Quiz - Complexity 2020 “Do NOT turn-in”

1. Assuming P is not equal to NP, which of the following is true ?  
   (A) NP-complete = NP  
   (B) NP-complete Union P = is empty  
   (C) NP-hard = NP  
   (D) P = NP-complete
2. Let S be an NP-complete problem and Q and R be two other problems not known to be in NP. Q is polynomial time reducible to S and S is polynomial-time reducible to R. Which one of the following statements is true?

* R is NP-complete
* R is NP-Hard
* Q is NP-complete
* Q is NP-Hard

1. Let X be a problem that belongs to the class NP. Then which one of the following is TRUE?

* There is no polynomial time algorithm for X
* If X can be solved deterministically in polynomial time then P = NP
* If X is HP-Hard, then it is NP-complete
* X maybe undecidable

1. Which of the following is true about NP-Complete and NP-Hard problems.

* To prove that a problem X is NP-Hard, take a known NP-Hard problem and reduce Y to X
* NP-complete is a subset of NP-Hard
* The first problem that was proved as NP-complete was the circuit satisfiability problem
* All of the above

1. Every problem in NP can be solved in exponential time.

* True
* False

1. If a problem X can be reduced to a known NP-hard problem, then X must be NP-hard.

* True
* False

1. Suppose you could reduce an NP complete problem to a polynomial time problem in polynomial time.  
   (A) What would be the consequence?

(B) What if the reduction required exponential time?

1. **Consider a reduction of problem A to problem B. What is the most precise claim you can make about problem B for each of the following situations?**1 A is NP-complete and the reduction is in polynomial time.
   * A is in polynomial time and the reduction is also in polynomial time.
   * A is NP-complete and the reduction is in PSPACE.
   * A is in nondeterministic polynomial time and the reduction is in polynomial time.
   * A requires exponential time and the reduction is in polynomial time.
   * A is PSPACE complete and the reduction is in PSPACE.

**9.0 What makes a NPC problem strong or weak? Relate to approximation  
               possibilities?**