**CS 3510: Design & Analysis of Algorithms** (Sections A & B)

# Practice Quiz 4 – Section A and B

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**1.)** (20 points total) For each of the following, select the most appropriate choice.

**(a.)** (4 points) If A is NP-Complete and B is reducible to A then we can conclude that B is NP-Hard:

- ◯ **A.** True
- ◯ **B.** False

**(b.)** (4 points) If we find a polynomial time algorithm for 3SAT, this gives a poly-time algorithm for SAT is a statement that is:

- ◯ **A.** True
- ◯ **B.** False

**(c.)** (4 points) The problem 3-Clique, where you must find a clique of size 3 in G, is NP-Hard.:

- ◯ **A.** True
- ◯ **B.** False

**(d.)** (4 points) If a problem is NP-complete then it is necessarily NP-Hard:

- ◯ **A.** True
- ◯ **B.** False

**(e.)** (4 points) A CNF-satisfiability problem is best described as belonging to class:

- ◯ **A.** Only NP
- ◯ **B.** Only P
- ◯ **C.** NP Complete
- ◯ **D.** Only NP Hard

**2.)** (40 points)

**(a.)** (15 points) Select all answer choices guaranteed to have a valid assignment if there exists such an assignment for $x_1 \vee x_2 \vee x_3 \vee \bar{x_4}$ :

**(A.)** $(x_1 \vee x_2 \vee \bar{y}) \wedge (x_3 \vee y \vee \bar{x_4})$

**(B.)** $(x_1 \vee x_2 \vee y) \wedge (x_3 \vee y \vee \bar{x_4})$

**(C.)** $(x_1 \vee z) \wedge (\bar{z} \vee x_2 \vee y) \wedge (\bar{y} \vee x_3 \vee \bar{x_4})$

**(b.)** (10 points) Draw a graph to represent the following 3CNF so it can be reduced to an Independent-Set problem: $(\bar{x_1} \vee x_2 \vee x_3) \wedge (x_1 \vee \bar{x_2} \vee x_3) \wedge (\bar{x_1} \vee x_2 \vee x_4)$

**(c.)** (5 points) Convert the following CNF to a 3CNF: $(x_1 \vee \bar{x_2} \vee x_3 \vee x_5) \wedge (\bar{x_1} \vee \bar{x_3} \vee x_4 \vee x_6 \vee x_7)$

**(d.)** (10 points) What is the minimal number of variables needed to transform clauses of length k: $(x_1 \vee x_2 \vee x_3 \vee ... \vee x_k)$ to 3-SAT ?:

**3.)** (40 points) In the HITTING SET problem, we are given a family of sets S1, S2, . . . , Sn and a budget b, and we wish to find a set H of size b which intersects every $S_i$ if such an H exists. In other words, we want H intersection $S_i$ $! =$ empty for all i. Show that HITTING SET is NP-complete.