1. (10 pts) Evaluate \( \lim_{x \to 0} \frac{\tan^{-1} x - x}{x \cos x - \sin x} \).

2. (10 pts) Write \(-1 + \sqrt{3} i\) as \(re^{i\theta}\) and find a square root of this quantity.

3. (10 pts) Find the arc length of the curve \(y = \log \cos x\) between \(x = 0\) and \(x = \pi/4\).
4. (10 pts) Evaluate the indefinite integral \( \int \frac{x^3 + 1}{x^3 - x^2} \, dx \).

5. (10 pts) Consider the plane region \( R \) bounded by the coordinate axes and the curve \( y = 1 - x^3 \). What is the volume of the solid obtained by rotating \( R \) around the \( y \)-axis?

6. (10 pts) A spring has a natural length of 10 cm. If a force of 20 N is needed to keep it stretched to a length of 12 cm., how much work is required to stretch it from 12 cm. to 14 cm. (Recall that a joule is a newton-meter.)
7. (10 pts) Evaluate the definite integral

\[ \int_{0}^{\pi^2} \sin \sqrt{x} \, dx. \]

8. (10 pts) Does the series \( \sum_{n=2}^{\infty} \frac{1}{n(n \log n)^2} \) converge or diverge?

9. (10 pts) Does the series \( \sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n}} \) converge, and if so, does it converge absolutely?
10. (10 pts) Does the series \( \sum_{n=0}^{\infty} \frac{2^n \sin n}{n!} \) converge, and if so, does it converge absolutely?

11. (20 pts) Give the expansion of \( \sqrt{1 + x} \) as a power series in \( x \), up to and including the \( x^3 \) term.
12. (20 pts) Give the radius of convergence and the interval of convergence of
\[ \sum_{n=1}^{\infty} \frac{(-1)^n (x - 2)^n}{3^n \sqrt{n}}. \]

13. (20 pts) Give the radius of convergence and the interval of convergence of
\[ 10x + \frac{10^3 x^3}{3} + \frac{10^5 x^5}{5} + \frac{10^7 x^7}{7} + \cdots. \]
14. (20 pts) Give the expansion of $\sin(x^3)$ as a power series in $x$ out to and including the $x^9$ term.

15. (20 pts) Give the Taylor series for $\cos x$ around $a = \pi/2$. You do not need to use $\sum$ notation but should either write down the form of the general term or write down enough terms to make the pattern clear.