1. Let $H = [-1, 1] \times \{0\}$ and $V = \{0\} \times [-1, 0)$ in the plane and let $T = H \cup V$. Show $T$ is not homeomorphic to the unit interval $I = [0, 1]$.

2. Let $(X, d)$ be a metric space and let $F$ be the family of all nonempty closed, bounded subsets of $X$. For $F, G \in F$, define $D(F, G) = \inf\{r | F \subset G_r \text{ and } G \subset F_r\}$, where $F_r = \bigcup_{x \in F} B(x, r)$ and $B(x, r)$ is the open ball of radius $r > 0$ centered at $x$. Show that $D$ is a metric on $F$.

3. Prove that if $X$ and $Y$ are connected spaces then $X \times Y$ is connected.

4. Prove that every compact regular space is normal.

5. Describe the one-point compactification of a locally compact Hausdorff space and prove that it is compact.

6. A set $X$ in $\mathbb{R}^n$ is star convex if there is $x_0 \in X$ such that for every $x \in X$, the segment from $x_0$ to $x$ lies in $X$. If $X$ is star convex, prove that $X$ is simply connected.

7. Let $p : E \longrightarrow B$ be a covering map. Prove that if $E$ is compact, then $p^{-1}(b)$ is finite for every $b \in B$. 