Multiple Choice Questions:

1. What number do we get if we approximate the integral \( \int_0^2 x^2 \, dx \) using the trapezoidal method with 4 intervals?

   (A) \( \frac{13}{4} \)  (B) \( \frac{15}{4} \)  (C) \( \frac{11}{4} \)  (D) \( \frac{9}{4} \)  (E) \( \frac{7}{4} \)

Determine whether each of these series diverge or converge and if it converges to which value:

2. \( \sum_{n=1}^{\infty} \frac{3^{2n+1}}{5^n 2^{2n}} \):

   (A) \( \frac{25}{13} \)  (B) \( \frac{23}{15} \)  (C) \( \frac{29}{13} \)  (D) \( \frac{27}{11} \)  (E) Diverges

3. \( \sum_{n=5}^{\infty} \frac{6}{9n^2 + 6n - 8} \):

   (A) \( \frac{29}{208} \)  (B) \( \frac{24}{143} \)  (C) \( \frac{20}{99} \)  (D) \( \frac{28}{187} \)  (E) Diverges

Determine whether each of these series diverge or converge:

4. \( \sum_{n=2}^{\infty} \frac{1}{n \ln(n) \ln(\ln(n))} \):

   (A) Converges  (B) Diverges

5. \( \sum_{n=2}^{\infty} \frac{7n}{n^3 - 4n^2 + 2} \):

   (A) Converges  (B) Diverges

6. \( \sum_{n=0}^{\infty} \frac{1}{n^2 - 1} \):

   (A) Converges  (B) Diverges

7. \( \lim_{n \to \infty} \frac{n!}{4^n} \):

   (A) Converges  (B) Diverges

8. \( \sum_{n=1}^{\infty} \sin\left(\frac{1}{n}\right) \):

   (A) Converges  (B) Diverges

9. True or False: If \( \sum_{n=1}^{\infty} a_n \) converges, then the sequence \( \{s_n\}_{n=1}^{\infty} \) converges, \( s_n = a_1 + a_2 + \ldots + a_n \)

   (A) True  (B) False
Free Response:

10. Consider the lamina \( L \) in the plane of constant density \( \rho \), which is bounded by the curves

\[
x = 5 - y^4, \quad x = y^2 - 1.
\]

Find the moments \( M_x \) and \( M_y \) and the center of mass of \( L \).

11. We have a triangle shaped swimming pool formed by the lines \( y = -2x \) \( y = 0 \) and \( x = 5 \), which is completely filled up with water. Draw a picture of the pool and find the hydrolic force of the water at the bottom.

12. Let \( y = \sqrt{x - 1} \) from \( x = 1 \) to \( x = 10 \). Set up but do not evaluate the following:
   a) The arc length of the curve
   b) The surface area when rotated around the \( x \)-axis where the integral has to be in terms of \( x \).
   c) The surface area when rotated around the \( x \)-axis where the integral has to be in terms of \( y \).
   d) The surface area when rotated around the \( y \)-axis.

13. Suppose the sum of the series \( s = \sum_{k=1}^{\infty} \frac{1}{k^3} \) is approximated by its 5th partial sum, \( s_5 = 1 + \frac{1}{8} + ... + \frac{1}{125} \). Approximate the maximum possible error in this estimation.