Name: _____

Directions: Show all work. No credit for answers without work.

1. **[4 parts, 1 point each]** Let $A = \{(2,4), \{4,2\}, 3\}$, $B = \{3, (4,2)\}$, and $C = \{1,2,3\} \times \{3,4\}$.

   (a) Determine the sizes of A, B, and C.

   (b) Find $A \cap B$.

   (c) Find B^2.

   (d) Find C^0.

2. **[2 points]** Is it true or false that for all sets A, B, C, we have that $(A \times B) \times C = A \times (B \times C)$? If true, then explain why this is true, and if false, then give an example of sets A, B, C where $(A \times B) \times C \neq A \times (B \times C)$.

3. **[2 points]** Is the set $\mathbb{N}^5$ countable or not? Justify your answer.

4. **[2 points]** Let A be the set whose members are the subsets of the positive integers. For example, the following sets are members of A: $\{1, 3, 5, 7, \ldots\}$, $\{n : n \text{ is prime}\}$, $\{1, 2, 3, 4, 5\}$, $\varnothing$, and $\{1, 4, 9, 25, 36, \ldots\}$. Let $S_1, S_2, S_3, \ldots$ be a list of members of A. Adapt Cantor's diagonalization argument to construct a set D which does not appear on the list.