1. (20 points) Does the following sequence $\{a_n\}$ converge? If yes, find its limit. Justify your answers.

a) (10 points)

$$a_n = \left(\frac{1}{2+(-1)^n}\right)^n$$

b) (10 points)

$$a_n = \left(\frac{3}{7+(-1)^n}\right)^n$$

Test the following series for convergence. Justify your answers.

2. (10 points)

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

3. (10 points)

$$\sum_{n=1}^{\infty} \frac{3^n n!}{n^n}$$

4. (10 points)

$$\sum_{n=1}^{\infty} \frac{\ln n}{n^{3/2}}$$

5. (10 points)

$$\sum_{n=1}^{\infty} \frac{3^n - 2^n}{2 \cdot 3^n - 1}$$

6. (10 points)

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

7. (20 points) Consider $\sum_{n=1}^{\infty} \frac{(-1)^n \ln n}{n}$.

a) (10 points) Does the series converge?

b) (10 points) Does the series converge absolutely?

Justify your answers.