Problem Set 1 **Due F Sept 1, Noon**

A. Use truth tables to answer the following questions. ***In each case, write out the full truth table***.

1. Determine whether or not each of the following arguments is valid:

   (a) $A \rightarrow B, \neg C \rightarrow \neg B \therefore A \rightarrow C$

   (b) $A \vee B, A \rightarrow C, D \rightarrow B \therefore C \vee D$

2. For each of the following sentences, determine if it is a tautology, a contradiction, or neither (i.e., contingent):

   (a) $A \rightarrow (A \vee B)$

   (b) $\neg (\neg A \vee \neg B) \leftrightarrow \neg (A \wedge B)$

3. Determine whether the following pairs of sentences are logically equivalent:

   (a) $(A \wedge \neg B) \vee (\neg A \wedge B)$ $\quad A \leftrightarrow \neg B$

   (b) $A \vee (B \wedge C)$ $\quad (A \vee B) \wedge (A \vee C)$

(30)

IF YOU DON'T TYPE THE FOLLOWING ANSWERS, PLEASE WRITE LEGIBLY:

B. Translate the following sentences into our formal language, Propositional Logic. *In each case, explicitly state the English sentence corresponding to each sentence letter*.

Important Note: You should fully expose the logical structure of the sentence e.g. "John and Kate went to the store" should not be symbolized as "J", but as "$(J \wedge K)$" with J = "John went to the store" and K = "Kate went to the store". Similarly, if one sentence is the negation of another, you should translate it as such, even if it does not explicitly contain the word "not". *Warning, at least one of these is tricky in that regard.*

1. Not only will Germany win the European Championships, but they will win the World Cup as well.
2. Either we buy the groceries, or we visit your relatives, but not both.

3. If Kite misses his tap-in and the spectators groan loudly, then Watson's concentration will be disturbed.
4. I don't remember falling down, but if I did, then I must have been sleepwalking.
5. John did not go to the store, but Kate did.
6. At least one of John and Kate went to the store.
7. Neither John nor Kate went to the store, but Peter did.
8. Some cities have skyscrapers, but not all of them do.
9. I drink if, and only if, I am thirsty.
10. I drink only if I am thirsty

(40)

C. Translate the following argument into our formal language, Propositional Logic, and determine whether or not it is valid using a truth-table. *Explicitly state the English sentence corresponding to each sentence letter*.

If Sartre is an existentialist, he isn't rational. If he's not rational, he's an existentialist. So, he's not an existentialist if, and only if, he is rational.

(10)

D. True or False? Where true, provide a proof. Where false, provide a counterexample i.e., a particular case that demonstrates that the claim is false. *All counterexamples should be in our formal language (i.e. not arguments or sentences in English)*.

1. If a sentence is not a contradiction, then its negation must be one.
2. If a sentence is contingent (i.e., neither a tautology nor a contradiction), then its negation is also.

(20)