1. Massey, Chap 2, Section 7, #5. (p.78)
2. Massey, Chap 3, Section 3, #3. (p.97)
3. Hatcher, Chap 1, Section 1, #10. (p.39):
   From the isomorphism \( \pi_1(X \times Y, x_0 \times y_0) \cong \pi_1(X, x_0) \times \pi_1(Y, y_0) \) it follows that loops in \( X \times \{y_0\} \) and \( \{x_0\} \times Y \) represent commuting elements of \( \pi_1(X \times Y, x_0 \times y_0) \). Construct an explicit homotopy demonstrating this.

4. Let \( X \) and \( Y \) denote topological spaces. What are each of the following spaces?
   a. \( \lim(X \to Y) \)
   b. \( \colim(X \to Y) \)
   c. \( \lim(X \to \ast \to Y) \)
   d. \( \lim(X \equiv Y) \) where the two maps are \( f : X \to Y \) and \( g : X \to Y \).
   e. \( \colim(D^n \leftarrow S^{n-1} \to D^n) \) where both maps are the inclusion of the boundary.
   f. \( \colim((-1,1) \to (-2,2) \to (-3,3) \to \ldots) \).

5. Hatcher, Chap 1, Section 1, #16. (p.39):
   Show that there are no retractions \( r : X \to A \) in the following cases:
   a. \( X = \mathbb{R}^3 \) with \( A \) any subspace homeomorphic to \( S^1 \).
   b. \( X = S^1 \times S^2 \) with \( A \) its boundary torus \( S^1 \times S^1 \).
   c. \( X = D^2 \vee D^2 \) with \( A \) its boundary \( S^1 \vee S^1 \).
   d. \( X \) a disc with two points on its boundary identified and \( A \) its boundary \( S^1 \vee S^1 \).
   e. \( X \) the Mobius band and \( A \) its boundary circle.

Bonus. Recall from class that if \( f : M \to M \) is a self map of a compact surface with finitely many fixed points and if at each fixed point \( f \) is locally homeomorphic to either \((x, y) \mapsto (x/2, y/2)\) (case \( t=0 \)), \((x, y) \mapsto (x/2, 2y)\) (case \( t=1 \)), or \((x, y) \mapsto (2x, 2y)\) (case \( t=2 \)), then
\[
\chi(M) = \sum_{p \in \text{Fix}(f)} (-1)^t(p)
\]
Call a self map of this kind \textit{type R}. Is there a self map of \( P^2 \) with exactly one fixed point? If not, what is the minimum number of fixed points? Is there a type R self map of \( P^2 \) with exactly one fixed point? If not, what is the minimum number of fixed points? Is there a self map of \( T^\#T \) with exactly one fixed point? Is there one with exactly two fixed points? If not either of these, what is the minimum number of fixed points? The Euler characteristic shows that there cannot be a type R self map of \( T^\#T \) with exactly one fixed point. Is there a type R fixed point of \( T^\#T \) with exactly two fixed points? If not, what is the minimum number of fixed points?