NAME ________________________________

Work all problems. Each problem is worth 20 points. Partial credit will be given for correct reasoning. Credit will be deducted for statements and reasoning that are incorrect.

**Problem 1.** Show that a regular Lindelöf space is normal.

**Problem 2.** Let $C$ be the Cantor set. Show that there is a continuous function $f : C \rightarrow [0, 1]^2$ which is onto.
Problem 3. Let \( f, g : X \to S^n \) be continuous. Suppose that for all \( x \in X \), \( f(x) \neq -g(x) \). Show that \( f(x) \) and \( g(x) \) are homotopic.

Problem 4. Let \((X, x_0)\) be a pointed space. Define \( \pi_1(X, x_0) \). Define the binary operation on \( \pi_1(X, x_0) \) that makes \( \pi_1(X, x_0) \) a group.
Problem 5. State the following theorems.

The Urysohn Metrization Theorem

The Urysohn Lemma

The Tietze Extension Theorem

The Hahn-Mazurkiewicz Theorem