CSE 311: Foundations of Computing I

Practice Midterm

Name: _____

UW ID: _____

Instructions:

- You have **1 hour** to complete the exam.
- There are 5 problems on this exam, totaling 100 points.
- The exam is closed book. You may not use cell phones or calculators. You may only use the reference sheets provided.
- All answers you want graded should written on the exam paper.
- If you need extra space, use the back of a page.

1. Predicate Translation [15 points]
Let the domain of discourse be novels, comic books, movies, and TV shows. Translate the following statements to predicate logic, using the following predicates:

Novel(x) := x is a novel
Comic(x) := x is a comic book
Movie(x) := x is a movie
Show(x) := x is a TV show
Adaptation(x, y) := x is an adaptation of y

(a) (5 points) A novel cannot be adapted into both a movie and a TV show.

(b) (5 points) Every movie is an adaptation of a novel or a comic book.

(c) (5 points) Every novel has been adapted into exactly one movie.

2. CNF and DNF [15 points]
The boolean function f takes in three boolean inputs x_1, x_2, x_3, and outputs $\neg((x_1 \oplus x_2) \wedge x_3)$.

Note: You may write your solutions using boolean algebra or propositional logic notation.

(a) (5 points) Draw a truth table for f.

(b) (5 points) Write a propositional logic expression for f in DNF form (ORs of ANDs).

(c) (5 points) Write a propositional logic expression for f in CNF form (ANDs of ORs).

3. Odd and Even [20 points]
Prove that for all integers k, if $k^3 + 1$ is odd, then k is even.

4. Sets [30 points]

(a) (5 points) Compute $\mathcal{P}(\{1,2\} \times \{3\})$.

(b) (5 points) Compute $\{1,2\} \cap (\{2,3\} \times \varnothing)$.

(c) (20 points) Prove that for all sets A, B, C that if $A \subseteq B$ and $B \subseteq C$, then $B \times A \subseteq C \times C$.

5. Induction [20 points]
Prove by induction that $(1+\pi)^n > 1 + n\pi$ for all integers $n \geq 2$.