1. Compute (5 points each):

(a) \[ \int_0^2 (x^3 - 4x^2 + 3) \, dx \]

(b) \[ \int x \sin(x) \, dx \]

(c) \[ \int_0^{\pi/6} 3 \cos(3x)e^{\sin(3x)} \, dx \]

(d) \[ \int \frac{dx}{\sqrt{9 - x^2}} \]

(e) \[ \int \frac{dx}{(x + 1)(x + 3)} \]

(f) \[ \int_0^{\infty} e^{-x} \, dx \]

2. Compute the area that lies between the curves (10 points):

\[ y = x^2 \text{ and } y = x \text{ for } x \in [0, 2]. \]

3. (10 points) Compute the volume obtained by rotating the region bounded by the curves \( y = x^2, \) \( y = \sqrt{x} \) between \( x = 0 \) and \( x = 1 \) about the x-axis.

4. (10 points) Find the length of the curve \( y = x^3 \) from \( x = 0 \) to \( x = 4. \) Recall that the formula for arc-length is \( L = \int_a^b \sqrt{1 + (f'(x))^2} \, dx. \)

5. (10 points) A force of 25-Newton will stretch a spring 5 meters beyond its natural length. Assuming that Hooke’s Law applies, how much work does it take to stretch the spring 10 meters beyond its natural length? Recall: Hooke’s law states that the force required to stretch a spring is proportional to the length that it is stretched.
6. (10 points) The half-life of the plutonium isotope is 24,360 years. If 10 grams of plutonium is released into the atmosphere by a nuclear accident, how many years will it take for 90% of the isotope to decay? You don’t need to simplify your answer.

7. Find the limit if it exists (5 point):
   (a) \[ \lim_{n \to \infty} \frac{n^2 - 3}{2n^2 - 2n + 1} \]
   (b) \[ \lim_{n \to \infty} \sqrt{\frac{n}{n + 1}} \]
   (c) \[ \lim_{n \to \infty} \left[ (-1)^n + \frac{1}{n} \right] \]
   (d) \[ \lim_{n \to \infty} \frac{(-6)^n}{n!} \]

8. Find the sum (5 points):
   \[ 1 + \frac{2}{5} + \frac{4}{25} + \frac{8}{125} + \cdots + \frac{2^n}{5^n} + \cdots \]

9. Use any test that you like to determine if the given series converges (5 points each).  
   (a) \[ \sum_{n=1}^{\infty} \frac{1}{n^{1.1}} \]
   (b) \[ \sum_{n=1}^{\infty} \frac{n}{n^2 + 1} \]
   (c) \[ \sum_{n=1}^{\infty} \frac{1}{6^n + 1} \]
   (d) \[ \sum_{n=1}^{\infty} \frac{n!}{(2n)!} \]
10. Compute the interval of convergence for the series (10 points):

\[ \sum_{n=0}^{\infty} \frac{(x - 1)^n}{2^n} \]

11. (10 points) Use substitution to find the Taylor series about x=0 (MacLaurin series) of the function \( f(x) = e^{-2x} \).

12. (5 points) Give a parametrization of the ellipse \( \frac{x^2}{16} + \frac{y^2}{9} = 1 \) that starts at (4,0) and travels once counter-clockwise in the interval \( t \in [0, 2\pi] \).

13. (10 points) Compute the area enclosed by the polar graph: \( r = \cos(\theta) \) for \( \theta \in [-\pi/2, \pi/2] \).