ROLE OF PROBLEM SOLVING IN PHYSICS EDUCATION

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"Man knows physics, if he is able to solve problems"
Enrico Fermi

When we try to determine the basic tendencies of educational development both in Russia and in other countries of the world we find that the main role is played by such factors, as increase of intellectual activity in all areas of human life, increase of person creative potential. That is why the tasks of development become more important in education of generation next, in turn it promotes the growth of intellectual pupil's level. It is well known "that education is what remains, when all learnt is forgotten".

According to the modern concepts of school education development, the schoolboy from passive object of training should turn to the active and purposeful subject. Cognitive activity becomes the main in the educational process. It promotes the development of cognitive thinking, transformation of educational process to the process of searching new knowledge instead of learning by heart the basic formulations and formulas. For awakening and development of cognitive interest it is important for schoolboys to realized the necessity, practical and scientific importance of the knowledge, they should learn. This fact is already realized by the teachers of physics both in Russia and all over the world. In overwhelming majority of the reports on the international teaching conferences from year to year professors repeat one and the same idea — physics is a science about the world around us, we collide with the physical laws daily, hourly, every minute. Physics is delightful, it is necessary to enjoy physical explanation of the environmental phenomena. It is necessary to teach children to enjoy physics! On examples from everyday life, also it is necessary to explain physical laws, instead of thinking out abstract dull experiments.

In Russian school the problem solving is one of the necessary forms of studding physics. It is also the main part of the entrance exams in all the technique universities and institutes. It is easy to explain physical laws in the process of problem solving and at the same time it is the best way to make the knowledge control. The authors of the given work develop an educational material containing tasks offered on the entrance examinations in the main universities of Moscow with the

recommendations, prompts and answers. Soon we plan to make the databank of modern level tasks, which can be used for repeating school course of physics and preparation for examinations or for former studding in the universities. The works of the authors on methods of problem solving, recommendation how to use different types of problems on the lessons are published. This section will be a component already a well known site of Federation f Internet Education (www.center.fio.ru/som).

The tasks offered on the entrance examinations on physical department of Moscow state university during last 20 years, basic methods of their decision, leading questions and helps to the decision are submitted as section of site (www.astronet.ru).

1. Physical problems and their role in teaching physics at school.

The decision of physical problems plays the basic role in development of thinking and formation of skills of independent work. Skills of problems solving most completely characterizes a level of knowledge mastering, shows, how the schoolboys can practically apply available knowledge. The questions of problems solving technique is studied by special science – "raciology", borne in the beginning of the 70-s' years of the 20-th century.

However the tendency to use in physics training the simple qualitative tasks is observed in many countries of the world recently. Thus the complex physical problems with long numerical calculations and analysis of the received results are used not often. In comparison with foreign schools at modern Russian school the physical problems are considered as the powerful instrument of subject study, and it is rue not only for physics. Now many specialists write about necessity of joint or coordinated teaching of physics and mathematics.

There are many definitions of a physical problem. We offer the following.

Physical problem — is a real situation, which we meet in educational, scientific or daily activity, when it is necessary to determine unknown sizes on the basis of their relations to the known parameters (physical or logic laws). It looks like mental experiment.

The basic purpose of physical tasks use is to learn the schoolboys to apply available knowledge to the analysis of processes and phenomena, decision of concrete practical tasks. It promotes deeper understanding of physical laws.

The analysis of tasks use during training physics allowed to allocate their functions.

Knowledge function: by carrying out the appropriate selection of physical tasks, it is possible to acquaint pupils with a new data, expanding the area of their knowledge.

The union of theory and practice at the decision of physical tasks show how to apply the physical laws to an explanation of natural phenomena and to the decision of practical questions. Thus the physical formulas become "alive", filled with the concrete contents.

With the help of physical tasks the intersubject connections of physics, first of all — with mathematics, and engineering, astronomy, chemistry, geography and biology are evidently demonstrated.

The ***function of the knowledge control***: the decision of tasks allows to determine the pupil's level of mastering of material, and also to check up, as far as this knowledge is qualitative.

The decision of physical tasks allows to overcome the basic lack of modern training — knowledge formalism.

2. Kinds of physical tasks.

The tasks can be classified according to various attributes:

1. contents: abstract and concrete, with industrial and cultural - historical contents, entertaining.

2. didactic aims: training, control, creative.

3. the way of the task's data presentation: textual, graphic, task - figure, task - experience.

4. the degree of difficulty: simple (contain one-two actions, use one physical law), complex(difficult), combined.

5. character and method of research: quantitative, qualitative, experimental.

The ***quantitative tasks*** are especially necessary at study of themes containing a number of quantitative laws (laws of dynamics, laws of constant current etc.), as without them pupils can not realize deeply physical contents of these laws. Here it is necessary to pay attention to necessity of quantitative research of the received results. One can see that physical process can go on in different ways (tasks on calorimeters).

The ***graphic tasks*** allow evidently and clearly to express functional dependences between parameters of the processes, taking place in nature around us, or in engineering. The decision of graphic tasks is closely connected with the functional analysis in mathematics course. The study of the same material in different school subjects mutually enriches them, and fills with concrete sense abstract mathematical examples.

The ***experimental tasks***: the decision is received from experimental demonstration, or on performance of independent experiment. On decision of these tasks the pupils show special activity and independence.

The ***creative tasks***: are most common situations we meet in practice, including research, and other forms of activity. It is possible to distinguish "research" (requires the answer to a question "why?") and design (answer the question "how to make?") tasks. The creative tasks bring the essential contribution to development of pupil's thinking, but we can rarely find them in textbooks.

The ***estimating tasks*** recently become more and more popular. Their use allows to overcome a formalism in knowledge. It is known, that many physical values, especial which we collide in every day life, remain for the pupil an "empty sound". For example, the pupils cannot estimate the values of magnetic field,

speed of electron movement in Bore atom model.

The tasks with incomplete data can be found very often in life, when the missing values should be extracted from the tables, or by measurements or assumptions. The decision of these tasks promotes formation of pupil's creative skills and skills to work with literature ore some other storage of information (Internet).

3. Methods of the decision.

Two methods of physical tasks decision are applied frequently: analytical and synthetic. These methods are equivalent and usually are applied simultaneously. Let's give the brief characteristic to each method.

The ***analytical method*** assumes splitting a complex task into a number of simple tasks. The decision begins with the search of the law, which gives the direct answer to the question of the task.

The ***synthetic method*** is characterized by that the decision of the problem begins not with required unknown value but from additional values, which can be found directly from the given data. The decision is found step by step, until we obtain the enquired value.

4. Physical problem at modern school

And now we shall talk about what problems are most useful from the point of view of increasing the quality of physical education. Let's give one of the modern classification of problems.

1. Information problems. Provide receiving the new information from the decision of a problem.

2. Intersubject, entertaining problems. The additional information from other subjects of the school program - chemistry, geography etc. is required for their solving, frequently.

3. Heuristic problems. Creative problems suppose at their decision the heuristic receptions. The decision of such problems occurs in sub consciousness. Such decision can be called intuitive.

4. Reduced tasks. Their decision does not require non-standard receptions. Frequently they are called "typical".

5. Integrative problems. It is non-standard creative problems, with not designated ways of the decision. A nucleus of these problems is the situation. Integrative problems are intersubject. The text of Integrative problems gives the schoolboys new knowledge.

What type of problems is preferable? The experience shows, that all tasks are good and necessary, but in proper time. The information, intersubject, entertaining and reduced problems — are the basis for formation physical world of schoolboys. Heuristic — are the problems for wakening interest to physics in general, giving understanding, that all natural phenomena around us submit the physical laws. Integrative problems are best for using for repeating the material.

Special attention should be given to selection of tasks for repeating the material. On the basis of our wide experience of work with the schoolboys, entrants and students, we offer as generalizing problems for repeating the material to use tasks describing a physical situation with the task: "to

investigate!". Word - "to investigate" - adjusts the pupils on the analytical approach. As experience of such lessons shows, nearly each of the schoolboys goes by his own way and allocates the features, marked by him, and only the discussion in class gives fruitful multilane research of a problem. Let's emphasize, that the problems should be multilevel, each pupil could solve a part of a problem appropriate to his level of knowledge.

So, the physical problems are the important component of training physics. The success of decision of problems appreciably depends on, whether the teacher uses the generalized methods of the decision of problems, or each problem is solved separately. Just the analysis of real situations promotes development of creative, research abilities of the pupils.