This is the homework for the week of September 1–5, covering Chapter 1, Sections 1 to 3. It is due in class on Wednesday, September 10. You can work with other people in the class, but you should write up your solutions in your own words to turn in. Remember that unsupported answers will not receive any credit.

1. Use truth tables to determine whether the following compound propositions are tautologies:

a) $(q \wedge (p \rightarrow q)) \rightarrow p$ **b)** $\big((p \rightarrow q) \wedge (r \rightarrow \neg q)\big) \rightarrow \big(r \rightarrow \neg p\big)$

2. Consider an ordinary deck of 52 playing cards. A *face card* is a card that is either a Jack, a Queen, or a King. For how many cards in the deck is it true

a) that "This card is either a face card or a spade"?

b) that "If this card is a face card, then it is a spade"?

c) that "This card is a face card if and only if it is a spade"?

3. For each of the following pairs of propositions, show that the two propositions are logically equivalent by finding a chain of logical equivalences that leads from one to the other. State which definition or law of logic justifies each step in the chain.

a) $p \wedge (q \vee \neg p)$, $q \wedge p$

b) $(p \rightarrow q) \vee (r \rightarrow q)$, $(p \wedge r) \rightarrow q$

4. Draw a logic circuit that computes the value of the following propositions from its three inputs, A, B, and C. Describe in words how you constructed the circuit

$$(A \vee B \vee C) \wedge \neg(A \wedge B) \wedge \neg(A \wedge C)$$

5. Find a proposition in disjunctive normal form that is equivalent to the proposition

$$(p \vee \neg q) \wedge (\neg(r \wedge p)) \wedge (\neg(p \wedge q \wedge r))$$

(Hint: Start with a truth table for the given proposition.)

6. Convert each of the following English statements into propositional logic. You should introduce symbols such as p and q to stand for the simple propositions that occur in the statements. The first statement is *ambiguous*; you should give two possible translations and explain the difference.

a) I will order Subgum Chicken or Kung-Pao Shrimp with white rice.

b) If I have to listen to another one of Fred's jokes, then I will either kill myself or kill him.

7. Express the logical negation of each of the following sentences in natural English

a) I don't watch TV, and I don't listen to the radio.

b) If I don't pass this course, then I am not a computer science major.

8. State the *converse* and the *contrapositive* of the English statement, "If the bus does not arrive on time, then Fred is late for work."