Computational Classes of Problems

For each of these problems, or languages, give its best **known** computational class. For example, the answer could be $\mathcal{P}$, $\mathcal{NP}$, $\mathcal{NP}$-complete, $\mathcal{P}$-SPACE, recursive, recursively enumerable, to name just a few. For example, if a prblem is known to be in the class $\mathcal{NP}$, but is not known to be in $\mathcal{P}$, and is also not known to be $\mathcal{NP}$-complete, you answer would be "$\mathcal{NP}$." If there is no class with a standard definition which contains the problem, you can say, "Not a member of any class that I can find." That could be the correct answer!

1. Given a graph G, is G planar? (That is, can it be drawn in a plane with no crossings?)

2. Given a room and various pieces of furniture and equipment, it is possible for those items to fit into the room?

3. Given a room with a door, and various pieces of furniture and equipment, is it possible to move those items into the room through the door? (This is not the same question!)

4. Doea a context-free grammar generate all string? More specifically, given a context-free grammar G where Σ is the set of terminals of G, is it true that $L(G) = \Sigma^*$?

5. Given an $n \times n$ checkerboard, for some n, and given a configuration of checkers on that board, can the black player win?

6. Given a Turing machine M and a number t, will M halt within t steps?

7. Does a given general grammar G generate a given string w?

8. Given a set of jobs and a set of workers, where each worker is trained to work some given subset of the jobs, each job takes a given amount of time, and pairs of jobs (X, Y) are given, where X must be finished before work on Y begins, can all the jobs be finished within T hours?

9. We define a *partial inversion* of a string to be the string obtained reversing any substring. For example, *abaacdab* is a partial inversion of *abadcaab*. Given strings u and v and a number k, is it possible to obtain v from u by a sequence of k partial inversions?