1. Calculate $\pi_2(S^2 \vee S^1)$.
   Hint: use covering spaces

2. Let $p: \tilde{X} \to X$ be a regular covering map, with $X, \tilde{X}$ connected and locally path connected.
   Let $\tilde{x}, \tilde{y}, \tilde{z}$ be points of $\tilde{X}$, such that $p(\tilde{x}) = p(\tilde{y}) = p(\tilde{z})$ and let $g: \tilde{X} \to \tilde{X}$ be the covering transformation that maps $\tilde{y}$ to $\tilde{z}$. Explain how to construct $g(\tilde{x})$ by lifting suitable paths, and prove that your construction is correct.
Let $C = \{C_n, \partial_n\}$ and $D = \{D_n, \partial_n\}$ be chain complexes and let $f : C \to D$ be a chain map. Let $E_n = C_{n-1} \oplus D_n$ and define $\partial : E_n \to E_{n-1}$ by $\partial(x, y) = (\partial x, f x - \partial y)$. Show that $E = \{E_n, \partial_n\}$ is a chain complex, and that if all the homology groups of $E$ are zero, then $f$ induces an isomorphism: $f_* : H_n(C) \to H_n(D)$.

4. Prove that $H_n(X \times D^k, X \times \partial D^k) \cong H_{n-k}(X)$ for any space $X$ and all $n, k$.

5. Let $(X, A)$ be a pair of spaces, $i : A \to X$ - inclusion. Give a proof or counterexample:
   a) If $H_n(X,A) = 0$ for $0 \leq n \leq k$ then $i_* : H_n(A) \to H_n(X)$ is an isomorphism for $0 \leq n \leq k$. 
b) If $i_x: H_n(A) \to H_n(X)$ is an isomorphism for $0 \leq n \leq k$ then $H_n(X,A) = 0 \ \forall \ 0 \leq n \leq k$. 