No Calculators, closed book, no lecture notes, no homework. Show steps. Use proper notation.

1. Show series converges, then calculate the estimate of the absolute value of the Remainder, or error, in approximating the sum of the series \( \sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n}} = 1 - \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{3}} - \frac{1}{\sqrt{4}} + \frac{1}{\sqrt{5}} - \ldots \) using 8 terms.

2. Calculate the radius of convergence and interval of convergence for \( \sum_{n=1}^{\infty} \frac{(4x + 1)^n}{3n^2} \)

3. Prove (show steps and reasoning for full credit) whether the series \( \sum_{n=1}^{\infty} \frac{n - 1}{n^2 + n} \) converges or diverges.
4. Calculate sigma notation, and show terms up to order four, for the Taylor series of \( \sin x \) expanded at \( \frac{\pi}{2} \).

Then calculate the error in approximating \( \sin(3\pi/4) \) with this series using 2 non-zero terms.

5. Prove (show steps and reasoning for full credit) whether the series \( \sum_{n=1}^{\infty} \frac{\sqrt{n^2 - 1}}{n^3 + 2n^2 + 5} \) converges or diverges.

6. Find an equation of the sphere with center \((3, 8, 1)\) and with point \((4, 3, -1)\) on its surface.
7. Sketch and calculate the scalar and vector projections of $\vec{u} = \langle 1, 2 \rangle$ onto $\vec{v} = \langle 4, -1 \rangle$. 