1) Do problems 13.10, 13.11, 13.12, 17.4, 17.9, 18.9 from the book.

2) Suppose that \( \{p_n\} \) and \( \{q_n\} \) are Cauchy sequences in a set \( S \) with metric \( d \). Define \( a_n = d(p_n, q_n) \). Show that the sequence \( \{a_n\} \) converges.

3) Suppose that \( \{p_n\} \) is a Cauchy sequence in a set \( S \) with metric \( d \), and that some subsequence \( \{p_{n_k}\} \) converges to a point \( p \in S \). Prove that the full sequence \( \{p_n\} \) converges to \( p \).

4) Consider the function \( f : \mathbb{R} \to \mathbb{R} \) defined as follows: \( f(x) = x \) if \( x \in \mathbb{Q} \) and \( f(x) = 0 \) if \( x \notin \mathbb{Q} \). Show that \( f \) is continuous at 0 but at no other point.

**Optional Problem (for fun):** A real valued function \( f \) on an interval \( I \) is called convex if for all \( x, y \in I \), and \( 0 < \lambda < 1 \) one has

\[
    f((1 - \lambda)x + \lambda y) \geq (1 - \lambda)f(x) + \lambda f(y).
\]

Suppose \( f \) is convex on \([a, b]\). Prove that \( f \) is continuous at \( x \) for \( a < x < b \), but need not be continuous at \( a \) or \( b \).

5) How difficult was this homework? How long did it take?