1. Suppose $P(x) : x \in [0, 10]$ and $Q(x) : |x| > 5$ both over the domain $\mathbb{R}$. For which values in the domain is the biconditional $P(x) \leftrightarrow Q(x)$ a false statement? Note: $P \leftrightarrow Q$ is true when they’re both true or both false, so when would $P \leftrightarrow$ be false?

2. For statements $P$ and $Q$ show that

$$(P \land (P \rightarrow Q)) \rightarrow Q$$

is a tautology by writing out the truth table.

3. For statements $P$ and $Q$ show that

$$(\neg (P \rightarrow Q)) \land (\neg Q)$$

is a contradiction by writing out the truth table. Note: This problem has a mistake.

4. For each of the following pairs of statements write out a truth table to show whether or not the statements are equivalent.

(a) $P \lor (Q \land R)$ and $(P \lor Q) \land R$
(b) $\neg (P \land Q)$ and $(\neg P) \lor (\neg Q)$
(c) $P \rightarrow Q$ and $Q \rightarrow P$

5. Show that

$$P \rightarrow (Q \lor R) \equiv (\neg Q) \rightarrow ((\neg P) \lor R)$$

by finding a chain of simple logical steps between them.