

Books, watches, notes or cell phones are **not** allowed. The **only** calculators allowed are the Sharp EL-531\*\*\*. You **must** show all your work, the correct answer is worth 1 mark the remaining marks are given for the work.

**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.**<sup>1</sup> (3 marks) The Cantor ternary set  $\mathcal{C}$  is created by iteratively deleting the open interval middle third from a set of line segments. One starts by deleting the open middle third  $(\frac{1}{3}, \frac{2}{3})$  from the interval  $[0, 1]$ , leaving two line segments:  $[0, \frac{1}{3}] \cup [\frac{2}{3}, 1]$ . Next, the open middle third of each of these remaining segments is deleted, leaving four line segments:  $[0, \frac{1}{9}] \cup [\frac{2}{9}, \frac{1}{3}] \cup [\frac{2}{3}, \frac{7}{9}] \cup [\frac{8}{9}, 1]$ . 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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<sup>1</sup>[https://en.wikipedia.org/wiki/Cantor\\_set](https://en.wikipedia.org/wiki/Cantor_set)