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THE DEGREE OF COMPLEXITY OF COMBINATORIAL PROBLEMS IN PRIMARY AND HIGH SCHOOL AND WAYS TO SOLVE THEM

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Abstract: This article discusses the measures taken to develop mathematics in Uzbekistan, the role of combinatorics in the development of students' intellectual abilities from primary school age, methods of combinatorial problems in primary school textbooks, and the distribution of some problems according to combinatorial laws and the level of difficulty in class textbooks, provided with their solutions.

Keywords: finite set elements, the combination of elements, tuples, configuration, repetitive placement, non-repetitive placement, and grouping.

The Uzbek people do not say in vain that "Mathematics is the king of subjects". Mathematics is also the main field that encourages people to think and develop their worldview. At a meeting with scientists, research institutions, and representatives of the manufacturing sector, President Shavkat Mirziyoyev said: "Mathematics is the basis of all sciences. A child who knows this science well will grow up to be intelligent, broad-minded, and successful in any field." In particular, the visit of President Shavkat Mirziyoyev to the Institute of Mathematics of the Academy of Sciences of Uzbekistan is a clear example of the attention and demand for mathematics. “The cornerstone of mathematics was laid by our great ancestors such as Al-Khorazmiy, Ahmad-Farghaniy, and Abu Rayhan Beruniy. Mathematics is in our blood. But in the last twenty years, the level of knowledge in mathematics has decreased. Because we did not pay enough attention to teachers, we did not give them a decent salary, we did not set a final goal. The consequences are now felt in many areas.

Today, our goal is to create a competitive environment in mathematics, to train advanced personnel in the industry and engineering, “said President Shavkat Miromonovich Mirziyoyev. Various practical works are being carried out to popularize mathematics among the youth. A regular general meeting of the Mathematical Society of Uzbekistan was held on March 14, 2020, to celebrate the International Day of Mathematics in Uzbekistan. A variety of topics have been explored to engage children in mathematics from an early age. On this issue, the President said: “Mathematics cannot be developed rapidly with the old method of teaching. Therefore, it is necessary to retrain teachers by first creating educational programs based on foreign methods that have yielded good results in practice. The methodology should be such that it instills in children a love for mathematics. For this, students need to understand that this subject is necessary for life, in every field. Young people should study to become educated professionals, not to pass exams," he said. Combinatorics is also used in textbooks to develop students' thinking skills. Although combinatorics was originally included in high school textbooks, it is now used in elementary math textbooks to cover simple combinatorics. This is encouraging students to develop their thinking skills from primary school onwards.

Problems related to finding different combinations of elements and their number are called "combinatorial problems". Combinatorics emerged mainly in the XVII-XIX centuries as an independent science, and its development was contributed by such scientists as B. Pascal, P. Fermi, G. Leibniz, Y. Bernulli, and I. Euler. it can be regarded as part of the theory of sets because of the study of a finite set, their part sets, tuples composed of elements of a finite set, and the problem of finding their number.

Currently, the data of combinatorics are used in various fields of human activity. In terms of set theory, checking whether the tuple elements have a configuration with a given property, studying the methods of constructing and finding their number if any, and improving these methods on any parameter are the main problems of combinatorics.

In 1666, the German mathematician Leibniz considered combinatorics as a branch of mathematics in his work The Art of Combinatorics, and he was the first to use the term combinatorics. Combinatorial problems are solved using concepts such as substitution, non-repeating placements, and groupings.

In Grade 3, the following example is given: "How many times do you press the 7-digit key when typing numbers from 1 to 100 on a computer?"

This problem belongs to the combinatorics section and is solved according to the rules of this section. However, for 3rd-grade students this method is complicated. They solve this problem using the "count" method, i.e., writing the numbers in which the number 7 participates from 1 to 100:

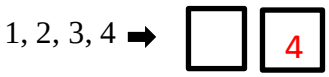
△ $\underbrace{\{7, 17, 27, 37, 47, 57, 67, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 87, 97\}}$

Total 20 ▲

Answer: 20

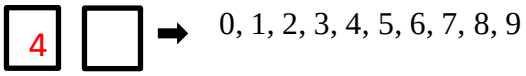
△ In the 6th grade textbook, this question is given as follows: "The houses on the street are numbered from 1 to 50. How many times did the number 4 appear in the numbers of these houses?" In this case, students do not use the method used in elementary school, because they have at least some understandings of combinatorics.

1. The number 4 in one-digit numbers is used only 1 time, i.e., only in 1 number;
2. When finding how many times the number 4 is used in a 2-digit number up to 50, if the number 4 is only in a single-digit room:



we can put the numbers 1, 2, 3, and 4 in the room of tens (because the houses are numbered from 1 to 50), i.e., the number of possibilities is only 4;

3. Number 4 only comes in the tens room:



we can put the numbers 0,1, 2, 3, 4, 5, 6, 7, 8, 9 in the single-digit room, that is, the number of possibilities is 10;

4. When we add up all the methods found, we get how many times the number 4 is used in numbers from 1 to 50.

1 + 4 + 10 = 15 Answer: 15

Check: $\underbrace{4, 14, 24, 34, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49}_{15}$ ▲

In the 7th grade textbook, examples of this type are given in a more general way:

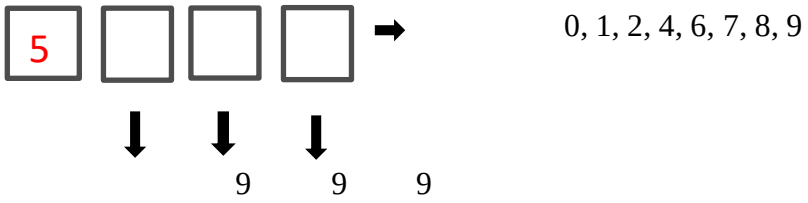
"How many 4-digit numbers have only one digit 5? "

We solve this in the following way:

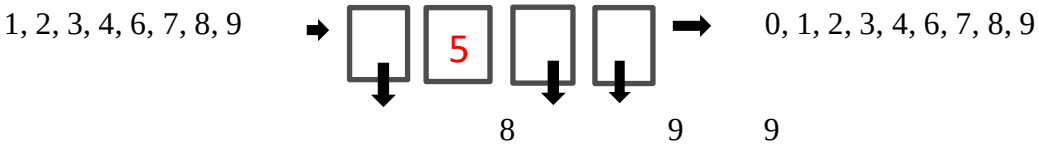
1. In 4-digit numbers, the number 5 can appear in 1st, 2nd, 3rd, and 4th place. If the number 5 is in the 1st place, the 2nd, 3rd, and 4th places are fill in:

according to the instructions of the problem, in order to have only one digit 5, for the 2nd, 3rd, and 4th places we can put the numbers 0, 1, 2, 3, 4, 6, 7, 8, 9 i.e., other than five, that is:

Number of possibilities $9 \times 9 \times 9 = 729$

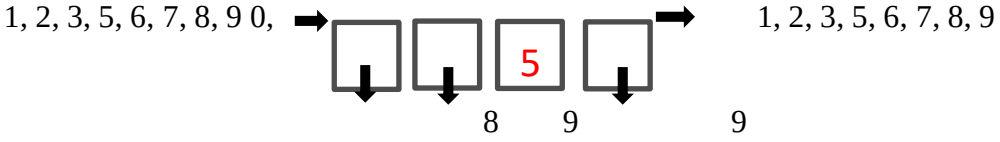


2. If the number 5 is in the 2nd place, then the 1st place can be an arbitrary number other than 0 and 5. We can put numbers other than 5 in the 3rd and 4th places.



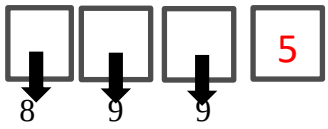
Number of possibilities $8 \times 9 \times 9 = 648$

3. If the number 5 is in the 3rd place, we can put 8 numbers in the 1st place, and 9 numbers in the 2nd and 4th places:



Number of possibilities $8 \times 9 \times 9 = 648$

4. If the number 5 is in the 4th place:



Number of possibilities $8 \times 9 \times 9 = 648$

5. If we add up all the possibilities that we have, we get the number of 4-digit numbers that the digit 5 participated once.

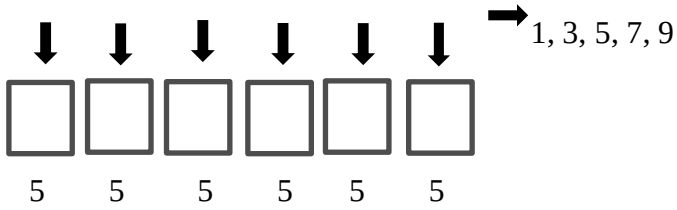
729 + 648 + 648 + 648 = 2673 Answer: 2673.

When students move to 8th grade, the problem becomes a bit more complicated. In the 8th grade textbook, we can see the following example:

"How many 6-digit numbers have at least one even number in them?"

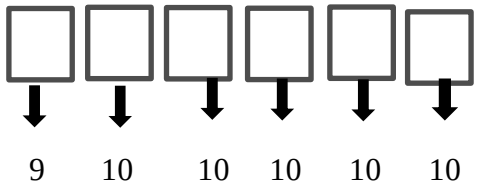
Now the problem is not about only 1 number, but 5 numbers, that is, 0, 2, 4, 6, 8.

▲ **1.** We find the number of 6-digit numbers with only odd numbers in the record.



The number of possibilities: $5 \times 5 \times 5 \times 5 \times 5 \times 5 = 15625$

2. We find the total number of 6-digit numbers:



Total: $9 \times 10 \times 10 \times 10 \times 10 = 900\,000$

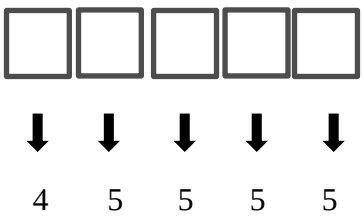
3. If we subtract from the total six-digit numbers all numbers consisting of only odd numbers, then by itself there are six-digit numbers with at least one even number left.

900 000 - 15625 = 884 375

Answer: 884 375 pcs. ▲

In the 11th grade textbook, we also encounter the following question: “How many 5-digit numbers that all of their digits even are there? “.

▲



Even numbers: 0, 2, 4, 6, 8

4 numbers can be put in the 1st place, namely: 2, 4, 6, 8;

5 numbers can be put in the 2nd place, that is: 0, 2, 4, 6, 8;

It is also possible to put 5 numbers in the 3rd, 4th, 5th places, i.e.: 0, 2, 4, 6, 8;

So, to fill the digit places:$4 \times 5 \times 5 \times 5 \times 5 = 2500$

Answer: 2,500. ▲

In conclusion, it should be noted that in solving each combinatorial problem, the student always uses convenient and simple methods to explain the problem to students, which will increase their interest in mathematics and make them more active in the classroom. and provides.

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