inflection of points of \( f \).