NOTE: For this exam, unless a specific problem indicates otherwise, you may assume the following problems are NP-Complete for your reductions. Do not assume that any other problems are NP-complete! For many of these problems, you have to find some structure, if it exists. If it doesn't exists, you can assume the algorithm returns "FALSE", "UNSATISFIABLE", or anything else convenient.

- SAT: Given a boolean formula F in CNF form with n variables and m clauses, find an assignment of the n variables that satisfies F, if one exists.
- $3-\mathsf{SAT}$: A special case of SATwhere every clause has at most 3 literals.
- Vertex Cover : Given graph G and number k, find a vertex cover of size $\leq k$, if one exists. For a graph $G = (V, E)$, $S \subset V$ is a vertex cover if it covers every edge: for every edge $(x, y) \in E$ either $x \in S$ or $y \in S$ (or both). (So one or both endpoints of every edge are in the vertex cover.)
- Independent Set : Given graph G and number k, find an independent set of size $\geq k$, if one exists. For a graph $G = (V, E)$, $S \subset V$ is an independent set if no edges are contain in S - for all $x, y \in S$, $(x, y) \notin E$.
- Clique : Given graph G and number k, find a clique of size $\geq k$, if one exists. For a graph $G = (V, E)$, $S \subset V$ is a clique if for all $x, y \in S$, $(x, y) \in E$. (S is a fully connected subgraph - all pairs of vertices in S have an edge between them).