Recall:

1. **Definition:** An **alternating series** is one whose terms alternate in sign. That is, a series of the form $a_1 - a_2 + a_3 - \cdots$
   where a_k is positive for all $k \geq 1$.

2. **Alternating Series Test:**
   - Suppose $\lim_{k\to\infty} a_k = 0$ *and* $\{a_k\}$ is a non-negative decreasing series for all $k \geq 1$. Then the alternating series $\sum_{k=1}^{\infty} (-1)^{k+1} a_k$ converges.
   - Furthermore, its limit lies between any two consecutive partial sums. That is, if the series converges to S, then S lies between S_N and S_{N+1} for any N.
     Because of this,
     $$|S - S_N| \leq a_{N+1}.$$

Determine whether or not the following alternating series converge. For those that converge, first find upper and lower bounds, and then approximate accurate to within 0.001.

1. $\displaystyle\sum_{k=2}^{\infty} \frac{(-1)^k}{\ln(k)}$

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

3. $\displaystyle\sum_{j=3}^{\infty} \frac{(-1)^j}{4^j}$

Determine whether or not the following alternating series converge conditionally, converge absolutely, or diverge.

1. $\displaystyle\sum_{j=0}^{\infty}(-1)^j \frac{e^j}{3^{j+1}+j}$

2. $\displaystyle\sum_{k=1}^{\infty}(-1)^{k+1} \frac{2k+2}{k^2+2k}$