COMPLEXITY: Exercise No. 7

1. (Test 98) Is the following problem in **NL**?
   Given an undirected graph G, vertices x, y from G, and a positive integer k, does the shortest path from x to y is of length (exactly) k?

2. What is the approximation ratio of the greedy algorithm for SET-COVER, when all the sets except one are of size at most k?

3. Show that the following problem is PSPACE-complete:
   Instance: A deterministic TM M and an input x for M.
   Question: Does M accepts x without leaving the first $|x| + 1$ places of the tape?

4. Find a constant c for which it is NP-hard to approximate VERTEX-COVER to within any constant factor $< c$.

5. Show that for any constant $c > 1$, there exists a constant k, such that it is NP-hard to approximate the following problem to within c.
   Instance: m CNF formulas $\Phi_1, \Phi_2, ..., \Phi_m$, where each formula consists of k clauses, over the variables $x_1, x_2, ..., x_n$.
   Problem: Find an assignment that satisfies as many formulas as possible.
   (Note that k is constant, and only m and n depend on the input.)