

**Do not open this notebook until instructed.**

## MAT 1301 Algebraic Topology

# Term Test

University of Toronto, February 5, 2026

**Respond to all 3 tasks in this booklet.**

The tasks are of equal weight.

You have an hour and fifty minutes to write this test.

## Notes

- No outside material allowed other than stationery, minimal hydration and snacks, and stuffed animals.
- Write your response to each task on its designated pages and their backs. If you run out of space you may continue into the scratch pages, but you **must** indicate this on the task page or else the scratch pages will not be read.
- **Neatness counts! Language counts!** The *ideal* written responses to tasks looks like a page from a textbook – neat and clean and consisting of complete and grammatical sentences. Definitely phrases like “there exists” or “for every” cannot be skipped. Lectures are mostly made of spoken words, and so the blackboard part of proofs given during lectures often omits or shortens key phrases. The ideal written response to a task does not do that.
- Please return this booklet intact, without tearing out any pages. If you use some of the pages as scratch, mark them SCRATCH and return them too.

**Good Luck!**

**Task 1.** Write an essay on “Maps  $S^2 \rightarrow \mathbb{R}^2$ , antipodes, and cool applications”.

**Tip.** Don’t start working! Read the whole exam first. You may wish to start with the tasks that are easiest for you.

**Tip.** Neatness, cleanliness and organization count, here and everywhere else!

**Task 2.** Write an essay on “van Kampen’s Theorem”.

**Task 3.** If  $X$  is path-connected and  $x_0 \in X$ , prove that  $[S^1, X]$  is a singleton iff  $[(S^1, 1), (X, x_0)]$  is a singleton (in other words, show that all unbased loops in  $X$  are homotopic iff all based loops in  $X$  are homotopic via basepoint preserving homotopies).

**Tip.** “Iff” always means that there are two things to prove.

**Tip.** Once you have finished writing an exam, if you have time left, it is always a good idea to go back and re-read and improve everything you have written, and perhaps even completely rewrite any parts that came out messy.