1. Find the DNF for the compound proposition \((- (r \rightarrow \neg q)) \leftrightarrow (p \rightarrow r)\)

2. (a) Show that \(\neg\) and \(\land\) form a functionally complete set of operators, that is, show that for any compound proposition \(p\), there is a logically equivalent proposition \(q\) that uses only the operators \(\neg\) and \(\land\). (Hint: Find logically equivalent propositions to \(p \rightarrow q\) and \(p \lor q\) that use only the operators \(\neg\) and \(\land\).)

(b) Consider the proposition \((p \rightarrow \neg q) \lor (r \rightarrow q)\). Give a logically equivalent proposition that only uses the operators \(\neg\) and \(\land\).

3. (Sec. 1.5 p. 12) Let \(I(x)\) be the statement “\(x\) has an Internet connection” and \(C(x, y)\) be the statement “\(x\) and \(y\) have chatted over the Internet”, where the domain for the variables \(x\) and \(y\) consists of all students in your class. Use quantifiers to express each of these statements.

(a) No one in the class has chatted with Bob.
(b) Sanjay has chatted with everyone except Joseph.
(c) Someone in your class does not have an Internet connection.
(d) Not everyone in your class has an Internet connection.
(e) Exactly one student in your class has an Internet connection.
(f) Everyone in your class with an Internet connection has chatted over the Internet with at least one other student in your class.
(g) There are two students in your class who have not chatted with each other over the Internet.
(h) There are two students in your class who between them have chatted with everyone else in the class.

4. (Sec. 1.5 p. 2) Translate these statements into English, where the domain for each variable consists of all real numbers.

(a) \(\exists x \forall y \ (xy = y)\)
(b) \(\forall x \forall y \ (((x \geq 0) \land (y < 0)) \rightarrow (x - y > 0)))\)
(c) \(\forall x \forall y \exists z \ (x = y + z)\)