1. Differentiate the function
\[ y = \frac{(x + 1)\sqrt{x + 2}}{\sqrt{x + 3}}. \]

2. Evaluate the limit if it exists (possibly as an infinite limit).
   (a) \[ \lim_{x \to 1^+} \frac{x}{1 - x} \]
   (b) \[ \lim_{x \to 1^-} \frac{x}{1 - x} \]
   (c) \[ \lim_{x \to 1} \frac{x}{1 - x} \]

3. Find all points \( P \) on the curve \( y = x^2 + 1 \) with the property that the tangent line at \( P \) passes through the origin.

4. Use a linear approximation to estimate \( \sqrt{37} \).

5. If \( \sin(y - x) = y + x \), express \( dy/dx \) in terms of \( x \) and \( y \).

6. Find the constant \( a \) for which \( f(x) = x^3 + ax^2 \) has an inflection point at \( x = 1 \). For this value of \( a \), find the intervals of concavity of \( f(x) \).

7. Use Newton’s method to find the root of \( x^4 + x - 4 = 0 \) in the interval \([1, 2]\), correct to 6 decimal places.

8. Find the points on the parabola \( y = x^2 \) closest to \((0, 1)\).

9. Find the limit.
   \[ \lim_{x \to 1} \left( \frac{1}{\ln x} - \frac{1}{x - 1} \right) \]

10. Evaluate the integral.
    \[ \int_1^2 x\sqrt{x - 1} \, dx \]

11. Find the area enclosed by the lines \( x = 0, \ y = 1 \) and the curve \( y = \sqrt{x} \).

12. Evaluate the integral.
    \[ \int_0^{\pi/2} \left| \cos x - \frac{1}{2} \right| \, dx. \]
13. Differentiate the function

\[ f(x) = \int_x^{2x} \frac{e^t}{t} dt. \]

14. Find the most general function \( f(x) \) for which \( f''(x) = \cos x \).

15. Find an interval \([0, c]\) on which the average value of the function \( f(x) = x^2 + 2 \) is equal to 5.

16. Set up an integral for the volume of the solid obtained by rotating the region enclosed by the \( x \) axis, the line \( x = 2 \), and the curve \( y = \ln x \) about the \( y \) axis, using

(a) the method of slices;

(b) the method of cylindrical shells.

Evaluate one of these integrals to find the volume.

17. Find the volume of a pyramid with a square base of length 2 on each side, and height 3.

18. Evaluate the limit by expressing it as an integral.

\[ \lim_{{n \to \infty}} \frac{1}{n} \sum_{i=1}^{n} \frac{i^2}{n^2}. \]