CSE3502 - Theory of Computation April 28, 2014

**Due: Before class on April 29, 2014**

Homework 9

1. Did you do the reading? YES/NO/SORTA
2. Did you do the reading before class? YES/NO/SORTA
3. How long did you spend on this homework (rounding up)? ___________hours.

# 1 Reductions and NP-Completeness

Let $A$ and $B$ be languages such that $A \leq_P B$. That is, there is a polylnomial-time reduction from $A$ to $B$. In each question below there are some suppositions about $A$ and $B$ followed by some possible conclusions. Circle all of the possible conclusions that are *necessarily* true assuming the suppositions.

**1.1**
**Suppose:** $A \in P$ and $B \in$ NP-COMPLETE.
**Conclude:** $A \in NP$? $A \in$ NP-COMPLETE?

**1.2**
**Suppose:** $A \in$ NP-COMPLETE and $B \in P$.
**Conclude:** $B \in NP$? $B \in$ NP-COMPLETE? $A \in P$?

**1.3**
**Suppose:** $A \in NP$ and $B \in P$.
**Conclude:** $B \in$ NP-COMPLETE? $A \in P$? $P = NP$?

**1.4**
**Suppose:** $A \in$ NP-COMPLETE.
**Conclude:** $B \in$ NP-COMPLETE?

# 2 Subgraph Isomorphism

**2.1** The *clique* problem takes as input a graph $G$ and a number $k$, and it asks whether or not $G$ has a clique (a complete subgraph) of size $k$. The Sipser book contains a proof that the clique problem is NP-COMPLETE.

The *subgraph isomorphism* problem takes as input a pair of graphs and asks if the first graph is isomorphic to a subgraph of the second graph. Prove that subgraph isomorphism is NP-COMPLETE.

**To think about:** Why doesn't your answer work to show also that graph isomorphism is NP-COMPLETE?