1. Prove that the fundamental group of a product of two topological spaces is the product of their fundamental groups.

2. Prove that a retract of a Hausdorff space is closed.

3. Let $T$ be a torus (i.e. $T = S^1 \times S^1$), and let $x_0$ be a point in $T$. Show that $T - \{x_0\}$ has a 'figure eight' as a deformation retract.

4. Let $X$ be a simply connected topological space, and let $x$ and $y$ be two distinct points in $X$. Show that there is a unique path class in $X$ with initial point $x_0$ and terminal point $y_0$.

5. Prove that the subspace $S^1 \times \{x_0\}$ is a retract of $S^1 \times S^1$ but is not a deformation retract, for any point $x_0 \in T$.

6. Let $G$ be a topological group, with identity element $e$. (A topological group is a topological space $G$ that also happens to be a group, such that the multiplication map $G \times G \to G$ is continuous, and the map $G \to G$ which sends $g$ to $g^{-1}$ is continuous.) Prove that $\pi_1(G,e)$ is an abelian group.