You are strongly encouraged to do all of the problems. However, only the ones marked with (*) will be graded.

**Question 1:** Use truth tables to prove the bi-conditional law. (See Section 2.5 in the book for the statement of this law.)

**Question 2:** We discussed in class that there are 16 distinct operators on 2 logical variables. How many possible operators are there on 3 variables?

**Question 3:** Exercise 2.2 in the book, as modified below:
Suppose we have an empty table of this type and size, and wish to fill one of its four cells with the logical constant TRUE and the other three cells with FALSE. There are four possible ways to do this, depending on the location of TRUE. Each of the resulting four truth tables corresponds to a simple expression of logic. Give an expression corresponding each of the four tables, using whatever you need from the seven symbols $p, q, \land, \lor, \neg, \iff$ and $. Use as few occurrences of the operators as you can.

**Question 4:** Prove that the following proposition is a tautology (using the rules of inference from the book).

$$(\neg p \to q) \land \neg q \to p$$

(*) **Question 5:** Prove that the following proposition is a tautology (using the rules of inference from the book).

$p \land q \to \neg(p \to \neg q)$