Answer the following questions without giving proofs.

1. Let $X \subseteq Y$.
   a) What does it mean for $X$ to be a retract of $Y$?
   b) What does it mean for $X$ to be a deformation retract of $Y$?

2. Let $K$ be a finite simplicial complex. Define $\chi(K)$, the Euler characteristic of $K$.

3. Define what it means for a topological space to be
   a) normal
   b) connected

4. State the Brouwer fixed point theorem.

   Answer the following questions, giving proofs or counterexamples.

5. Let $p: X \to Y$ be a $d$-sheeted covering projection, where $X$ and $Y$ are finite simplicial
   complexes. Show that $\chi(X) = d \cdot \chi(Y)$.

6. Compute the fundamental group of a closed, orientable surface $X$ of genus 3.

7. Let $X$ be a closed, orientable surface of genus 3.
   a) Compute the homology groups of $X$.
   b) Compute the Euler characteristic of this surface $X$.

8. Show that every continuous map $f: S^2 \to S^1$ is homotopic to a constant map.

9. For $i = 1, 2, \ldots$ let $P_i$ be a 2-dimensional plane in $\mathbb{R}^3$.
   a) Show that $S = \mathbb{R}^3 \setminus \bigcup_{i=1}^\infty P_i$ is not empty.
   b) Must $S$ be an open set?

10. Let $C$ be the Cantor set and let $S$ be any compact metric space. Show that there is a
    continuous map $f: C \to S$ such that $f$ is onto.