1. Integrate:
   (a) \[ \int \frac{4x - 1}{(x - 1)(x + 2)} \, dx \]
   (b) \[ \int_{3\pi/4}^{\pi} \sec^2(x) \tan(x) \, dx \]
   (c) \[ \int \frac{e^x}{1 - e^{2x}} \, dx \]
   (d) \[ \int_{1}^{e} (x - 1)^2 \ln(x) \, dx \]
   (e) \[ \int x \cos(2x) \, dx \]
   (f) \[ \int \frac{\cos(\sqrt{x})}{\sqrt{x}} \, dx \]
   (g) \[ \int_{3}^{\infty} e^{3-x} \, dx \]
   (h) \[ \int_{-\infty}^{-1} xe^{-x} \, dx \]
   (i) \[ \int_{1}^{\infty} \frac{1}{x^3 - x^2} \, dx \]

2. Find the arc-length along the curve \( y = \frac{x^3}{21} + \frac{7}{4x} \) from \( x = 1 \) to \( x = 2 \).

3. Use any appropriate method to determine the volume of the solid generated by revolving the segment of the curve \( y = \sqrt[3]{x} + 1 \) from \((0, 1)\) to \((7, 2)\) about the y-axis.

4. Find a solution to the differential equation, and to the initial value problem where applicable; if possible, write the solution as an explicit function of \( x \):
   (a) \[ \frac{dy}{dx} = x^3 y^4, \quad y(0) = 1 \]
   (b) \[ xe^y - \frac{dy}{dx} = 0 \]
   (c) \[ \frac{dy}{dx} = y^2 - y \]
   (d) \[ \frac{dy}{dx} = 12x^2 y - xy \]

5. The population of a small city in the rural midwest satisfies the exponential growth model. In this city, the population doubled from 1960 to 2010. What will the population be in 2030, relative to the 1960 population?

6. Determine whether each sequence with the given \( n^{th} \) term converges. If so, calculate the limit.
   (a) \[ a_n = \frac{n}{n^3 - 3n} \]
(b) \( b_n = \frac{n(1 - e^n)}{e^{2n}} \)

(c) \( c_n = n^{20} \cdot 2^{-n} \)

(d) \( d_n = \frac{\ln(\ln(n))}{\ln(n)} \)

(e) \( \alpha_n = \sin\left(\frac{1}{n}\right) \cdot e^n \)

(f) \( \beta_n = \frac{n^4 - \ln(2n)}{1 - n^4} \)

(g) \( \gamma_n = \frac{\sqrt{n^4 - 1}}{n^2} \)

(h) \( \delta_n = \frac{3^n}{n!} \)

(i) \( \varepsilon_n = \frac{\tan^{-1}(n)}{n} \)

7. Using any appropriate method, determine whether or not the series converges. You do not have to find the sum.

(a) \( \sum_{n=1}^{\infty} \frac{2}{n^2} \)

(b) \( \sum_{n=1}^{\infty} \frac{10}{5^{2n}} \)

(c) \( \sum_{n=2}^{\infty} \left(\frac{2}{n - 1}\right)^{1.001} \)

(d) \( \sum_{n=1}^{\infty} \frac{2^n - 1}{7^n} \)

(e) \( \sum_{n=1}^{\infty} (-1)^{n+1} \cdot \left(1 - \sqrt[5]{\frac{1}{5}}\right) \)

(f) \( \sum_{n=1}^{\infty} \frac{\sqrt{n}}{n} \)

(g) \( \sum_{n=1}^{\infty} \frac{\ln(5n)}{(n + 2)^2} \)

(h) \( \sum_{n=1}^{\infty} \frac{n + 6^n}{n!} \)

(i) \( \sum_{n=1}^{\infty} \frac{1}{n^2 + 1} \)
(j) \[ \sum_{n=2}^{\infty} (-1)^n \cdot \frac{n-1}{\ln(n)} \]

(k) \[ \sum_{n=1}^{\infty} \frac{2^n \cdot n!}{(2n)!} \]

(l) \[ \sum_{n=1}^{\infty} (-1)^n \cdot \frac{n^3 - 5}{n^4 + 2n - 1} \]

(m) \[ \sum_{n=1}^{\infty} (n!)e^{-n} \]

8. Find the sum:

(a) \[ 1 - \frac{2}{3} + \frac{4}{9} - \frac{8}{27} + \cdots \]

(b) \[ \sum_{i=4}^{\infty} \frac{1}{\sqrt{n}} - \frac{1}{\sqrt{n-3}} \]

9. For each of the series below, find the radius and interval of convergence for \( x \).

(a) \[ \sum_{n=0}^{\infty} (x - 3)^n \]

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

(c) \[ \sum_{n=0}^{\infty} \left( \frac{x^2 + 5}{5} \right)^n \]

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

(e) \[ \sum_{n=0}^{\infty} (e^x - 4)^n \]