Topology 2
Mid Terminal Examination

February 26 2018

This exam is of **40 marks**. Please **read all the questions carefully** and **do not cheat**. Please feel free to use whatever theorems you have learned in class after stating them clearly. Please **hand in your phones** at the beginning of the class.

1a. Let $p : (E, e_0) \longrightarrow (X, x_0)$ be a covering map. Let α be a loop in X based at x_0 and $\tilde{\alpha}$ its lifting to a path in E based at e_0. When is $\tilde{\alpha}$ a loop? (5)

1b. Let G be a finite Abelian group. Show that there exists a covering $p : (E, e_0) \longrightarrow (X, x_0)$ with group of covering transformations isomorphic to G. (5)

2. Compute the fundamental group of the following space using whatever means necessary. If you use a theorem, please state it carefully. (10)

3. What is $\pi_3(S^1)$? Prove your result. (10)

4. Let X be a space and A a subspace. If $r : X \to A$ is a *retraction* show that

$$H_q(i) : H_q(A) \longrightarrow H_q(X)$$

is in an injection, where $i : A \to X$ is the inclusion map. (10)