

Mathematics Project Competition (2025/26) 數學專題習作比賽 (2025/26) Information Sheet資料頁				
Category 參賽組別	✓* A組: 初中習作 (Category A: Junior secondary project)			
Title of Project 專題習作題目	The Infinity Walls Inside a Finite City			
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A. Introduction

In this project, we designed a defensive city to protect against a giant who wants to **reach the center and occupy the city**. Our city uses a series of walls in two different shapes: **circles (annular)** and **triangles (trigonal)**.

The giant cannot walk through the walls because they are too strong. He can only pass through the **entrances**, which are also used by the **citizens to travel between the walls**. To make the giant's journey as long as possible, we do not put the entrances in a straight line. Instead, we place them at the **North and South poles** alternately. This forces the giant to walk a long, "zig-zag" path to get to the center.

Mathematical Assumptions

To calculate the total distance the giant must travel, we have made the following assumptions:

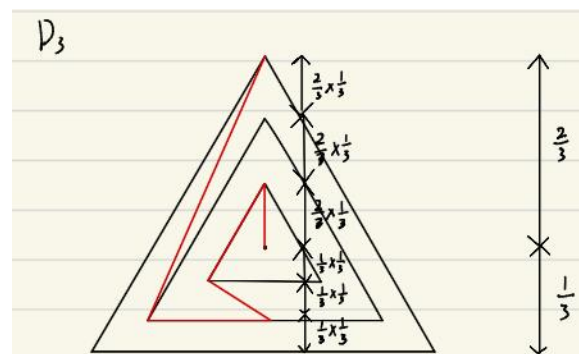
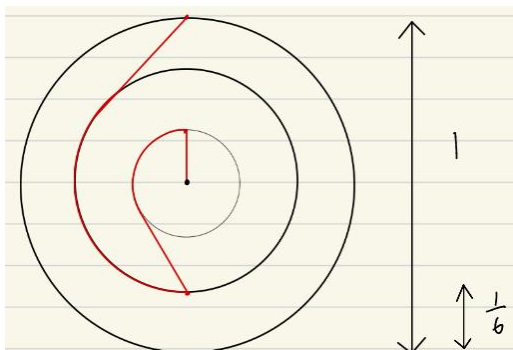
Number of Walls: There is a specific number of walls (**n**) inside the city.

Uniform Gaps: The distance (width) between every wall is exactly the same.

Total Size: The diameter of the outermost circle is fixed at **1 unit**.

The Giant's Path: The giant is smart and will always choose the mathematical shortest path available between two entrances to save time.

Entrance Positions: The first entrance is at the North Pole. Every following entrance is **180°** away from the previous one (alternating North and South).



F. Conclusion

To conclude, our group has learned a lot of advanced mathematics in this project.

We feel happy that we have found a way to determine the convergence of the sequences. It was such a satisfying feeling when we created the general formula.

The general formula of any wall widths with a_n could be used to determine the convergence of the distance of the giants' path. Therefore, we could study any sequence (with total sum =1) easily. The formula could simplify the process of calculating time by time.

G. Reference

Ratio Test

<https://web.ma.utexas.edu/users/m408s/CurrentWeb/LM11-6-2.php>

Sum of Geometric Sequence

<https://www.mathsisfun.com/algebra/sequences-sums-geometric.html>

Testing for Convergence or Divergence of a Series

<https://www.csusm.edu/mathlab/documents/seriesconvergediverge.pdf>
