1. Suppose (X_1, d_1) and (X_2, d_2) are metric spaces, and suppose $f : X_1 \to X_2$ is a function such that the preimage of every open set is open, i.e, for every open set $A_2 \subset X_2$, $f^{-1}(A_2)$ is open in X_1. Prove that f is continuous according to the definition of continuity for metric spaces.
2. Find all topologies on the set $X = \{a, b, c\}$. Just list the different topologies, without proving that they really are topologies. In your list, identify the discrete and the indiscrete topologies.
3. Let $X = \mathbb{R}$, $\mathcal{T} = \{[a, b] \mid a, b \in \mathbb{R}\} \cup \{\mathbb{R}, \phi\} \cup \{[a, \infty) \mid a \in \mathbb{R}\} \cup \{(-\infty, b] \mid b \in \mathbb{R}\}$. Is $\mathcal{T}$ a topology? Prove your answer.
4. Let (X, d) be a metric space. Prove that for every point $p \in X$, the set $\{p\}$ is closed in X.

Extra Credit Problems

5. Find a homeomorphism between the Cantor set C (see previous homework for definition) and its left half, i.e., $C \cap [0, 1/3]$.