Subject 24.241. Logic I. Assignment due Thursday, October 6

1. Write a sentence with the following truth table:

P	Q	R	
1	1	1	0
1	1	0	1
1	0	1	1
1	0	0	0
0	1	1	1
0	1	0	1
0	0	1	0
0	0	0	0

2a) Write a sentence that is logically equivalent to "(P ↔ (Q ↔ R))" and that is a disjunction of conjunctions of atomic and negated atomic sentences.

b) Write a sentence that is logically equivalent to "(P ↔ (Q ↔ R))" and that is a conjunction of disjunctions of atomic and negated atomic sentences.

3. Write a sentence logically equivalent to "(P ↔ ¬ Q)" whose only connective is "NOR," and then write such a sentence whose only connective is "NAND," where these connectives are described by the following truth table:

φ	ψ	(φ NOR ψ)	(φ NAND ψ)
1	1	0	0
1	0	0	1
0	1	0	1
0	0	1	1

4. How long is the longest list of SC sentences with the following two properties: None of the sentences on the list contains any atomic sentence other than "P," "Q," "R," or "S"; and no two sentences on the list are logically equivalent? You don't need to write out the list; just tell me exactly how long it is.

5. Test each of the following sentences for validity by using the method of truth tables, then test each sentence again by the search-for-counterexamples method:

a) ((P → (Q ∨ R)) ∨ (¬ P → (S ↔ U)))
b) ((¬ P → (Q ∨ R)) ∨ (¬ P → (S ↔ U)))
c) ((P → (Q → R)) → ((P → Q) → R)
d) (((P → Q) → R) → (P → (Q → R)))
e) (((P → Q) → R) → ((P → R) → R))