Name:

Spring 2017 Math 245 Exam 1

Please read the following directions:
Please write legibly, with plenty of white space. Please print your name on the designated line, similarly to your quizzes (last name(s) in ALL CAPS). Please fit your answers in the designated areas. To get credit, you must also show adequate work to justify your answers. If unsure, show the work. All problems are worth 5-10 points. The use of notes, calculators, or other materials on this exam is strictly prohibited. This exam will begin at 12:40 and will last at most 60 minutes; pace yourself accordingly. Please leave **only** at one of the designated times: 1:00pm, 1:20pm, or 1:40pm. At all other times please stay in your seat (emergencies excepted), to ensure a quiet test environment for others. Good luck!

Problem	Min Score	Your Score	Max Score
1.	5		10
2.	5		10
3.	5		10
4.	5		10
5.	5		10
6.	5		10
7.	5		10
8.	5		10
9.	5		10
10.	5		10
Exam Total:	50		100
Quiz Ave:	50		100
Overall:	50		100

Problem 1. Carefully define the following terms:

a. composite

b. conjunction

c. tautology

d. Double Negation semantic theorem

Problem 2. Carefully define the following terms:

a. Addition semantic theorem

b. Trivial Proof theorem

c. Direct Proof theorem

d. converse

Problem 3. Calculate and simplify $\frac{(\lfloor 13.9\rfloor+\lfloor -1.2\rfloor)!}{\lceil 8.4\rceil !}$.

Problem 4. Let $a, b, c \in \mathbb{Z}$. Suppose that $a|b$ and $a|c$. Prove that $a|(b+c)$.

Problem 5. Use truth tables to prove the half of De Morgan's Law which states that for any propositions p, q we have $\neg(p \vee q) \equiv (\neg p) \wedge (\neg q)$.

Problem 6. Simplify $\neg((p \to q) \wedge r)$ as much as possible. (i.e. where only basic propositions are negated)

Problem 7. Let $x \in \mathbb{R}$. Prove that if x is irrational then $\frac{x}{3}$ is irrational.

Problem 8. Let $n \in \mathbb{Z}$. Suppose that n is even. Prove that $3n^2 + 1$ is odd.

Problem 9. Using semantic theorems, prove that for any propositions p, q, r, we have $((p \vee q) \vee r), (\neg q) \vdash p \vee r$.

Problem 10. Using semantic theorems, prove that for any propositions p, q, r, we have $(p \to q), (q \to r) \vdash (p \to r)$.