Set Identities

Let all sets referred to below be subsets of a universal set \( U \).

1. Commutative Laws: For all sets \( A \) and \( B \),
   \[(a) \ A \cup B = B \cup A \text{ and (b) } A \cap B = B \cap A \]

2. Associative Laws: For all sets \( A, B, \) and \( C \),
   \[(a) \ (A \cup B) \cup C = A \cup (B \cup C) \text{ and (b) } (A \cap B) \cap C = A \cap (B \cap C) \]

3. Distributive Laws: For all sets \( A, B, \) and \( C \),
   \[(a) \ A \cup (B \cap C) = (A \cup B) \cap (A \cup C) \text{ and (b) } A \cap (B \cup C) = (A \cap B) \cup (A \cap C) \]

4. Identity Laws: For all sets \( A \),
   \[(a) \ A \cup \emptyset = A \text{ and (b) } A \cap U = A \]

5. Complement Laws: For all sets \( A \),
   \[(a) \ A \cup A^C = U \text{ and (b) } A \cap A^C = \emptyset \]

6. Double Complement Law: For all sets \( A \),
   \[(A^C)^C = A \]

7. Idempotent Laws: For all sets \( A \),
   \[(a) \ A \cup A = A \text{ and (b) } A \cap A = A \]

8. Universal Bound Laws: For all sets \( A \),
   \[(a) \ A \cup U = U \text{ and (b) } A \cap \emptyset = \emptyset \]

9. De Morgan’s Laws: For all sets \( A \) and \( B \),
   \[(a) \ (A \cup B)^C = A^C \cap B^C \text{ and (b) } (A \cap B)^C = A^C \cup B^C \]

10. Absorption Laws: For all sets \( A \) and \( B \),
    \[(a) \ A \cup (A \cap B) = A \text{ and (b) } A \cap (A \cup B) = A \]

11. Complements of \( U \) and \( \emptyset \):
    \[(a) \ U^C = \emptyset \text{ and (b) } \emptyset^C = U \]

12. Set Difference Law: For all sets \( A \) and \( B \),
    \[A \setminus B = A \cap B^C\]