MATHEMATICAL MODELLING IN SOLVING TEXT PROBLEMS IN MATHEMATICS

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Abstract: This article describes the essence of the method of mathematical modelling. The article gives the concept of mathematical model, practical problem, the stages of solving practical problems are considered, examples of solving problems with the help of making mathematical models are given.

Keywords: mathematical model, practical problem.

The role of mathematics in different areas of natural science has varied at different times. Mathematical methods of research, which were previously used only in astronomy, physics and some areas of engineering, are now widely used in many areas of knowledge and practice. Mathematics makes it possible to describe the basic properties of an object in the language of mathematical concepts and relations, and thus to build a mathematical model of the object under study. Mathematical models are used in the study of biological phenomena, including medicine and agriculture.

A mathematical model is a problem condition written in mathematical language (in the form of equations, inequalities and their systems).

Here is a simple example of a mathematical model. Let us imagine that we need to determine the floor area of a room. To perform this task, we measure the length andwidth of the room and then multiply the obtained numbers. This elementary procedure actually means the following. The real object

- Floor of the room - is replaced by an abstract mathematical model - a rectangle. The rectangle is assigned the dimensions obtained as a result of measurement, and the area of such rectangle is approximated as the desired area.

The use of tasks with practical content in the teaching of mathematics is useful inpreparing students to solve problems directly posed by practice.

Strengthening the applied and practical orientation of mathematics teaching is directly related to the formation of students' understanding of the mathematisation of science and production, the specifics of applying mathematics to the solution of practical problems.

A practical task is a task arising in production activities, in different fields of knowledge, in the surrounding reality. These tasks are not mathematical, but many of them can be solved by means of mathematics. To do this, students must translate the problem into mathematical language and apply mathematical methods to solve it. Solving practical problems by means of mathematics consists of three stages.

At the **first stage** - ***the*** formalisation stage - the transition is made from the practicalproblem to be solved to the construction of its mathematical model; at the ***second stage, the*** mathematical problem formulated at the first stage is solved; at the ***third stage, the*** interpretation stage, the solution to the mathematical problem istranslated into the language of the original practical problem. Mathematical modelling is so widely used to study the real world that creating students' understanding of its essence, leading them to mastery of each of the stages should be the subject of constant concern of a mathematics teacher.

Mathematical modelling is carried out according to the given three-stage scheme.

The most responsible and complex is the first stage - the construction of the mathematical model itself. It is carried out logically on the basis of a deep analysis of the phenomenon (process) under study and requires the ability to describe the phenomenon (process) in the language of mathematics. Realisation of the first stage requires many skills, including the ability to identify the essential factors determining the phenomenon (process) under study, the ability to choose a mathematical apparatus for compiling the model.

Essential at the second stage is the skilful planning of the process of solving the formulated mathematical problem, the allocation of the components of the problem, the ability to analyse and refine the compiled model, At the third stage, the main thing is the ability to competently translate the result of solving a mathematical problem into the language of the original problem.

Of great importance at this stage is the mastery of methods of verifying the solution of a practical problem, the ability to extend the solution found to other practical problems.

Consider the application of mathematical modelling of practical problems in the study of progressions and in solving text problems to make equations.

Task1.

For the manufacture and installation of the lowest reinforced concrete ring of the well they paid 26 sum, and for each subsequent ring 2 sum less,

than for the previous one. In addition, another 40 sum were paid upon completion of the work. The average cost of manufacturing and installing one ring was $22\frac{4}{9}$ sum.how many rings were installed?

Decision

Stage I. *Compilation of the mathematical model.*

Let us denote the number of installed rings by the letter *n*, *a* and let us take the cost of manufacturing and installation of the bottom ring as $a_1 = 26$. Since for each the next ring was paid 2 sum less, then the cost of all rings is an arithmetic progression and $d = -2$. Then the final cost of the whole work on manufacturing and installation of all rings is equal to

$$S + 40 = \frac{2a_1 + d(n-1)}{2} * n + 40 = \frac{2 * 26 - 2(n-1)}{2} * n + 40 = 27n - n^2 + 40.$$

Since the average cost of manufacturing and installation of one ring is $22\frac{4}{9}$ sum,let's make an equation

$$\frac{27n - n^2 + 40}{n} = 22\frac{4}{9}$$

Stage II. *Work with the compiled model.*

Let's solve the equation:

$$\frac{27n - n^2 + 40}{n} = 22\frac{4}{9}$$

$$9n^2 - 41n - 360 = 0, n_1 = 9, n_2 = -\frac{40}{9}.$$

Stage III. Answering the question of the task

Since the problem requires finding the number of rings, negative and fractional values do not satisfy the problem condition, so n= 9.

answer: 9 rings.

Task2.

Two groups of tourists have to walk towards each other from camping sites A and B,the distance between which is 30 km. If the first group leaves 2 hours earlier than thesecond group, they will meet 2.5 hours after the second group leaves. If the second group leaves 2 hours earlier than the first group, they will meet 3 hours after the firstgroup leaves. At what average speed is each group travelling?

Decision

Stage I. *Compilation of the mathematical model.*

Let *x* km/h be the speed of the first group of tourists and *y* km/h be the speed of thesecond group of tourists.

If the first group leaves 2 h earlier than the second group, then $t_1 = 4.5\ h, and\ t_2 = 2.5\ h$. According to the problem condition, the groups of tourists will meet in 2.5 h after thesecond group leaves, i.e. $4.5x + 2.5y = 30$.

If the second group leaves 2 hours earlier, then $t_1 = 3\ h, and\ t_2 = 5\ h$. hours. According to the problem condition, the groups of tourists will meet in 3 h after the first group leaves, i.e. $3x + 5y = 30$.

We end up with a system of two equations:

$$\begin{cases} 4.5x + 2.5y = 30 \\ 3x + 5y = 30 \end{cases}$$

Stage II. *Work with the composed model.*

Let's solve the system of equations by algebraic addition, having simplified the first equation beforehand:

$$\begin{cases} 9x + 5y = 60 \\ 3x + 5y = 30 \end{cases}$$

$$6x = 30, x = 5, y = 3.$$

Stage III. *Answering the question of the task.*

Since the found values of *x* and *y are* positive, the speed of the tourists of the firstgroup is 5 km/h, the speed of the tourists of the second group is 3 km/h.

answer: 5 km/h and 3 km/h.

Task3.

The first pipe takes 3 hours longer to fill the pool than the second pipe. If two thirds of the pool is filled with one first pipe and the rest with one second pipe, it will take 8h 45 min to fill the pool. How many hours can one second pipe take to fill the pool?

Decision

Stage I. *Compilation of the mathematical model.*

We will consider the volume of the pool to be equal to 1. Let *x* (h) be the time taken by the first pipe to fill the pool;

y (h) is the time required for the second pipe to fill the pool. Then accordingto the problem *x - y = 3.*

$\frac{1}{x}$ -performance of the first pipe;

$\frac{1}{y}$ -the performance of the second pipe.

The first pipe will fill two-thirds of the pool in

$$\frac{2}{3}:\frac{1}{x}=\frac{2}{3}x(h);$$

the second pipe will fill one-third of the pool in

$$\frac{1}{3}:\frac{1}{y}=\frac{1}{3}y(h);$$

According to the problem condition the first pipe fills two thirds of the basin and thesecond one pipe one third of the pool in 8 h 45 min Let's make a second equation:

$$\frac{2}{3}x+\frac{1}{3}y=\frac{35}{4};$$

We obtain a system of two equations:

$$\begin{cases} x-y=3 \\ \frac{2}{3}x+\frac{1}{3}y=\frac{35}{4} \end{cases}$$

Stage II. *Work with the compiled model.*

Let's solve the system of equations by substitution:

$$\begin{cases} x-y=3 \\ \frac{2}{3}(y+3)+\frac{1}{3}y=\frac{35}{4} \end{cases}$$

$$\frac{2}{3}y+2+\frac{1}{3}y=\frac{35}{4};\ y=\frac{27}{4}=6\frac{3}{4}$$

Stage III. *Answering the task question*

Since the found value of *y is* positive, it fits the meaning of the problem. So, thesecond pipe will fill the pool in $6\frac{3}{4}\ h=6\ h\ 45min.$

answer: 6 h 45 min.

The creation of mathematical models facilitates the most fruitful thinking of students, as their attention is easily and timely switched from the model to theinformation about the object obtained with its help and vice versa.

When teaching students mathematics, the goal should not be to develop the many skills that are important in mathematical modelling. The main thing is to lay the foundation for such skills and to make students understand that in order to solve a practical problem, a mathematical model is created, which can be represented in theform of an equation, inequalities or their systems, or a function to be investigated.

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