(1) (Formalisation) Write down formulas in the language of set theory to express the following concepts:
   (a) $A = \emptyset$,
   (b) $A$ is a relation,
   (c) $A = B \times C$.

(2) (Ordered pairs and $n$-tuples) Recall the definition of the ordered pair: $(a, b) = \{\{a\}, \{a, b\}\}$. Let $p$ be an ordered pair.
   (a) Write down a formula to express “$x$ is the first coordinate of $p$.”
   (b) Write down a formula to express “$y$ is the second coordinate of $p$.”

(3) (Power set) Given a set $A$, prove that its power set $\mathcal{P}(A)$ is unique. Why does the power set exist?

(4) (Generalised pairs) Let $A$, $B$ and $C$ be sets. Show that there is a set $P$ such that $x \in P$ if and only if $x = A$ or $x = B$ or $x = C$.

(5) (Symmetric difference)
   (a) Show that the set of all $x$ such that $x \in A$ and $x \notin B$ exists.
   (b) Show that for sets $A$ and $B$ there exists a unique $C$ such that $x \in C$ if and only if either $x \in A$ and $x \notin B$ or $x \in B$ and $x \notin A$.

(6) (Intersections) Prove that $\bigcap S$ exists for all $S \neq \emptyset$. Where is the assumption $S \neq \emptyset$ used in the proof?

(7) (The Axiom of Existence) Replace The Axiom of Existence with the following weaker postulate:

   **Weak Axiom of Existence:** Some sets exist.

   Prove the Axiom of Existence using the Weak Axiom of Existence and the Comprehension Schema.