1. Consider the sets \( S = \{(x, y) \in \mathbb{R}^2 \mid x \leq 5\} \), \( T = \{(x, y) \in \mathbb{R}^2 \mid y \geq 2\} \), and \( U = \{(x, y) \in \mathbb{R}^2 \mid x^3 \leq 30y^3 + 4\} \), where \( \mathbb{R}^2 \) denotes the set of points in the plane. Prove: \( S \cap T \subseteq U \).

2. (a) Prove: \((A \cup B) \cap C \subseteq A \cup (B \cap C)\), for all sets \( A, B, C \).

(b) Show that equality need not hold in part (a) by giving an example of three sets \( A, B, C \) such that \((A \cup B) \cap C \neq A \cup (B \cap C)\).

3. Show that if \( A \subseteq B \) and \( X \subseteq Y \), then \( A \cup X \subseteq B \cup Y \).

4. Prove the distributive law: \( A \cap (B \cup C) = (A \cap B) \cup (A \cap C) \).

5. Prove the de Morgan’s law: \( A \setminus (B \cap C) = (A \setminus B) \cup (A \setminus C) \).