Question 1. *(5 marks)* Determine whether the series is absolutely convergent, conditionally convergent, or divergent.

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

Question 2. *(5 marks)* For which positive integers k is the following series convergent?

$$\sum_{n=1}^{\infty} \frac{(n!)^2}{(kn)!}$$

Question 3. *(5 marks)* Determine whether the series is absolutely convergent, conditionally convergent, or divergent.

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

Bonus Question.[1] *(3 marks)* The Cantor ternary set $\mathscr{C}$ is created by iteratively deleting the open interval middle third from a set of line segments. One starts by deleting the open middle third $\left(\frac{1}{3}, \frac{2}{3}\right)$ from the interval $[0,1]$, leaving two line segments: $\left[0, \frac{1}{3}\right] \cup \left[\frac{2}{3}, 1\right]$. Next, the open middle third of each of these remaining segments is deleted, leaving four line segments: $\left[0, \frac{1}{9}\right] \cup \left[\frac{2}{9}, \frac{1}{3}\right] \cup \left[\frac{2}{3}, \frac{7}{9}\right] \cup \left[\frac{8}{9}, 1\right]$. The Cantor ternary set contains all points in the interval $[0,1]$ that are not deleted at any step in this ad infinitum. Compute the length of the deleted intervals.

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[1] https://en.wikipedia.org/wiki/Cantor$_s$et