Topology **Hints for Final**

1. Let γ be a path from b_0 to b_1 and define a function $f : p^{-1}(b_0) \to p^{-1}(b_1)$ by $f(e) = \widetilde{\alpha}(1)$ where $\widetilde{\alpha}$ is the lifting of α beginning at e. Something similar with $\overline{\alpha}$ should provide an inverse.

2. Any loop based at 1 is path homotopic to $\alpha_k(t) = \cos 2\pi kt + i \sin 2\pi kt$ for some $k \in \mathbb{Z}$. Then use DeMoivre's formula.

3. Suppose not. Then we can define a function $r : B^2 \to S^1$ by letting $r(\vec{x})$ be the intersection of the line from $f(\vec{x})$ to $\vec{x}$ with S^1. This will be a retraction. Now use a previous homework.

4. Carry out the cutting and pasting procedure we used to classify compact surfaces.