Directions: Organize your work, use correct syntax, and write clearly.

1. Apply the limit process to find the derivative of \( f(x) = \sqrt{2x + 1} \).

2. Evaluate \( \int_{1}^{2} x^2 \, dx \) by applying the limit of a Riemann sum.

3. Sketch the region bounded by the graphs of the given equations.
   Then determine the area of the region.
   Determine the volume of the solid that is generated when the region is revolved about the line \( y = -1 \).
   Determine the volume of the solid that is generated when the region is revolved about the line \( x = -2 \).
   (a) \( y = x^2 + x \) and \( y = x + 1 \)
   (b) \( y = 1 - \sqrt{x} \), \( y = 0 \), and \( x = 0 \)

4. Evaluate the derivative of the function.
   Do not leave negative exponents in the final answer.
   (a) \( f(x) = \frac{3}{x} - \frac{4}{x^2} + 4\sqrt{x} - \frac{6}{\sqrt{x}} \)
   (b) \( f(x) = 6x^2\sqrt{4x + 5} \)
   (c) \( f(x) = \int_{\csc(x)}^{\sec(x)} \sqrt{1 + t^2} \, dt \)

5. The radius of a circle is increasing at a rate 2 feet per hour.
   If the area of the circle is \( 16\pi \) square feet, determine how fast the area of the circle increasing.

6. A car is driving north at a rate of 60 mph, and a truck is driving west at 45 mph. If the car and truck are at a common point \( P \) at 12 noon, determine how fast is the distance between the car and truck increasing after 5 minutes.

7. A 6-ft ladder is leaning against a wall. The base of the ladder is sliding away from the wall at a rate of 2 ft/min.
   Let \( A \) denote the area of a triangle that is formed by the wall, ladder, and the floor.
   If the base of the ladder is 2 ft from the wall, determine the rate of change of the area \( A \).

8. Evaluate the integrals.
   (a) \( \int_{0}^{\pi/2} \cos^2(x) \, dx \).
   (b) \( \int \left( \frac{x^2 + 3x + 4}{2\sqrt{x}} \right) \, dx \)
   (c) \( \int_{0}^{1} \frac{x^2 \, dx}{\sqrt{x^2 + 1}} \)
   (d) \( \int_{\pi/3}^{\pi/6} \frac{\cos(x)}{\sin^2(x)} \, dx \)
   (e) \( \int_{1}^{e} \frac{\ln(x)}{x^2} \, dx \)
   (f) \( \int_{1}^{2} \frac{dx}{\sqrt{8 - x^2 + 2x}} \).
   (g) \( \int_{4}^{7} \frac{dx}{x^2 - 8x + 25} \).
   (h) \( \int_{0}^{\pi/3} 2 \tan^3(x) \sec^2(x) \, dx \)
   (i) \( \int_{0}^{\pi/6} \sec(2x) \, dx \)
   (j) \( \int_{0}^{\pi/12} \tan(4x) \, dx \)
   (k) \( \int x \cot(x^2) \, dx \)
   (l) \( \int \sec(\sqrt{x}) \, dx \)
   (m) \( \int_{1/3}^{1/4} \frac{\cos^2(\pi x)}{\cot(\pi x)} \, dx \)
\(\int_{1/4}^{1/6} \frac{\sec^2(\pi x)}{\tan^2(\pi x)} \, dx\)

9. Determine the open intervals where \(h(x) = \frac{3}{4}x^{4/3} - \frac{1}{5}x^{5/3}\) is increasing or decreasing.

Then determine the relative maximum and relative minimum values of \(h(x)\).

10. Determine the open intervals where \(f(x) = 2x^3 + 12x^2 - x^4 + 30\) is concave upward or concave downward.

Also, determine the points of inflection of \(y = f(x)\).

11. Find the point on the graph of \(y = 2\sqrt{x}\) that is closest to the point \((3, 0)\).

12. A right triangle is formed in the first quadrant by the coordinate axes, and a hypotenuse that contains point \((1, 2)\).

Determine the minimum area of such a triangle.

13. Determine the extrema of \(f(x) = \sin(x) + \sqrt{3}\cos(x)\) where \(0 \leq x \leq 2\pi\).

14. Determine the values of \(c\) that satisfy the Mean Value Theorem for \(f(x) = \frac{2x-1}{x^3}\) where \(0 \leq x \leq 2\).

15. Find an equation of the tangent line to the graph of the function at the point whose \(x\)-coordinate is indicated.

(a) \(f(x) = x^2 \ln(x), \ x = e\).

(b) \(y = \sec^2(2x), \ x = \frac{\pi}{6}\)

16. Evaluate the limit

(a) \(\lim_{x \to \infty} \sqrt{x + 4} - \sqrt{x + 1} \sqrt{x}\).

(b) \(\lim_{n \to \infty} \sqrt{x^2 + 2x} - \sqrt{x^2 + 25}\)