

MAT 215A Fall 2025
Instructor: Melissa Zhang
Exam 2

By providing my signature below I acknowledge that I abide by the University's academic honesty policy. This is my work, and I did not get any help from anyone else:

Name (sign): _____ Name (print): _____

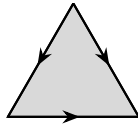
Question	Points	Score
Q1	30	
Q2	30	
Q3	40	
Total:	100	

- This is a **closed-book** exam. You may not use the textbook, cheat sheets, notes, or any other outside material. No calculators, computers, phones, or any other electronics are allowed.
- You have **50 minutes** to complete this exam. If you are done early, you may leave after handing in your exam materials.
- Everyone must work on their own exam. Any suspicions of collaboration, copying, or otherwise violating the Student Code of Conduct will be forwarded to the Student Judicial Board.

Instructions

1. Use the scratch paper provided to work out the problems. You may submit your scratch paper for recycling at the end of the exam.
2. Write down your solutions **in the exam packet**. Please write legibly and coherently; otherwise style points may be deducted.

1. Let X be the space obtained by identifying the three sides of an equilateral triangle as shown:



Compute $\pi_1(X)$.

Be careful. No points will be given for computing π_1 of the wrong space.

2. For a covering space $p : \tilde{X} \rightarrow X$ and a subspace $A \subset X$, let $\tilde{A} := p^{-1}(A)$. Show that the restriction $p|_{\tilde{A}} : \tilde{A} \rightarrow A$ is a covering space.

3. Find two non-homeomorphic 2-sheeted, path-connected covering spaces of $X = S^1 \vee \mathbb{R}P^2$. Prove that the covers are indeed not homeomorphic.

You do not need to explicitly prove your covers are 2-sheeted; just make sure to clearly indicate how your covering map sends pieces of $\tilde{X}$ to pieces of X , as we did in class when we studied covers of $S^1 \vee S^1$.

Here is a cartoon of X , to possibly help you depict $\mathbb{R}P^2$:

