1. For the function \( f(x) = \begin{cases} 
\frac{5x^2 - 45}{x^2 - 7x + 12} & x \neq 4, x \neq 3 \\
1 & x = 4, x = 3
\end{cases} \), find all \( x \)-values at which \( f(x) \) is not continuous and give a reason for each. Show all work.
2. For the function \( f(x) = \begin{cases} \sqrt[3]{x} + 1 + 3 & x < 0 \\ 2x^3 + 4x & 0 \leq x < 1 \\ 8x - 2 & 1 \leq x \end{cases} \) find all \( x \)-values at which \( f(x) \) is not differentiable and give a reason for each. Show all work.
3. Find the vector component of the vector \(<4, 6>\) in the direction of the vector \(<2, -1>\).

4. Find an equation of the tangent line to \(f(x) = 5(x + 3)^{2/3}\) at \((5, f(5))\).

5. Evaluate the limit.

\[
\lim_{x \to 0} \frac{\tan^2(3x)}{2x \sin x}
\]

6. Write out the **limit definition** of the derivative for \(f(x) = x^2 + e^x\). **Do not work it out.**
7. Find the linear approximation to \( f(x) = \sec^2 x \) at \( a = \frac{\pi}{4} \).

8. Find the linear approximation to \( \sqrt[3]{7.5} \) using \( a = 8 \).

9. Simplify \( \tan(\arcsin 2t) \).
10. A curve is described parametrically by \[ x(t) = t^3 - 2t^2 \quad y(t) = t^3 + 3t^2. \]

Find all values of \( t \) so that the tangent to the curve at \((x(t), y(t))\) is horizontal and all values of \( t \) at which the tangent is vertical.

11. Find the derivative of each function.

\[ a) \quad f(x) = x \arctan x - \frac{1}{2} \ln(1 + x^2) \]

\[ b) \quad f(x) = 5e^{\sqrt{x^2 + 1}} \]
12. Find the x-coordinate(s) of the inflection point(s) of
a) \( f(x) = x^5 + x^4 \).

b) \( f(x) = x^4 \ln x \)
13. Evaluate each limit.

a) \( \lim_{x \to 0^+} x e^{1/x} \)

b) \( \lim_{x \to \infty} \left( \frac{x + 2}{x - 2} \right)^x \)
14. Find the most general antiderivative of each function.

\(a\) \( f(x) = x(x + 4) \)

\[ b) \quad f(x) = \frac{x^2 - \sqrt{x}}{x} \]

\(c) \quad f(x) = \sec x(\sec x + \cos^2 x) \)
15. The base of a right triangle is increasing at the constant rate of \( 2 \text{ cm/s} \) and the height is decreasing at the constant rate of \( 1 \text{ cm/s} \).

a) Find the rate of change of the angle between the base and the hypotenuse at the instant when the base is 6 cm and the height is 12 cm.

b) If the base is initially 10 cm and the height is initially 20 cm, find the maximum area.
16. a) Find the Riemann sum for \( f(x) = 8^x \) on the interval \([0, 2]\) using three equal subintervals and the midpoints of the subintervals as evaluation points. Sketch the rectangles and the graph.

b) Find the exact value of the area under \( f(x) = 8^x \) over the interval \([0, 2]\).
17. Use geometry to evaluate \( \int_{-2}^{4} f(x) \, dx \) for the function shown.

\[ f(x) = \begin{cases} 
\sqrt{4 - x^2} & x < 0 \\
-2x + 2 & 0 \leq x 
\end{cases} \]
18. Evaluate the definite integral.

a) \[ \int_{1}^{4} \frac{3}{x} + e^x \, dx \]

b) \[ \int_{0}^{\frac{\pi}{3}} \sin x \, dx \]

c) \[ \int_{0}^{\frac{1}{2}} \frac{1}{\sqrt{1 - x^2}} \, dx \]