1. Determine which of the following are statements, and give the truth value.

   (a) “Is it raining outside now?”
   (b) “February 14 is Valentine’s Day”
   (c) “This sentence is false”
   (d) “Add the first three positive integers”
   (e) “√2 is a rational number”
   (f) “She is taller than I am”

2. Consider the open sentence $P(x) : -1 \leq 2x - 3 < 5$, with domain $\mathbb{R}$. Find the following sets as intervals:

   (a) $A$, the truth set of $P(x)$
   (b) $\mathbb{R} - A$, the set for which $P(x)$ is false.

3. Let $P : \sqrt{2}$ is rational, $Q : 2/3$ is rational, $R : \sqrt{3}$ is rational. Write the following implications in words, and determine the truth values:

   (a) $(P \land Q) \Rightarrow (\sim R)$
   (b) $(P \lor Q) \Rightarrow R$

4. Consider the open sentences $P(x) : |x| = 4$ and $Q(x) : x = 4$, with domain $\mathbb{Z}$. Find the truth sets of the following:

   (a) $P(x) \Rightarrow Q(x)$
   (b) $Q(x) \Rightarrow P(x)$

5. The propositional form $((P \Rightarrow Q) \land (Q \Rightarrow R)) \Rightarrow (P \Rightarrow R)$ is called a syllogism. Show that this is a tautology.

6. The inverse of the implication $P \Rightarrow Q$ is $(\sim P) \Rightarrow (\sim Q)$.
   Show that a statement and its inverse are not logically equivalent.

7. Find and simplify the negations of the open sentences with domain $\mathbb{R}$:

   (a) Either $x = 0$ or $y = 0$
   (b) $x = 1$ or $y = 2$
   (c) $x < 2$ and $y \geq 4$