1. State the exact homology sequence of a pair.

2. Describe all coverings of the torus $\mathbb{T}^2 = \mathbb{S}^1 \times \mathbb{S}^1$.

3. State the Lefschetz fixed point theorem for compact simplicial complexes.

4. State Tietze's extension theorem for normal spaces.

5. Let $K = K_1 \cup K_2$ be a simplicial complex with K_1 and K_2 subcomplexes, and let $A = K_1 \cap K_2$. State the Mayer-Vietoris sequence for this.

6. Let X be the set of points in the plane which is the closure of the set $S = \{(x, \sin(\frac{1}{x})) \mid 0 < x \leq 1\}$. Show that there is no continuous mapping $f : [0,1] \to X$ which is onto.

7. Prove that a compact Hausdorff space is normal.

8. Let $f, g : X \to \mathbb{S}^n$ be any continuous mappings. Suppose that for all $x \in X, f(x)$ and $g(x)$ are not antipodal. Show that f and g are homotopic.

9. Use the Van Kampen theorem to compute the fundamental group of the surface of genus 2.

10. Give an example of a space X for which $\pi_1(X, x_0)$ is not finitely generated.

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