Name: 

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

Write your name in the space provided above.

2. (9 pts.) For each value of $n = 0, 1, \ldots, 5$, depict all possible binary min-heaps containing the $n$ keys $1, 2, \ldots, n$. **Justify your answer briefly**, explaining why the heaps you depict are the only ones possible.
3. (5 pts.) For each binary heap of Question 2 either provide a sequence insertions that produces the tree using no swaps (when following the standard method for binary heap insertions) or prove that no such sequence exists.
4. (10 pts.) Repeat Question 3 replacing *using no swaps* with *using exactly one swap*. For each sequence, depict the heaps immediately before and immediately after the swap operation.
[additional space for answering the earlier question]
5. (5 pts.) Repeat Questions 2, 3, and 4 for the single value \( n = 6 \). You may abbreviate your depictions as long as the result is unambiguous and precise.
[additional space for answering the earlier question]