1. Prove $B \setminus A = B \cap A^{\mathsf{c}}$.

2. Prove the following are equivalent: $A \subseteq B, A \cap B = A, A \cup B = B$.

3. Prove the Distributive Law: $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$.

4. Write the dual of: $(\mathbf{U} \cap A) \cup (B \cap A) = A, (A \cap \mathbf{U}) \cap (\varnothing \cup A^{\mathsf{c}}) = \varnothing$.

5. Prove $(A \cup B) \setminus (A \cap B) = (A \setminus B) \cup (B \setminus A)$.

6. Prove:
   a. $(A \cap B) \cup (A \cap B^{\mathsf{c}}) = A$
   b. $A \cup B = (A \cap B^{\mathsf{c}}) \cup (A^{\mathsf{c}} \cap B) \cup (A \cap B)$

7. Prove $n(P(S)) = 2^{n(S)}$ if S is a finite set.

8. Try to figure out the formula for: $n(partition(S))$.

9. Let $[A_1, A_2, \cdots, A_m]$ and $[B_1, B_2, \cdots, B_n]$ be partitions of a set S. Prove the following collection is also a partition (called the *cross partition*) of S:

$$P = [A_i \cap B_j | i = 1, \cdots, m, j = 1, \cdots, n] \setminus \{\varnothing\}$$

10. Prove the following properties of the symmetric difference:
    a. Associative Law $(A \oplus B) \oplus C = A \oplus (B \oplus C)$
    b. Comutative Law $A \oplus B = B \oplus A$
    c. Cancellation Law $A \oplus B = A \oplus C \implies B = C$
    d. Distributive Law $A \cap (B \oplus C) = (A \cap B) \oplus (A \cap C)$

11. Consider m nonempty distinct sets, $A_1, A_2, \cdots, A_m$ in a universal set $\mathbf{U}$. Prove:
    a. There are 2^m fundamental products of the m sets.
    b. Any two fundamental products are disjoint.
    c. $\mathbf{U}$ is the union of all the fundamental products.