## Math 151b, Winter 2011

1. Suppose  $H \subset G$  is a closed subgroup, and the inclusion of groups is a homotopy equivalence. Show that if X is a CW complex, and E is a principal G bundle over X, there is a principal H bundle E' over X so that  $E'(G) := (E' \times G)/H$  is isomorphic to E, where H acts on G by left multiplication.

2. Show that isomorphism classes of principal  $S^1$  bundles over CW complexes X are in bijection with elements of  $H^2(X; \mathbb{Z})$ . What operation on principal  $S^1$  bundles corresponds to the group operation in  $H^2$ ? Work this out explicitly (e.g. using transition functions) for  $X = S^2$ .