1. Is the series
\[ \sum_{k=1}^{\infty} (-1)^k \frac{1 + k\sqrt{k}}{k^2} \]
convergent? Does it converge absolutely?

2. Find the interval of convergence of the series
\[ \sum_{k=0}^{\infty} \frac{(-1)^k x^k}{\sqrt{k^2 + 3}}. \]

3. Find the sum of the series
\[ \sum_{k=0}^{\infty} \frac{(x - 1)^{2k}}{4^k}. \]

4. Estimate the error in Simpson’s rule when you use eight subintervals to approximate
\[ \int_{1}^{2} \left( \frac{x^5}{2} + 3x^2 + 5 \right) dx. \]

5. Solve the following differential equations and initial value problems:
(a) \[ x \frac{dy}{dx} = x^2 + 3y, \quad x > 0. \]
(b) \[ \frac{dy}{dx} = 2(x + y^2 x), \quad y(0) = 1. \]

6. Let
\[ A = \begin{pmatrix} 1 & 1 & 0 \\ 2 & 0 & 1 \\ 3 & 1 & 1 \end{pmatrix}, \quad \vec{a} = \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix}. \]
Find \( A^T, AA^T, A \vec{a} \).

7. Find the matrix \([S]\) corresponding to the reflection \( S : \mathbb{R}^3 \to \mathbb{R}^3 \) in the plane \( x = z \). Calculate \([S]^{99}\).