1. Let $X$ be a topological space and $A$ a subset of $X$. Show that 
\[ \overline{X - A} = X - \text{Int}(A) \quad \text{and} \quad \text{Int}(X - A) = X - \overline{A} \]
Use these equalities to show that $\partial A = \partial (X - A)$.

2. Let $(X, <)$ be a simply ordered set and let $\mathcal{T}_\sigma$ be the order topology on $X$. Show that with respect to the order topology the inclusion $\langle a, b \rangle \subseteq [a, b]$ holds for any two elements $a, b \in X$ with $a < b$. Under what conditions is the equality $\langle a, b \rangle = [a, b]$ true?

3. For subsets $A \subseteq X$ and $B \subseteq Y$ of the topological spaces $X$ and $Y$, show that $\overline{A \times B} = \overline{A} \times \overline{B}$ in the product topology on $X \times Y$.

4. Show that $X$ is a Hausdorff space if and only if the diagonal $\Delta = \{(x, x) \mid x \in X\}$ is a closed set in $X \times X$ (equipped with the product topology).

5. Let $X$ be a topological space and let $A_i, i \in \mathcal{I}$ be a family of subsets of $X$ with $\mathcal{I}$ some (possibly infinite) indexing set. Prove or disprove the equality 
\[ \bigcup_{i \in \mathcal{I}} A_i = \bigcup_{i \in \mathcal{I}} \overline{A}_i \]

6. Which of the separation axioms $T_0$–$T_4$ are satisfied by the Fort topology $\mathcal{T}_{F,p}$ on $X = \mathbb{R}$? See the Notes 2 online or Homework 1 for a definition of the Fort topology. The particular choice of the point $p$ is immaterial for this problem, choose it as you please.