Math 5863
Written Assignment # 3
due: Friday, March 8

PROBLEM 1. Let $T^2 = S^1 \times S^1$ be the torus with $x_0 \neq x_1 \in T^2$, and let $X = T^2 - \{x_1\}$.
(a) Show that $\pi_1(X, x_0)$ is isomorphic to the free group $F(a, b)$ and in the process describe loops in X corresponding to a and b.
(b) Show that X is not a retract of T^2.
(c) Which elements of $F(a, b)$ are in the kernel of the homomorphism $i_{X*} : \pi_1(X, x_0) \to \pi_1(T^2, x_0)$? Describe this kernel subgroup of $\pi_1(X, x_0)$.

PROBLEM 2. Work problem # 2 from section 58 of Munkres' book. Just list the fundamental groups for each of (a)–(l), no explanations required.

PROBLEM 3. Work problem # 12 on page 39 of Hatcher's book.