1. [10 points] Recall the Bully Algorithm for leader election. The system model is a synchronous system with reliable messaging, crash failures, and recovery. Suppose we execute the Bully Algorithm in a synchronous system with crash failures and recovery, but where messaging is not reliable. Show that the algorithm may lead to a situation where every process has finished its execution of the algorithm and more than one process is elected as a leader.

2. [10 points] Answer the following questions about the Two-Phase Commit and Three-Phase Commit algorithms.
   a) Define the Non-Blocking Property.
   b) Give an example execution of the Two-Phase Commit algorithm that violates the Non-Blocking Property.
   c) Briefly explain how the Three-Phase Commit algorithm satisfies the Non-Blocking Property in a scenario similar to the one you described in part (b), i.e., show that the system is not blocked in your scenario and explain why.

3. [10 points] Recall the FLP impossibility theorem: “no consensus protocol is totally correct in spite of one fault.” To prove this theorem, we first assume that there is a consensus protocol $P$ that is totally correct in spite of one fault. We next prove Lemma 2, which states: “$P$ has an initial bivalent configuration”.
   a) What is a bivalent configuration?
   b) Does the proof of Lemma 2 involve a faulty process? Answer YES or NO. You do not need to provide a justification.
   c) What is the significance of Lemma 2 in the roadmap of the FLP theorem, i.e., why do we need $P$ to have an initial bivalent configuration?