

Problem 1)

$$\begin{aligned}
 \sum_{n=1}^{\infty} (-1)^{n+1} \frac{n}{(n+1)^2} &= \sum_{n=1}^{\infty} (-1)^{n+1} \frac{n+1-1}{(n+1)^2} = \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n+1} - \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{(n+1)^2} \\
 &= \sum_{n=2}^{\infty} \frac{(-1)^n}{n} - \sum_{n=2}^{\infty} \frac{(-1)^n}{n^2} = \left(1 - 1 - \sum_{n=2}^{\infty} \frac{(-1)^{n+1}}{n} \right) - \left(1 - 1 - \sum_{n=2}^{\infty} \frac{(-1)^{n+1}}{n^2} \right) \\
 &= \left(1 - \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n} \right) - \left(1 - \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^2} \right) \\
 &= \left(1 - \ln 2 \right) - \left(1 - \frac{\pi^2}{12} \right) \\
 &\quad \underbrace{= \frac{\pi^2}{12} - \ln 2.}_{\text{Final Answer}}
 \end{aligned}$$