1. Given bijections \( f: X \to A \) and \( g: Y \to B \), define \( h: X \times Y \to A \times B \) by \( h(x, y) = (f(x), g(y)) \). Prove: \( h \) is a bijection.

2. Let ~ be the relation on \( \mathbb{R}^2 \) given by
\[
(x, y) \sim (a, b) \iff y - 2x = b - 2a
\]
(a) Prove that ~ is an equivalence relation on \( \mathbb{R}^2 \).

(b) Pick three points in \( \mathbb{R}^2 \), and give a geometric description of \([ (a, b) ]\) for each of the three points, i.e., describe the graph of \([ (a, b) ]\).

3. Let \( R \) and \( R' \) be equivalence relations on a set \( X \).
   (a) Show that \( R \cap R' \) is an equivalence relations on \( X \).
   (b) Give an example of a set \( X \) and equivalence relations \( R \) and \( R' \) on \( X \) to show that \( R \cup R' \) need not be an equivalence relation on \( X \).

4. Prove: \([a, b] \cong [c, d]\), for all closed intervals \([a, b]\) and \([c, d]\) of \( \mathbb{R} \).

5. Let \( X \) be a set, and let \( X^{\{1,2\}} \) denote the set of functions \( \{1, 2\} \to X \).
   Prove: \( X^{\{1,2\}} \cong X \times X \).