

Study Exercises

To assist you with thinking about the topics of the course and about how to solve the problems, we provide the following suggestions for exercises. You may work on them on your own or with classmates (or both) as you choose. When you get stuck, please feel free to ask an instructor or IA.

How many exercises you work on is entirely up to you. We do suggest, however, that knowing the answers is NOT the important part. The important part is to practice finding such answers yourself. You will need to do this on exams.

SE 1. Huth & Ryan, Exercise 1.4.6, p. 85.

SE 2. Huth & Ryan, Exercises 1.4.7, 1.4.8, and 1.4.10, pp. 85–86.

SE 3. For each of the propositional formulas given below, answer all three of the following questions: Is the formula satisfiable? Is the formula a tautology? Is the formula a contradiction? Justify your answers using truth tables and/or valuation trees.

(a) $((p \wedge q) \rightarrow r) \rightarrow ((p \rightarrow r) \vee (q \rightarrow r))$

(b) $((\neg(p \rightarrow q)) \rightarrow ((\neg p) \rightarrow (\neg q)))$

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

SE 4. Prove or disprove each of the following equivalence statements. Justify your answers by using a truth table, a proof with logical identities or by providing a truth valuation for which the two formulas have different truth values.

(a) $((p \wedge q) \vee (q \wedge r)) \equiv (q \wedge (p \vee r))$

(b) $(p \vee (p \wedge q)) \equiv p$

(c) $(\neg((\neg p) \vee (\neg(r \vee s)))) \equiv ((p \wedge r) \vee (p \wedge s))$

(d) $(\neg((\neg(p \wedge q)) \vee p)) \equiv \mathbf{F}$

(e) $p \equiv (p \wedge (q \rightarrow p))$

(f) $p \equiv (p \wedge ((\neg((\neg q) \wedge (\neg p))) \vee p))$

(g) $(p \wedge ((\neg((\neg q) \wedge (\neg p))) \vee p)) \equiv q$