1. **History**

   (a) Give one example of a symbol, other than =, that was used for equality.
   
   (b) In one sentence, state the difference between public key cryptography and private key cryptography.
   
   (c) Give the typical name used for two of the three participants (sender, receiver, eavesdropper) in secure communication. (Hint: think 1960’s)
   
   (d) Give an example of Russell’s paradox.

2. **Sets.** For each of the following relationships, state whether the relationship is true or false. If it is true, give a proof; if it is false, supply a counterexample. (Recall that \ is the relative complement operator.)

   (a) \( A \setminus B = B \setminus A \).
   
   (b) \( S \setminus (T \cup W) = (S \setminus T) \cap (S \setminus W) \).

3. **Functions.** Consider \( f : R \times R \to R \times R \times R \) given by \( f(x, y) = (y, x, x + y) \). Is \( f \) one-to-one? If so, prove it; if not, give a counterexample. Is \( f \) onto? If so, prove it; if not, give a counterexample.

4. **Logical Implication.** Prove that \( (p \to q) \land \lnot q \to \lnot p \).

5. **Proofs.**

   (a) Prove the following Lemma: if \( a^3 \) is even, then \( a \) is even.
   
   (b) Prove that \( \sqrt{2} \) is irrational. You may use the Lemma from part (a).