1. [7] For each of the following series determine if it is geometric or not. If it is geometric find the sum or state the series diverges.

(a) \[ \sum_{n=0}^{\infty} \frac{1}{2^n} = \frac{1}{1 - \frac{1}{2}} = 2 \]
- The series is geometric
- If geometric, find the sum or state the series diverges.

(b) \[ \sum_{n=1}^{\infty} \frac{1}{n^2} \]
- The series is geometric
- If geometric, find the sum or state the series diverges.

(c) \[ \sum_{n=0}^{\infty} \frac{2^n}{3^n} = \sum_{n=0}^{\infty} \left( \frac{2}{3} \right)^n \]
- The series is geometric
- If geometric, find the sum or state the series diverges. \[ r = \frac{2}{3} < 1 \]

(d) \[ 3 - \frac{6}{5} + \frac{12}{25} - \frac{24}{125} + \frac{48}{625} - \ldots = \frac{3}{1 - \left( -\frac{2}{5} \right)} = \frac{3}{\frac{7}{5}} = \frac{15}{7} \]
- The series is geometric
- If geometric, find the sum or state the series diverges.

2. [3] Consider the series \[ \sum_{n=2}^{\infty} \left( \frac{1}{n-1} - \frac{1}{n} \right) \]

(a) Write out the partial sums \( S_3, S_4 \) and \( S_N \).
\[ S_3 = \left( 1 - \frac{1}{3} \right) \times \left( \frac{1}{2} - \frac{1}{3} \right) = \frac{1}{3} \]
\[ S_N = 1 - \frac{1}{N} \]
\[ S_4 = \left( 1 - \frac{1}{4} \right) \times \left( \frac{1}{3} - \frac{1}{4} \right) = \frac{1}{4} \]

(b) Find the sum of the series or show that it diverges.
\[ S_N = 1 - \frac{1}{N} \quad \text{as} \quad N \rightarrow \infty \quad \text{or} \quad 1 \]