1. Use the definition of a limit to prove \( \lim_{j \to \infty} \frac{\sin j - \cos j}{j} = 0 \).

2. Let \( \{a_j\} \) be a convergent sequence of integers having the limit \( L \). Prove that the sequence is “eventually constant”, i.e. there exists \( N \in \mathbb{N} \) such that for all \( j > N \), \( a_j = L \).

3. Let \( \{a_j\} \) be a sequence of nonnegative real numbers that converges to 0 and \( \{x_j\} \) is a sequence for which there exists \( N \in \mathbb{N} \) such that for all \( j \geq N \), \( |x_j - L| < a_j \). Prove that \( \lim_{j \to \infty} x_j = L \).