1. Prove \( A \times (B \cap C) = (A \times B) \cap (A \times C) \)

2. Let \( A = \{a, b, c, \{d, e\}\} \)
   
   (a) Find the Power Set \( \mathcal{P}(A) \)
   
   (b) Find the Partition Set \( \Pi(A) \)

3. (a) Let \( \mathcal{M} = \{D, D^c\} \)
   
   Is \( \mathcal{M} \) an algebra of the subsets of \( \mathcal{U} \)? Justify your answer.

   (b) Let \( A \) and \( B \) be algebras of subsets of \( \mathcal{U} \).
   
   Is the union \( (A \cup B) \) also an algebra of subsets of \( \mathcal{U} \)? Justify your answer.