$$\frac{g+a\dot{x}^2}{g+a\upsilon_0^2}=\frac{e^{-2f\,\mathrm{arctg}\,ax}}{1+a^2x^2}.$$

Пусть в момент времени τ колечко достигло высоты h, тогда $y(\tau)=h$ и $(\dot{x}(\tau))^2\geq 0$. Следовательно, выполняется неравенство

$$\frac{g}{g+a\upsilon_0^2}\leq\frac{e^{-2f\,\mathrm{arctg}\sqrt{2ah}}}{1+2ah}\quad\Leftrightarrow\quad\upsilon_0\geq\left(g\left((1+2ah)e^{2f\,\mathrm{arctg}\sqrt{2ah}}-1\right)/a\right)^{\frac{1}{2}}.$$

Ответ: $\upsilon_0\geq\left(g\left((1+2ah)e^{2f\,\mathrm{arctg}\sqrt{2ah}}-1\right)/a\right)^{\frac{1}{2}}$. ►

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I. V. CHERNOOKIY
Brest, BrSTU

MAJOR BRANCHES OF COMBINATORICS

How many passwords can be formed using five letters and two special characters? How long would it take a computer to generate all such passwords as a way of compromising computer security? How many lottery tickets are needed to cover all possibilities? Counting techniques provide tools for answering questions like these.

Combinatorics is a branch of mathematics concerning the study of finite or countable discrete structures. Combinatorics is very concrete and has a wide range of applications. The main fields of application of combinatorics are: enumeration, graph theory, Ramsey Theory, design theory, coding theory and etc. Let us consider some of them.

Enumeration is a big fancy word for counting. When a mathematician is calculating the "probability" of a particular outcome in circumstances where all outcomes are equally likely, what they usually do is enumerate all possible outcomes, and then figure out how many of these include the outcome they are looking for. The object of enumeration is to enable us to count outcomes in much more complicated situations. This sometimes has natural applications to questions of probability, combinatorics are focused on the counting, not on the probability. The technique of enumeration is based on the following notations: the product and the sum rule, combination of the product rule and the sum rule, which can explore more challenging questions.

When more than one item from a finite population is selected in which every item is uniquely identified – for example, choosing people from a family, or cards from a deck dependently of the conditions of selection we can use permutations or combinations. So a permutation involves choosing items from a finite population in which every item is uniquely identified, and keeping track of the order in which the items were chosen. And a combination involves choosing items from a finite population in which every item is uniquely identified, but the order in which the choices are made is unimportant.

For many practical purposes, even if the number of indistinguishable elements in each class is not actually infinite, we will be drawing a small enough number that we will not run out. Suppose that there are n different "types" of item, and there are enough items of each type that we won't run out. Then we'll choose items, allowing ourselves to repeatedly choose items of the same type as many times as we wish, until the total number of items we've chosen is r. Notice that, in this scenario r may exceed n. There are two scenarios: the order in which we make the choice matters, or the order in which we make the choice doesn't matter.

The following statement can be used to give us a general formula for counting the number of ways of choosing r objects from n types of objects, where we are allowed to repeatedly choose objects of the same type.

THEOREM The number of ways of choosing r objects from n types of objects (with re placement or repetition allowed) is C^r_{n+r-1}.

The next field of application of a combinatorics is a generating function. A generating function is a formal structure that is closely related to a numerical sequence, but allows us to manipulate the sequence as a single entity. Some technique for finding generation function is based on combinatorics and generating functions is very helpful to count things.

The Pigeonhole Principle is a technique that you can apply when you are faced with items chosen from a number of different categories of items, and you want to know whether or not some of them must come from the same category, without looking at all of the items. This principle is also based on the elements of the combinatorics.

There is a general formula calculates the cardinality of the union of any number of sets, by adding or subtracting the cardinality of every possible intersection of the sets. It is called the Inclusion-Exclusion formula, because it works by adding (or "including") the cardinalities of certain sets, and subtracting (or "excluding") the cardinalities of certain other sets.

Combinatorics is widely used in graph theory for finding for example the number of edges of complete graph with n vertices or to determining is a graph planar or not.

Combinatorics is also widely used in the creating nice structures in which different combinations of elements occur equally often. This is the general structure of all of the design theory, orthogonal Latin squares are the natural thing to learn about. Combinatorics is a tool for solving a Steiner triple system or for determining the number of points of a finite affine plane of order, what is also necessary when solving problems of design theory.