Exercise Sheet 5
Propositional Logic – Semantics

1. Provide an example of:

   - a satisfiable formula, which is not valid, containing at least a conjunction, a disjunction, a negation, and an implication
   - a falsifiable formula, which is not unsatisfiable, containing at least a conjunction, a disjunction, a negation, and an implication
   - an unsatisfiable formula, containing at least a conjunction, a disjunction, a negation, and an implication
   - a valid formula, containing at least a conjunction, a disjunction, a negation, and an implication

2. Check whether the following formula is valid using a truth table: $(q \vee r \rightarrow p) \wedge (q \rightarrow r) \wedge \neg r$

3. Check whether the following formula is valid using a truth table: $(q \vee r \rightarrow p) \vee (q \rightarrow r) \vee \neg r$

4. Consider the following solution to the simple Sudoku puzzle discussed in exercise sheet 2:

   $(p_0 \vee p_1) \wedge (q_0 \vee q_1) \wedge (r_0 \vee r_1) \wedge (s_0 \vee s_1)$
   $\wedge (\neg p_0 \vee \neg p_1) \wedge (\neg q_0 \vee \neg q_1) \wedge (\neg r_0 \vee \neg r_1) \wedge (\neg s_0 \vee \neg s_1)$
   $\wedge (p_0 \vee q_0) \wedge (r_0 \vee s_0) \wedge (p_1 \vee q_1) \wedge (r_1 \vee s_1) \wedge (p_0 \vee r_0) \wedge (q_0 \vee s_0) \wedge (p_1 \vee r_1) \wedge (q_1 \vee s_1)$

   Find a valuation that satisfies this formula, and explain why it does satisfy the formula. Do not draw a truth table. How many rows would the truth table have if you had to draw it?