**"TO VERIFY THAT AMONG ALL THE RECTANGLES OF THE SAME PERIMETER, THE SQUARE HAS THE MAXIMUM AREA"**

**A PROJECT WORK SUBMITTED FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE GRADE 11 SCIENCE IN MATHS**

**By**

**Name:**

**Grade:**

**Roll No:**



**National Academy of Science and Technology(NAST)**

**National Education Board(NEB)**

**Dhangadhi, Kailali, Nepal**

**Date:**

**CERTIFICATE OF APPROVAL**

The project work entitled "TO VERIFY THAT AMONG ALL THE RECTANGLES OF THE SAME PERIMETER, THE SQUARE HAS THE MAXIMUM AREA" by Mr. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ under the supervision of Mr. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Of\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, Nepal, is hereby submitted for the partial fulfillment of requirement of Maths in Grade 11. This project work has not been submitted in any other school or institution previously for the award of Grade 11.

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**DECLARATION**

I, ­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ hereby declare that the project work entitled, "TO VERIFY THAT AMONG ALL THE RECTANGLES OF THE SAME PERIMETER, THE SQUARE HAS THE MAXIMUM AREA" under the supervision of Mr. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Of\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ , Nepal, presented herein is genuine work done originally by me and has not been published or submitted elsewhere for the requirement of any degree program. Any literature, data or works done by others and cited in this project work has been given due acknowledgement and listed in the reference section.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. **Introduction:-**

Calculus, originally called infinitesimal calculus or "the calculus of [infinitesimals](https://en.wikipedia.org/wiki/Infinitesimal)", is the [mathematical](https://en.wikipedia.org/wiki/Mathematics) study of continuous change, in the same way that [geometry](https://en.wikipedia.org/wiki/Geometry) is the study of shape, and [algebra](https://en.wikipedia.org/wiki/Algebra) is the study of generalizations of [arithmetic operations](https://en.wikipedia.org/wiki/Arithmetic_operations).

It has two major branches, [differential calculus](https://en.wikipedia.org/wiki/Differential_calculus) and [integral calculus](https://en.wikipedia.org/wiki/Integral_calculus); the former concerns instantaneous [rates of change](https://en.wikipedia.org/wiki/Rate_of_change_(mathematics)), and the [slopes](https://en.wikipedia.org/wiki/Slope) of [curves](https://en.wikipedia.org/wiki/Curve), while the latter concerns accumulation of quantities, and [areas](https://en.wikipedia.org/wiki/Area) under or between curves. These two branches are related to each other by the [fundamental theorem of calculus](https://en.wikipedia.org/wiki/Fundamental_theorem_of_calculus), and they make use of the fundamental notions of [convergence](https://en.wikipedia.org/wiki/Convergence_(mathematics)) of [infinite sequences](https://en.wikipedia.org/wiki/Infinite_sequence) and [infinite series](https://en.wikipedia.org/wiki/Series_(mathematics)) to a well-defined [limit](https://en.wikipedia.org/wiki/Limit_(mathematics)).

Infinitesimal calculus was developed independently in the late 17th century by [Isaac Newton](https://en.wikipedia.org/wiki/Isaac_Newton) and [Gottfried Wilhelm Leibniz](https://en.wikipedia.org/wiki/Gottfried_Wilhelm_Leibniz). Later work, including [codifying the idea of limits](https://en.wikipedia.org/wiki/(%CE%B5,_%CE%B4)-definition_of_limit), put these developments on a more solid conceptual footing. Today, calculus has widespread uses in [science](https://en.wikipedia.org/wiki/Science), [engineering](https://en.wikipedia.org/wiki/Engineering), and [social science](https://en.wikipedia.org/wiki/Social_science).

Optimization, or finding the maximums or minimums of a function, is one of the first applications of the derivative you'll learn in college calculus.

1. **Motivation:-**

Modern calculus was developed in 17th-century Europe by [Isaac Newton](https://en.wikipedia.org/wiki/Isaac_Newton) and [Gottfried Wilhelm Leibniz](https://en.wikipedia.org/wiki/Gottfried_Wilhelm_Leibniz) (independently of each other, first publishing around the same time) but elements of it appeared in ancient Greece, then in China and the Middle East, and still later again in medieval Europe and in India.

Calculations of [volume](https://en.wikipedia.org/wiki/Volume) and [area](https://en.wikipedia.org/wiki/Area), one goal of integral calculus, can be found in the [Egyptian](https://en.wikipedia.org/wiki/Egyptian_mathematics) [Moscow papyrus](https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus) (c. 1820 BC), but the formulae are simple instructions, with no indication as to how they were obtained.

1. **Materials Required:-**

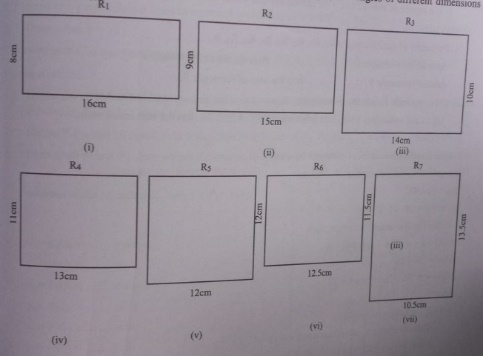
* Cardboard
* Chart Paper
* Scale
* Pencil and Eraser
* Paper Cutter
* Glue

1. **Objective:-**

This project is useful in explaining idea of maximum of a function by an experiment.

1. **Method of Construction:-**

* Take a cardboard of a convenient size and paste a white paper on it.
* Make rectangles each of perimeter 48 cm on a chart paper, Rectangles of different dimensions are as follows:



**Fig. Rectangles of Different Dimensions**

R1: 16cm\*8cm R2: 15cm\*9cm

R3: 14cm\*10cm R4: 13cm\*11cm

R5: 12cm\*12cm R6: 12.5cm\*11.5cm

R7: 10.5cm\*13.5cm

* Cut out these rectangles and paste them on the white paper on the cardboard.
* Repeat step 2 for more rectangles of different dimensions each having perimeter 48 cm.
* Paste these rectangles on cardboard.

1. **Demonstration:-**
2. Area of rectangle R1= 16cm \* 8cm= 128 cm2

Area of rectangle R2= 15cm \* 9cm= 135 cm2

Area of R3= 14cm \* 10cm= 140 cm2

Area of R4=13cm \* 11cm= 143 cm2

Area of R5=12cm \* 12cm= 144 cm2

Area of R6=12.5cm \* 11.5cm= 143.75 cm2

Area of R7=10.5cm \* 13.5cm= 141.75 cm2

1. Perimeter of each rectangle is same but their area is different. Area of rectangle R5 is the maximum. It is a square of side 12 cm. This can be verified using theoretical description given in the note.
2. **Observation:-**
3. Perimeter of each rectangle R1, R2, R3, R4, R5, R6, R7 is 48 cm.
4. Area of the rectangle R3 is 4 cm2 less than the area of rectangle R5.
5. Area of the rectangle R6 is 0.25 cm2 less than the area of rectangle R5.
6. The rectangle R5 has the dimensions 12cm \* 12cm and hence it is a square.
7. Of all the rectangles with same perimeter, rectangle R5 has the maximum area.
8. **Verification:-**

Let the length and breadth of the rectangle be x and y.

The perimeter of the rectangle P= 48cm

2(x + y) = 48

or, x + y = 24 or, y = 24 – x

Let A(x) be the area of the rectangle, then

A(x) = x\*y = x(24 - x) = 24x - 24x2

A'(x) = 24 - 2x

A'(x) =⇒ 24 - 2x = 0 ⇒ x = 12

A'(x) = -2

A'(12) = -2(a negative value)

Therefore, area is maximum when x = 12

Now, y = 24-12 = 12

∴ x = y = 12

1. **Literature Review:-**

Like trigonometry and geometry, calculus is an important branch of mathematics that plays a major role in many scientific careers, from engineering to design, and even in business-related fields such as business and finance.

Calculus can also be used to calculate the amount of pressure applied to an object and an object’s centre of mass. Integral calculus can be used to calculate an item’s volume, size, area and other useful information.

Calculus can be used to solve a huge number of mathematical problems, from the speed at which an object gradually accelerates (or decelerates) to the slope of an object or curve.

It provides a way to measure quantities that vary as the rate of change, such as [interest](https://curiousdesire.com/why-investment-is-important/) rates, [net](https://curiousdesire.com/why-networking-is-important/) worth, velocity, and acceleration.

1. **Conclusion:-**

The experiment shows that, amongst all rectangles of same perimeter the square has the maximum area.

From this experiment, we came to know about the history, purpose and importance of calculus. Calculus is a very useful medium to calculate the maximum area of any shape or object. This project also helped us in clearing our concepts regarding the uses of calculus which are important for our course as well.

1. **Acknowledgement:-**

I would like to express my special thanks of gratitude to my teacher Mr. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_ as well as our principal Mr. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ who gave us the golden opportunity to do this wonderful project on the topic “TO VERIFY THAT AMONG ALL THE RECTANGLES OF THE SAME PERIMETER, THE SQUARE HAS THE MAXIMUM AREA”, which also helped me in doing a lot of research and I came to know about so many new things I am really thankful to them.

Secondly, I would like to thank my parents and friends who helped me a lot in finalizing this project within the limited time frame.

1. **References:-**

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* [www.wikipedia.com](http://www.wikipedia.com)
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