1. Evaluate \( \int \frac{x^2}{x^6 - 1} \, dx \). Hint: try a substitution first.

2. Evaluate \( \int e^{\sqrt{x}} \, dx \).

3. For each of the following integrals, state whether it is convergent or divergent and give your reasons.
   
   a. \( \int_1^\infty \frac{x^3 \, dx}{\ln x + x^4} \).
   
   b. \( \int_0^\infty \frac{dx}{x^3 + \sqrt{x}} \).

4. Find each of the following limits or show that it does not exist.
   
   a. \( \lim_{n \to \infty} \frac{n + 17 \tan^{-1} n + 2}{1 - n} \).
   
   b. \( \lim_{n \to \infty} n \left( 1 - \cos \frac{1}{n} \right) \).

5. For what \( x \) does the following series converge? Give your reasons.

   \[ \sum_{n=2}^{\infty} \frac{(2x - 1)^n}{n \ln n} \]

6. Find the Taylor series at 0 of

   \[ f(x) = \frac{1 - \cos(2x^2)}{x} \]

   and find \( f^{(7)}(0) \) and \( f^{(8)}(0) \).

7. Find all complex numbers \( z \), in Cartesian (rectangular) form, such that

   \[ (z - 1)^4 = -1. \]
8. For what $\theta$ does
\[\sum_{n=0}^{\infty} \frac{\cos n\theta}{2^n}\]
converge? Evaluate the series.

9. Find all real solutions of the following differential equations:
   a. $y'' + 4y' + 13y = 0$.
   b. $y'' + 4y' + 13y = 13x^2 - 5x + 24$.

10. Find the arc length of the curve given by
    \[y = \frac{x^2}{2} - \frac{\ln x}{4}\]
    for $x$ in the interval $[2, 3]$. Hint: the quantity under the square root sign can be rewritten as a square.

11. Let $R$ be the region bounded by $y = x + x^2$, $x = 1$, $x = 2$, and the $x$-axis. Consider the solid formed by revolving $R$ about
    a. the $y$-axis
    b. the line $x = 3$
    c. the $x$-axis.
    In each case express the volume of the solid as a definite integral, but do not evaluate the integral.