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LAWS AND THEIR APPLICATION BASED ON SOME INTERESTING COMBINATORIAL PROBLEMS

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ABSTRACT

In this article, the origin, recent and distant history of the combinatorics department, the development of combinatorics and the scientists who contributed to its development, the laws that arise based on some issues related to combinatorics, the methods of determining continuous sequences using simple problems and their interpretation.

Key words *: algebra, finite and infinite set, non-repeating permutation, grouping, plane, straight line, point of intersection of straight lines, circle, point of intersection of circles, formula.*

АННОТАЦИЯ

В данной статье зарождение, недавняя и далекая история кафедры комбинаторики, развитие комбинаторики и ученые, внесшие свой вклад в ее развитие, закономерности, возникающие на основании некоторых вопросов, связанных с комбинаторикой, способы определения непрерывных последовательностей с помощью простых задач. и их интерпретация.

Ключевые слова: *алгебра, конечное и бесконечное множество, неповторяющаяся перестановка, группировка, плоскость, прямая, точка пересечения прямых, окружность, точка пересечения окружностей, формула.*

INTRODUCTION

Mathematics is a complex of sciences that encourages us to think and develops our interests from a young age. It is not for nothing that mathematics is taught as a science from elementary grades. Mathematics performs a foundation function in the creation of every science. In a word, mathematics is both the king and the queen of sciences. Tchaikovsky said: "If mathematics was not beautiful, perhaps mathematics itself would not exist. Otherwise, what force could attract the great geniuses of humanity to this difficult science?" .Mathematics is a very interesting subject, but there are not a few people who consider mathematics as a complex subject. As the

sages said: "There is nothing complicated in life. There is only difficult understanding and difficult explanation." In our daily life, we almost always use mathematics. Also, the word "algebra" is pronounced in the same voice in all languages of the world. It originated from the Arabs, it was created by Al Khorezmi,the great mathematician of Central Asia in the VII-XIX centuries.

Mathematics is divided into separate sections: algebra, linear algebra, geometry, analytic geometry, etc. One of the interesting and popular sections of mathematics is combinatorics. Combinatorics is such a section that everyone understands it according to their own thinking. Therefore, no matter how many new ideas are expressed about combinatorics problems, a new concept will emerge under it. Today, combinatorics is almost a part of our life also in chemistry, physics, biology, information technology and other areas business professionals face problems related to combinatorics. Basically, the initial development of combinatorics is related to the analysis of gambling games . Some famous mathematicians Eyler, B.Pascal, Jacob Bernoulli used combinatorics to make the necessary decisions for gambling games. As you might expect combinatorics is a very interesting branch of mathematics.

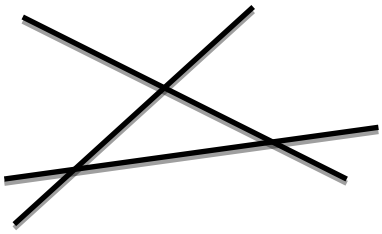
DISCUSSION AND RESULTS

Problems related to various combinations of elements and finding their number are called "problems of combinatorics". Scientists such as Bernoulli and I. Euler have contributed to it. The German mathematician Leibniz considered combinatorics as a branch of mathematics in his creative work "The Art of Combinatorics" in 1666, and he was the first to use the term combinatorics. Combinatorics problems are solved using concepts such as substitution, non-repeating placements and groupings.

In the process of solving problems related to combinatorics, we encounter problems of the following from :

"In how many points can 3 straight lines intersect in a plane?"

Δ In the process of solving this problem, we imagine a drawing for problem:



Answer: In 3 points

That is, by drawing a diagram, we can find out that straight lines intersect at most 3 points. But as the number of straight lines in the problem condition increases,

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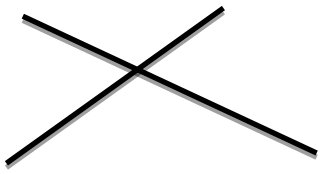
drawing a diagram becomes more complicated and may cause some confusion. Therefore, by identifying the law hidden in the problem we have to get know.

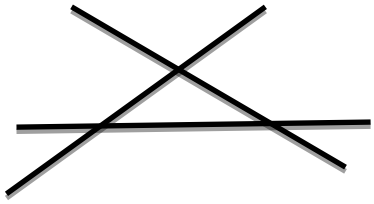
Axiom:

Any two straight lines taken in a plane intersect in only one point.



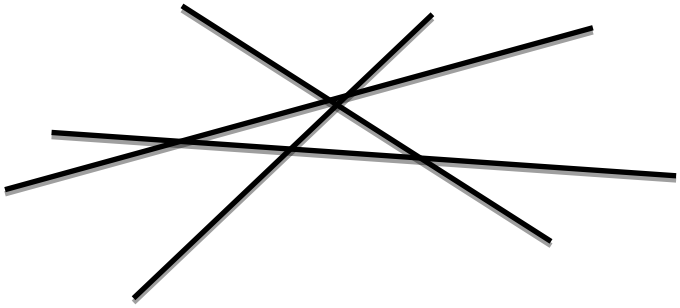
Two straight lines – at 1 point

As we saw above, 3 straight lines intersect in at most 3 points:



Three straight lines - at 3 points

4 straight lines intersect in at most 6 points:



Four straight lines – at 6 points

That is, the fourth straight line intersects with each of the remaining 3 straight lines. From this we can understand that the straight lines intersect as follows:

2 straight lines ➡ at 1 point
3 straight lines ➡ 1+2 i.e. 3 points
4 straight lines ➡ 1+2+3 i.e. 6 points
5 straight lines ➡ 1+2+3+4 i.e. 10 points
6 straight lines ➡ 1+2+3+4+5 i.e. 15 points
7 straight lines ➡ 1+2+…+6 points
n straight lines ➡ 1+2+3+…+ (n-1) points ▲

If we find the sum of the arithmetic progression based on this law, the following formula is derived:

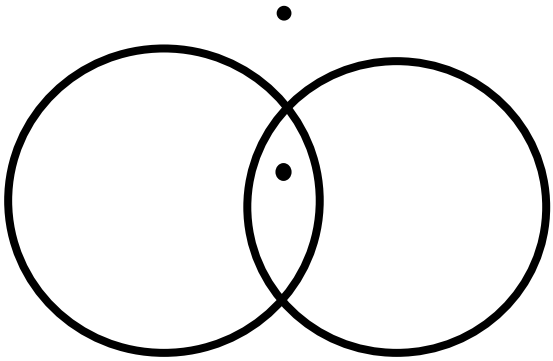
$$S_{n-1}=\frac{1+n-1}{2}\cdot(n-1)=\frac{n(n-1)}{2}$$

So, these types of questions are based on the above law $\frac{n(n-1)}{2}$ we can easily solve it using the formula.

Now let's consider the implementation of this type of problems in circles, not limited to straight lines only:

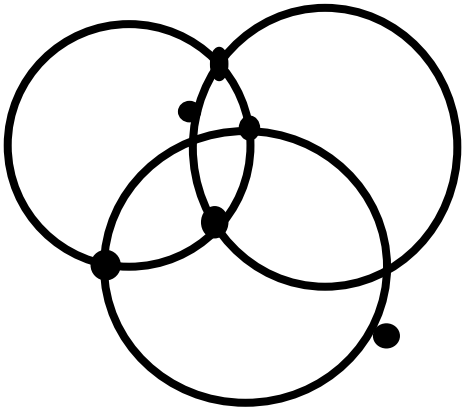
Δ " In what maximum number of points can two non-centered circles intersect in a plane?"

First of all, to solve this problem, we have the opportunity to draw a diagram.



Answer: two circles intersect at 2 points.

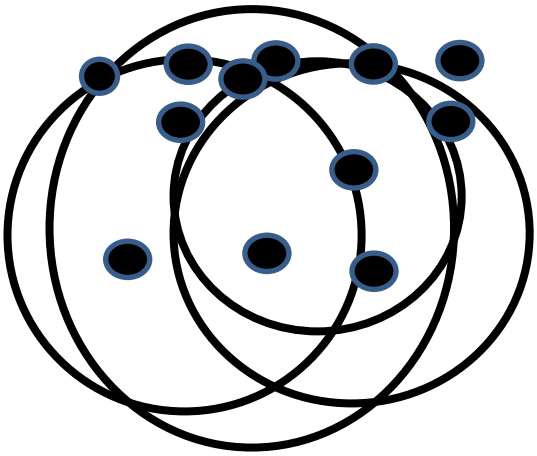
As the number of circles in the problem increases, the number of points of intersection also increases, and thus a law emerges. So, if 2 circles intersect at most 2 points, 3 circles intersect at most 6 points:



Three circles intersect in 6 points.

That is, the third circle intersects each of the remaining 2 circles at 2 points.

4 circles intersect at most 12 points:



That is, the fourth circle also intersects with each of the remaining 3 circles at 2 points. As the number of circles increases, the intersection points increase in the following order:

2 circles ➡ 2 points
3 circles ➡ 2+4 i.e 6 points
4 circles ➡ 2+4+6 i.e 12 points
5 circles ➡ 2+4+6+8 i.e 20 points
6 circles ➡ 2+4…+10 points
n circles ➡ 2+4…+2(n-1) points

As an arithmetic progression:

2 circles ➡ 2
3 circles ➡ 2(1+2)
4 circles ➡ 2(1+2+3)
……
n circles intersect at 2(1+2+3+...+ (n-1) points. ▲

Finding the sum of this arithmetic progression yields the following formula:

$$S_{n-1} = 2 \cdot \frac{1+n-1}{2} \cdot (n-1) = n(n-1)$$

can quickly and easily solve these types of problems related to circles using the formula $n(n-1)$

There are not only one type of people living in the world, each person has his own way of thinking, his own world-view. Therefore, every science develops by summarizing the thoughts of mankind. That is, no science is limited to a certain area.

In the problems discussed above, we focused our attention on the intersection points of straight lines and circles and determined the law in them.

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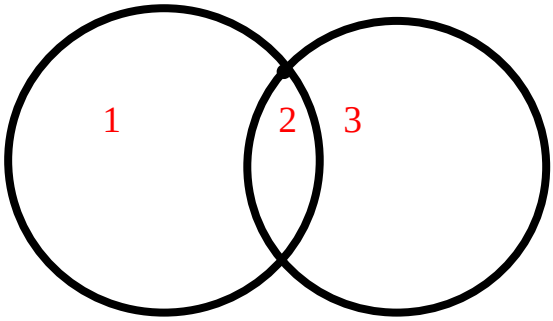
Δ "In how many parts does each of 2 non-centered circles taken in a plane intersect with each of the other circles (not including the outer area)?"

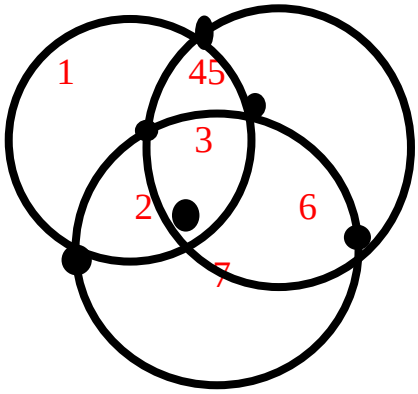


Answer: divides into 3 parts.

So, we can see from the drawing that 2 circles intersect and divide the plane into 3 parts.

Let's look at the increasing number of circles to determine the general pattern in the problem:

3 circles intersect the plane:



Divides into 7 parts.

4 circles intersect the plane:

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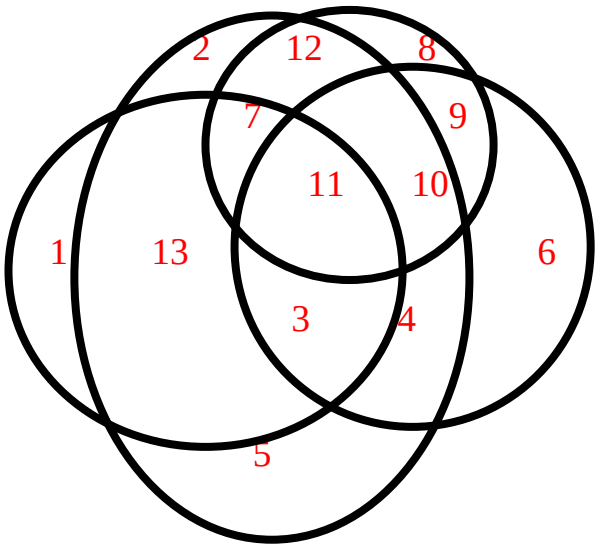

Divides into 13 parts.

As the circles increase, the parts they separate in the plane increase in the following order:

2 circles ➡ 1+2 i.e 3 parts

3 circles ➡ 1+2+4 i.e. 7 parts

4 circles ➡ 1+2+4+6 i.e. 13 parts

5 circles ➡ 1+2+4+6+8 i.e. 21 parts

6 circles ➡ 1+2+…+ 10 parts

n circles ➡ 1+2+…+ 2(n-1) parts

The sequence - if we put the sequence in the form of an arithmetic progression:

2 circles ➡ 1+2

3 circles ➡ 1+2(1+2).

4 circles ➡ 1+2(1+2+3).

……

n circles ➡ 1+2(1+2+…+(n-1)) ▲

The sum of the arithmetic progression produces the following formula:

$$S_{n-1} = 1 + 2 \cdot \left(\frac{1+n-1}{2} \cdot (n-1)\right) = 1 + n(n-1)$$

So, this is our law $1 + n(n-1)$ increases based on the formula.

So, mathematics is also a small world that includes the laws that the human mind has reached and not reached.

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