

1. Show that the fundamental group is a group. Write all appropriate homotopies explicitly.
2. Find the following homotopy groups
  - (a)  $\pi_1(T)$ ,
  - (b)  $\pi_1(S^1 \times \mathbb{R})$ ,
  - (c)  $\pi_1(\mathbb{R}P^2)$ ,
  - (d)  $\pi_n(S^k)$  for  $n, k = 1, 2, 3$ ,