

Mathematics Project Competition (2023/24) 數學專題習作比賽 (2023/24) Information Sheet 資料頁				
Category 參賽組別	<input checked="" type="checkbox"/> * A 組：初中習作 (Category A: Junior secondary project) <input type="checkbox"/> * B 組：中一小型習作 (Category B: S1 mini-project)			
Title of Project 專題習作題目	The Fragmented Stars			
Name of School	Yan Oi Tong Tin Ka Ping Secondary School			
學校名稱	仁愛堂田家炳中學			
Team members 隊員		Name in English	中文姓名	Class 班別
	1	Chan Chi Chun	陳致臻	3A
	2	Ho Man Kit	何文傑	3A
	3	Kei Hiu Nok	暨曉諾	3A
	4	Weng Tsz Ho	翁梓豪	3A
	5	Wong Constantine Tin Yan	黃天胤	3A
	6	Zhu Nanxi	朱南西	3A

Title: The Fragmented Stars**Table of Content**

A. Introduction	P. 3
B. Observation and Findings	P. 4 – P. 13
C. Explanation and Analysis	P. 14 – P. 21
D. Extension	P. 22 – P. 36
E. Conclusion	P. 37
F. Reference	P. 38

A. Introduction

One of our groupmates watched a video on YouTube called *‘你的智商到不到140？用三刀切甜甜圈試試看最多能得多少塊’ on YouTube which investigates the method to obtain the maximum number of pieces by cutting a pizza and a cake with three cuts. This video gave us the idea to find out the maximum pieces we can get by cutting different polygons.

We find such topic interesting as we encounter cutting problems like these in daily life scenarios like parties. The video has demonstrated that the maximum number obtained by cutting a pizza (a circle) three times is seven pieces, provoking our interest in cutting different shapes into pieces. So we pondered what would happen for various shapes and the strategy to obtain the maximum number of pieces.

As we were choosing which polygon to use for this project, someone came up with cutting a regular star polygon. A regular star polygon is a type of non-convex polygon. Unlike commonly used polygons like triangle, square and circle, with a single cut, a regular star polygon can be split into more than two pieces, sparking our interest in cutting a regular star polygon. Regular stars, with their unique symmetry and intricate patterns, have always captivated our attention. Finally, we have chosen the topic of cutting a regular star for seven times for our project because we are fascinated by geometric shapes and their transformations.

**YouTube Video: ‘你的智商到不到140？用三刀切甜甜圈試試看最多能得多少塊’*
<https://www.youtube.com/watch?v=kiezqwZm63Q>

E. Conclusion

To conclude, there are several things our group have learnt in this project.

Firstly, we feel delighted and satisfied to have found out the key point of this project: to obtain as many pieces of a polygon as possible is to attain the maximum number of interceptions when cutting lines. (*Details Discussed in part B*)

Secondly, we learnt a brand new idea called Polynomial Interpolation. After applying Lagrange Polynomial (拉格朗日插值法 a way to interpolate a set of data points using a polynomial function.) and proofing by contradiction (details in part C) we find that the equation of cutting a star shape will be $\frac{(x^2 + 3x + 2)}{2}$. For example, after cutting a regular five-pointed star 7 times, we can maximum obtain $\frac{(7^2 + 3(7) + 2)}{2} = \frac{72}{2} = 36$. Except having a better awareness about the concept of polynomial interpolation, we also gained a primary understanding of the utilisation of Lagrange Polynomial methods to construct a polynomial, which enriches our mathematical knowledge a lot.

Lastly, although we did face a lot of unexpected challenges and uncertainties during the exploration, we ultimately solved them one by one with full dedication and determination in this period of time. To ensure the precision of each result came out from the experiments, we also repeatedly verify the outcomes over 20 times patiently. The world of Mathematics is huge and broad. Curiosity and thirst for knowledge paved the way to the final result in this project. The sense of accomplishment is our best award.

Reference

Gordon, B., Jaglom, A. M., & Yaglom, I. M. (1967). *Challenging mathematical problems with Elementary Solutions*.

YouTube Video: ‘你的智商到不到 140 ? 用三刀切甜甜圈試試看最多能得多少塊’
<https://www.youtube.com/watch?v=kiezqwZm63Q>