1. Consider the region between the curves

\[ y = \sqrt{1 - x^2} \quad \text{and} \quad y = 0 \]

for

\[ 0 \leq x \leq \frac{1}{2}. \]

Find the volume of the solid obtained by rotating this region about the x-axis.

2. Use the Integral Test to determine whether the series

\[ \sum_{n=2}^{\infty} \frac{1}{n \ln n} \]

converges.

3. In each part of this problem, answer “true” or “false” (do not just write T or F). You do not need to give reasons in this problem.

(a) The sequence \( \{ \frac{1}{n} \} \) converges.

(b) The series \( \sum_{n=1}^{\infty} \frac{1}{n} \) converges.

(c) The series \( \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n} \) converges absolutely.

(d) The work done by the force \( f(x) \) in moving a particle from \( x = 0 \) to \( x = 1 \) is \( \int_{0}^{1} f(x) \, dx \).

(e) The conic

\[ \frac{(x - 1)^2}{4} - \frac{(y - 2)^2}{16} = 1 \]

is a hyperbola with vertices \((-1, 2)\) and \((3, 2)\).

(f) The 3-rd degree Taylor polynomial of \( \sin x \) expanded about 0 is \( x - x^3/6 \).

4. A pipe is 5 ft long. At each point \( x \) ft from one end of the pipe, the temperature of the pipe is \( \cos^2(\pi x) \) degrees. Find the average temperature of the pipe.

5. Find the partial fraction expansion of

\[ \frac{2x^2 + 11x + 5}{(x - 1)(x + 2)^2}. \]
6. (a) Convert the parametric equations
\[ x = \cos t, \quad y = 2 \sin t \]
to a Cartesian equation by eliminating the parameter.
(b) Convert the polar equation
\[ r = 4 \sin \theta \]
to a Cartesian equation.
(c) Set up, but do not evaluate, an integral for the arc length of the polar curve
\[ r = e^{\theta}, \quad 0 \leq \theta \leq \frac{\pi}{2}. \]

7. Find the centroid of the region bounded by the curves
\[ y = x^2, \quad y = 1. \]

8. (a) Find a power series expanded about 0 which represents
\[ \int e^{x^2} \, dx. \]
(b) Find a power series expanded about 0 which represents
\[ \frac{x}{1 + x^2}. \]

9. Find the largest open interval \( b < x < c \) in which the following power series converges. (Note that \( -\infty < x < \infty \) is a possibility.) Do not check the endpoints, if there are any.
\[ \sum_{n=1}^{\infty} \frac{(x - 2)^n}{3^n n}. \]

10. Find all complex numbers \( z \) such that
\[ z^5 = 32. \]