Please let me know if any of the problems are unclear or have typos.

Exercise 9.1. "Let $p(z) = z^3$ and $q(z) = z^2$; these are polynomials defined on the complex plane. Let $f(z,t) = (1-t)p(z) + tq(z)$, for $t \in [0,1]$. Thus f is a homotopy from p to q. Let P, Q, and F be the extensions of p, q, and f to the one-point compactification $S^2 = \mathbb{C} \cup \{\infty\}$. Thus $\deg(P) = 3$ and $\deg(Q) = 2$. Also, F is a homotopy from P to Q. Deduce $\deg(P) = \deg(Q)$, and so $3 = 2$."

Verify the true statements and disprove the false ones.

Exercise 9.2. Fix $\{a_k\}_{k=0}^d \subset \mathbb{R}$ with $a_d \neq 0$. Define $p\colon \mathbb{R}^1 \to \mathbb{R}^1$ by $p(x) = \sum a_k x^k$. Let P be the extension of p to the one-point compactification $S^1 = \mathbb{R}^1 \cup \{\infty\}$. Check P is continuous. Compute the degree of P.

Exercise 9.3. Use local degrees to give another proof that the map $f\colon S^1 \to S^1$ defined by $f(z) = z^d$ has degree equal to d.

Exercise 9.4. Find CW–complex structures for the once-holed torus T_1 and the once-holed Klein bottle K_1. (These are the torus T and the Klein bottle K, minus a small open disk.) Compute the cellular homology groups of each. Show T_1 is not homeomorphic to K_1.

Exercise 9.5. [Hatcher page 156, problem 15.] Suppose X is a CW-complex. Prove $H_n^{\mathrm{CW}}(X^n)$ is a free Abelian group.