In each problem, \((E, d)\) is a metric space.

1. Show that in \(E\)
   a. the union of any finite number of closed sets is a closed set.
   b. the intersection of any collection of closed sets is a closed set.

2. If the metric for \(E\) is the **discrete metric**, then show that each set \(S \subseteq E\) is always open and closed.

3. Show that the upper half plane
   \[
   \{(x, y) \in \mathbb{R}^2 | y > 0\}
   \]
   is an open set when \(d\) is the Euclidean metric (i.e. \(d_2\)).

4. (Grad Students and E.C.) Show that
   \[
   \{(x, y) \in \mathbb{R}^2 | x > y + 1\}
   \]
   is an open subset of the plane equipped with the standard Euclidean metric.

5. Suppose \(S \subseteq E\), then prove that \(p_0\) is a limit point of \(S\) if and only if each open ball in \(E\) which has \(p_0\) as its center contains an infinite number of points from \(S\).

6. Prove that any finite subset \(S\) of \(E\) is closed and each point of \(S\) is an isolated point.
   (Defn: a point \(p_0\) is called an **isolated point** of \(S\) if \(p_0 \in S\) and there is an open ball \(B_\epsilon(p_0)\) which contains no other points of \(S\).)