I. Using the differentiation formulas find $\frac{dy}{dx}$ for each of the following:

1. $y = \sqrt{x^3}$
2. $y = \cos(x)$
3. $y = x \sin(x)$
4. $y = \frac{x - 1}{x - 2}$
5. $y = \frac{\sin(x)}{x}$
6. $y = x^4 - 2x^2$

II. Evaluate the following limits:

7. $\lim_{x \to 0} \frac{9 - x}{3 - \sqrt{x}}$
8. $\lim_{x \to 0} \frac{\sin(5x)}{x}$
9. $\lim_{x \to 1} \frac{x^2 - 1}{x - 1}$

III.

10. Find the equation of the tangent line to the curve $y = \sqrt{x} + 2$ at the point where $(1, 3)$.

IV. Sketch each of the following and find the indicated limits.

11. Find $\lim_{x \to 1}$ of the following:

   $y = \begin{cases} 
   0 & \text{if } x > 1 \\
   1 & \text{if } x = 1 \\
   0 & \text{if } x < 1.
   \end{cases}$
12. Find \( \lim_{x \to 1^+} \) of the following:

\[
y = \begin{cases} 
0 & \text{if } x > 1 \\
1 & \text{if } x = 1 \\
1 & \text{if } x < 1.
\end{cases}
\]

13. Find \( \lim_{x \to 1} \) of the following:

\[
y = \begin{cases} 
x & \text{if } x > 1 \\
1 & \text{if } x = 1 \\
x^2 & \text{if } x < 1.
\end{cases}
\]

V. Sketch the graph and then use the definition of continuity to discuss the continuity at \( x = 2 \).

14. \( f(x) = \begin{cases} 
x - 3 & \text{if } x \geq 2 \\
x^2 - 2x - 1 & \text{if } x < 2
\end{cases} \)

15. Define \( P \) such that the following function is continuous at \( x = 3 \).

\[
f(x) = \begin{cases} 
(x^2 - 9) & \text{if } x \neq 3 \\
\frac{4x - 12}{P} & \text{if } x = 3
\end{cases}
\]

VI.

16. Using first principles (the definition of the derivative) find \( \frac{dy}{dx} \) at \( x = 0 \) for \( y = x^2 \)

VII.

17. The position of a particle is given by \( s = t^2 - 8t \)

a. Find the velocity at any time \( t \).

b. When does the particle hit the ground and with what speed is the particle at rest?