## Homework number 9

Do both exercises.
Exercise 19. Compute $\pi_{1}\left(\mathbb{R}^{3}-S^{1}\right)$ using van Kampen's theorem.
Exercise 20. Consider the space $Y$ which consists of a torus with two discs stuck inside the tube of the torus. Compute $\pi_{1}(Y)$ using van Kampen's theorem.

