Name: ____

1. (1 pt.)
   - **Read all material carefully.**
   - You may refer to your books, papers, and notes during this test.
   - No computer or network access of any kind is allowed (or needed).
   - Write, and draw, carefully. Ambiguous or cryptic answers receive zero credit.
   - Use textbook and classroom conventions for notation, algorithmic options, etc.
   - Ask for clarifications on the above if needed.

   Write your name in the space provided above.

2. (20 pts.) Use the polynomial time reduction described in the textbook, map the following 3SAT instance to an instance of CLIQUE.

$$(x \vee y \vee \bar{z}) \wedge (x \vee \bar{y} \vee z) \wedge (\bar{x} \vee y \vee \bar{z}) \wedge (x \vee \bar{y} \vee z)$$

   Depict **the complement** of the graph that is the input to the CLIQUE instance. (The complement of a graph $G = (V, E)$ is a graph $G' = (V, E')$ where $E' = \{(u, v) \in V \times V \mid (u, v) \notin E\}$.)

   Also depict corresponding solutions of the 3SAT and CLIQUE instances or explain why no solutions exists.

[additional space for answering the earlier question]

3. (20 pts.) Reduce the 3SAT instance of Question 2 to a SUBSET-SUM instance using the textbook's method.

   Present corresponding solutions of the 3SAT and SUBSET-SUM instances or explain why no solutions exists.

4. (19 pts.) Construct a generalized geography instance that has a winning strategy for the first player and explain your answer. Repeat for an instance that has a winning strategy for the second player. Use instances with 8–12 vertices that have at least two directed cycles of length at least 3.