

### HW 9 CMSC 452. DUE DUE April 24

(NOTE- I will be out-of-town April 22. There will be a sub. The material he teaches is part of the course. You have plenty of time to do this HW so the Due date is DUE DUE. Still THINK of it as due April 22, though don't hand it in that day.)

1. (0 points) What is your name? Write it clearly. Staple your HW. When is the Final?
2. (0 points but DO IT) READ my notes on P and NP up to but NOT INCLUDING the section on the Polynomial Hierarchy.
3. (30 points) Show that if  $A \leq B$  and  $B \in P$  then  $A \in P$ .  
(RECALL:  $A \leq B$  means that there exists a function  $f$  computable in poly time such that  $x \in A$  iff  $f(x) \in B$ .)
4. (30 points) Write psuedo code for the following problem: Given a CNF formula  $\phi$  with only three literals per clause,

$$(L_{11} \vee L_{12} \vee L_{13}) \wedge (L_{21} \vee L_{22} \vee L_{23}) \wedge (L_{31} \vee L_{32} \vee L_{33}) \wedge (L_{41} \vee L_{42} \vee L_{43}) \wedge \cdots (L_{k1} \vee L_{k2} \vee L_{k3})$$

(Each  $L_{ij}$  is either a var or the negation of a var.)

output a graph  $G$  and a number  $k$  (WHOOOPS-I gave it away, indeed the number  $k$  WILL be the number of clauses.) such that

$\phi \in SAT$  iff  $G$  has an INDEPENDENT SET of size  $k$ .

DO it directly. The word 'Clique' should NOT be anywhere near this problem. ALSO- Pretend the grader DOES NOT know the proof, so don't say things like 'just like in class'

5. (40 points) We have a new type of Turing Machine! Oh Joy! It can do the following in one step:  
If it's in state  $q$  and sees an  $a$  it replaces it with a  $b$ , and then moves LEFT and then changes to state  $p$ . (all of this in ONE step)  
Give the Boolean Formula that captures this instruction (similar to what we did with other instruction in the proof of the Cook-Levin Theorem).