**Practice questions**

Q1. Write each of these statements in the form “if p, then q” in English. [Hint: Refer to thelist of common ways to express conditional statements.]

a) It snows whenever the wind blows from the northeast.

b) The apple trees will bloom if it stays warm for a week.

c) That the Pistons win the championship implies that they beat the Lakers.

d) It is necessary to walk eight miles to get to the top of Long’s Peak.

e) To get tenure as a professor, it is suﬃcient to be world famous.

f) If you drive more than 400 miles, you will need to buy gasoline.

g) Your guarantee is good only if you bought your CD player less than 90 days ago.

h) Jan will go swimming unless the water is too cold.

i) We will have a future, provided that people believe in science.

Q2. Write each of these statements in the form “p if and only if q” in English.

a) If it is hot outside you buy an ice cream cone, and if you buy an ice cream cone it is hot outside.

b) For you to win the contest it is necessary and suﬃcient that you have the only winning ticket.

c) You get promoted only if you have connections, and you have connections only if you get promoted.

d) If you watch television your mind will decay,and conversely.

Q3. Construct a truth table for each of these compound propositions.

a) p → (¬q ∨ r)

b) ¬p → (q → r)

c) (p → q) ∨ (¬p → r)

Q4. State the converse, contrapositive, and inverse of each of these conditional statements.

a) If it snows tonight, then I will stay at home.

b) I go to the beach whenever it is a sunny summer day.

c) When I stay up late, it is necessary that I sleep until noon.

Q5. How many rows appear in a truth table for each of these compound propositions also construct truth table for these compound proposition?

a) p → ¬p

b) (p ∨¬r) ∧ (q ∨¬s)

c) q ∨ p ∨¬s ∨¬r ∨¬t ∨ u

d) (p ∧ r ∧ t) ↔ (q ∧ t)

d) (p → q) ∧ (¬p → r)

e) (p ↔ q) ∨ (¬q ↔ r)

f) (¬p ↔ ¬q) ↔ (q ↔ r)

Q6. Construct a truth table for ((p → q) → r) → s.

Q7.Are these system speciﬁcations consistent? “Whenever the system software is being upgraded, users cannot access the ﬁle system. If users can access the ﬁle system,

then they can save new ﬁles. If users cannot save new ﬁles, then the system software is not being upgraded.”

Q8. Are these system speciﬁcations consistent? “The router can send packets to the edge system only if it supports the new address space. For the router to support the new address space it is necessary that the latest software release be installed. The router can send packets to the edge system if the latest software release is installed. The router does not support the new address space.”

Q9 . Are these system speciﬁcations consistent? “If the ﬁle system is not locked, then new messages will be queued. If the ﬁle system is not locked, then the system is functioning normally, and conversely. If new messages are not queued, then they will be sent to the message buﬀer. If the ﬁle system is not locked, then new messages will be sent to the message buﬀer. New messages will not be sent to the message buﬀer.

Q10. Show that p ↔ q and (p ∧ q) ∨ (¬p ∧¬q) are logically equivalent.

Q11. Show that ¬(p ↔ q)andp ↔ ¬q are logically equivalent.

Q12. Show that p → q and ¬q → ¬p are logically equivalent.

Q13. Show that ¬p ↔ q and p ↔ ¬q are logically equivalent.