1. Consider the sequence \( \{a_k\}_{k=1}^{\infty} \) given by \( a_k = \frac{3^k - 1}{3^k} \).

1a. What are the first four terms of the sequence?

1b. What is the limit \( \lim_{k \to \infty} a_k \) of this sequence?

1c. Find \( N \) such that \( |a_N - L| < \epsilon = 0.001 \) but if \( n > N \), then \( |a_n - L| < \epsilon \). This may just involve writing out enough terms of the sequence until you “see where it happens”.

1d. Bonus Repeat (1c) for \( \epsilon = \frac{1}{1,000,000,000,000} = \frac{1}{\text{one trillion}} \). Show your computations!

2a. Using the notation developed in class, find \( a \) and \( r \) for the following geometric series:

\[
80 + 32 + \frac{64}{5} + \frac{128}{25} + \frac{256}{125} + \cdots
\]

2b. What’s the next term in the series?

2c. Does the series in (2a) converge? If so, to what?

2d. If the “80” was not actually the first term of the series, what would the term in front of it be?

3a. Explicitly, what is the harmonic series? (give the first 5 terms).

3b. It’s a fact that if a series \( \sum_{k=1}^{\infty} a_k \) converges, then the “individual terms” \( a_1, a_2, a_3, a_4 \) … have to “go to zero”. What does the harmonic series have to do with the converse of this fact?