1. (24 points) Determine whether the series converges or diverges. If it converges, find its sum. Show your work

(a) $\displaystyle\sum_{n=0}^{\infty} \frac{4(-1)^n}{5^n}$

(b) $\displaystyle\sum_{n=1}^{\infty} \frac{3^{n+1}}{4^n}$

(c) $\displaystyle\sum_{n=1}^{\infty} \frac{3^{2n}}{4^n}$

2. (24 points) Determine whether the series converges or diverges. Explain your answers.

(a) $\displaystyle\sum_{n=1}^{\infty} \frac{1}{n\sqrt{n^2+1}}$

(b) $1 + \dfrac{1}{2\sqrt{2}} + \dfrac{1}{3\sqrt{3}} + \dfrac{1}{4\sqrt{4}} + \dfrac{1}{5\sqrt{5}} + \ldots$

(c) $\displaystyle\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n+1}}$

3. (12 points) Determine whether the series converges absolutely, converges conditionally, or diverges. (You don't need to provide an explanation.)

(a) $\displaystyle\sum_{n=1}^{\infty} \frac{(-1)^n n}{\sqrt{n^2+1}}$

(b) $\displaystyle\sum_{n=1}^{\infty} \frac{(-1)^n\, n^2}{2^n}$

(c) $\displaystyle\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n} + \sqrt{n+1}}$

4. (12 points) Find the interval of convergence for the power series below. Show your work.

$$\sum_{n=1}^{\infty} (-1)^n \frac{x^n}{n3^n}$$

5. (12 points) Find the interval of convergence for the power series below. Show your work.

$$\sum_{n=1}^{\infty} \frac{n(x-2)^n}{(n+1)^2}$$

6. (6 points) For what values of q does the following series converge? Give a *brief* explanation of your answer.

$$\sum_{n=1}^{\infty} \frac{1}{\sqrt{n^q + 1}}$$

7. (10 points) Determine whether the improper integral converges or diverges. If it converges find its value. **Important:** Show clearly how limits are involved.

$$\int_0^{\infty} \frac{x\,dx}{(1+x^2)^2}$$