Young Physicists' Tournament (YPT): A Collective Competition

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YPT is a collective competition of high school students in their ability to solve complicated physical problems, to present solutions of these problems in convincing form to enable them to participate in scientific discussions or "physical fights" (PF).

YPT has been held in the USSR since 1979. It has become a traditional form of work with high school students (aged 14-17) at the Physics Department of Moscow State University.

YPT is a component of the complete system of talent searching, support and development.

The aims of this Tournament are to actuate physics studying outside the program, to include students into the real scientific investigations, to join them to the style and methods of research groups and also to attract scientists and postgraduates for work with students.

The YPT Structure

The YPT includes three stages:

Stage 1: Collective competition by mail. This stage is the main organizing basis of YPT. In this stage, school students obtain YPT problems, solve them and send their solutions to the Organizing Committee by mail. Collective competition by mail creates foundations for school team formation. During some months students participate in a serious scientific work, i.e. read special literature, make various calculations and discuss the solutions together.

Stage 2: Selective PF (scientific discussions). The main form of presentations of the solved problems is a scientific discussion, i.e. public protection of the solution in front of fault-finding rivals, interested audience and independent jury.

Stage 3: The final round of the Tournament. At the final round of the Tournament, the results of the competition are discussed and the winner is declared. Some physical mini-competitions are also carried out there.

Peculiarities of the YPT

Collective character of work

The YPT's distinction is a participation of collectives – school teams. As a rule, they consist of 10-20 students. Creative work of each member of the team in accordance with his or her interests and possibilities help to obtain essential final results. YPT's participants gain experience in scientific investigations in cooperation with others.

YPT problems

YPT problems always have multi-level character. They often resemble real scientific problems. To solve these problems, students must execute experimental and theoretical investigations themselves. Formula of YPT problems are short, without comments. Participants of YPT must make some approximations and simplifications, select theoretical model, compose the algorithm of decision, investigate obtained results, etc. i.e. pass through all stages of serious scientific work.

Scientific discussion (PF)

Scientific discussion is the main form of presentation of the solved YPT problems by participants. During the PF, every team one after another takes part in the discussion as a reporter, opponent or reviewer. Students must prove correctness of their solutions. It supposes profound knowledge about subjects discussed, ability to find relevant argumentation quickly and to see strong and weak points in their own solution of the other teams. Such discussions give students the possibility to communicate with scientists and postgraduates, to understand ethics and rules of scientific discussions, to obtain some experience in presentation of long period investigation results.

Long period of activity

YPT is not a set of some separated competitions. During the solution of the problems for competition, creative groups appear in every school. They act up to the final round of the Tournament, but even after this round they don't stop their activity. These groups are constantly replenished by next generations of young investigators–so appears a self-developing creative group.

Participation of colleges and universities

Scientists, postgraduates and students of colleges and universities participate in Tournament organization. They elaborate YPT problems, solve them and participate in jury. It's important to notice that elaboration of YPT problems and their solution are not easy. Difficulties here are almost the same that one has during the solution of a serious scientific problem. All these peculiarities of YPT put into practice ideas of pedagogical cooperation, uniting efforts of scientists, teachers, students of colleges and schools around common work.

The Rules of PF

Usually three teams take part in PF and it consists of three or six actions. Every team, one after another, participate in the PF as a reporter, opponent and reviewer.

One action includes:

a)	report	7 min.
b)	questions of opponent to reporter (each quest.)	1 min.
c)	opponent speech	3 min.
d)	polemics of reporter and opponent (each quest.)	1 min.
e)	critical review of report and opponent's speech	2 min.
f)	concluding polemics	4 min.

Note: When it is necessary to translate speeches and discussion into another language, the time limit is twice more.

At the beginning of every action, opponent orders the YPT problems for reporter from the list of YPT problems given beforehand. Reporter can decline this order (without explanation of reasons). In this case, opponent orders another YPT problem from the same list. Every team can decline the order twice.

Report

Reporters (one or several team members) give an account of the main ideas and conclusions for the solution of given YPT problem. It is desirable to use pictures, slides and photos prepared beforehand and demonstrate some experiments (if the problem is experimental).

Opponent Speech

In his speech, opponent expresses his opinion about the main ideas of report and makes critical remarks about report, showing mistakes and inaccuracies in understanding of the problem and in methods of its solution. Criticism of opponent must be concerned only with report. It cannot be an account of opponent's own solution.

Polemics of Reporter and Opponent

In this polemics solution of the reporter is discussed. Reporter answers the questions of YPT participants, but the opposing team has priority in discussion.

Review

Reviewer briefly mentions the main positive features of report and the most significant points in opponent criticism.

Concluding Polemics

In concluding polemics the opponent's speech and review can be discussed. Opponent and reviewer can, if it is necessary, present their own solution of the problem.

Limitation

Every team member can come out as a reporter, opponent or reviewer only once.

Judgement

YPT referee follows the execution of PF rules and time limitations, regulates team's activity during discussion and polemics. Jury gives marks to report, opponent speech, review and additional speaking on the problem. In concluding words, jury sums up result of discussion, emphasizes strong and weak points of the problem solution.

Final YPT Round

All participants of the Tournament are invited on the Final Round. All of them take part in various mini-competitions. Problem of the Final Rounds includes:

a) Jury introductions

b) Team introductions – This introduction is prepared in advance in accordance with traditional task:

Introduction

Prepare mini-performance on the physical theme in arbitrary genre with the help of team members and fans. Duration of the performance–5 minutes. This task gives students a possibility to include in their performance a good deal of jokes and humor to demonstrate their actor abilities.

c) Final PF – There are two participants in the final fight: reporter and opponent. The problem for the final round is similar to YPT problems for collective competition by mail. Leading scientists make review and comment solutions of the final problem.

d) Captain's competition – Every team has a captain. Captain and the assistants from all teams take part in solution of small physical problems. Time for solution of every problem is 5 minutes.

e) Fan's competition – This competition is held simultaneously with captain's competition. Problems for competition d) and e) are connected with various parts of physics and often it is required to explain some interesting physical experiments.

f) Various mini-competitions

g) Winner's rewarding

The Second International Young Physicists' Tournament

The II International YPT was held in Moscow at the Youth Center "Olympiets" from March 24 to April 2, 1989. It was combined with the II National YPT of the USSR in which 34 teams participated.

List of teams – participants of the final Round of the II International YPT:

Bulgaria
Stephan Piperov
Ivailo Velichkov
Rumen Bachev
Chavdar Chavdarov
Nikolai Nikolov

Leaders: Dr. Lydmil Vasilev
Mr. Jan Vidernov

Hungary
Chaba Antal
Gabor Felso
Rudolf Hornig
Akosh Levay
Szilard Szabo

Leaders: Dr. Lajosh Skrapits
Mr. Farence Zhigri

Federal Republic of Germany
Alexander Smola
Robert Kiendl
Matthias Bochtler

Leaders: Prof. Gunter Lind
Dr. Klaus Mie

Netherlands
Jolanda van Deurzen
Wim van Geloven
Ron Peerlings
Patrick Veldhuis
Vincent Verouden

Leaders: Mr. Willem Bouwman
Mr. Ad Molenaars

Poland

Andzhei de Flassilier	Leaders:	Dr. Andzhei Nadolny
Jacek Pietruszanis		Mr. Matey Jenike
Piotr Poncyljusz		
Krzysztof Szereda		
Jarek Zygierewicz		

Czechoslovakia

Lubosh Ciklamini	Leaders:	Dr. Zdenek Kluiber
Alesh Cherny		Mrs. Anna Sutakova
Peter Korbacka		
Richard Kyska		
Ivan Marchak		

USSR School No. 710, Moscow

Vladimir Roddatis	Leader:	Mrs. Elena Basova
Grigory Kopelevich		
Boris Cherny		
Vasily Shabat		
Alexander Yablonsky		

USSR Station of Young Technicals, Odessa

Andrey Boychuk	Leaders:	Dr. Vadim Manakin
Konstantin Waysman		Mr. Lev Stavchansky
Leonid Vul		
Vladislav Portnoy		
Dmitry Fisher		

International consultative meeting "Organization of the International Young Physicists Tournaments" was held in Moscow from April 3 to April 5, 1989. Decisions of the International Consultative Meeting "Organization of the International Young Physicists Tournaments":

> Participants of the Consultative Meeting consider Young Physicists Tournament as an effective form of search and support of talented young people. It is necessary to develop YPT further.
>
> YPT is not an alternative to the physics Olympiad. Both these forms of work with young people are mutually additional. They enrich each other. The way of physics problems solution of the tournament permits reproduction of all stages of scientific research rather exactly: problem determination, selection of method for solution of the given problem, calculations, obtaining of scientific result and its discussion. An important advantage of the YPT is a long period of YPT problems solution (2-3 months).

To develop YPT further, it is necessary:

1) To form International Organizing Committee for preparing and carrying out the III International Young Physicists' Tournament consisting of:

Czechoslovakia – all the members of the National Committee of YPT.

USSR – members of the National Committee of YPT.

Zatsepin, G. T.
– President, Academician, Moscow State University
Yunosov, E. N.
– Vice President, Moscow State University
Nikolaev, M. Y.
– Secretary, Moscow State University
Alminderov, V. V.
– Teacher of School No. 542, Moscow
Ernolaeva, L. P.
– Central Committee of the Komsomol representative
Koroteev, N. I.
– Professor, Moscow State University
Korneeva, T. P.
– Teacher of School No. 18, Moscow
Kusenko, A. Y.
– Student of the Moscow State University

Countries – participants – 1 or 2 members

2) To address the Central Committee of Czechoslovakian Youth Socialist Union and Ministry of Education, Youth and Physical culture of CSSR with an appeal about assistance in organization and carrying out of the III International Young Physicists' Tournament in Kladno (Czechoslovakia) from February 26 to March 3, 1990 and formation of the national Czechoslovakian Organizing Committee for carrying out the Young Physicists' Tournaments.

3) To give to the National Czechoslovakian Organizing Committee the right to form a Jury of the III International YPT, with the possibility to include in this Jury representatives of the countries' participants of YPT.

4) To set a Jury of the III International YPT problems for this Tournament (17 tasks) and to spread among all interested organizations and persons till October 15, 1989.

5) To invite about 15 teams from various countries for participation in the III International YPT; include teams from countries' participants of the II International YPT—Bulgaria, Hungary, FRG, Netherlands, Poland, USSR.

6) To determine the following composition of team —5 school students and 2 supervisors. It is desirable that one of these supervisors will be ready to work on the Jury of Organizing Committee of the III International YPT.

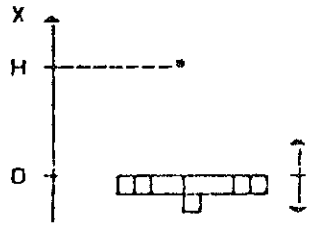
7) Consultative meeting appeals to UNESCO with a hope to obtain assistance and support and requests sending an observer to the III International YPT.

The Third International Young Physicists' Tournament

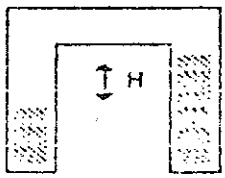
YPT problems for collective competition by mail.

1) *"Invent Yourself"* (physical photo competition). Produce photos of high speed physical processes. Explain value of these photos for understanding the nature of the process considered.

2-4. *"A ball and a piston"*



Pic. 1



Pic. 2

A piston vibrates along vertical axis up and down (Pic. 1). Position of the upper piston surface is determined by the following low X=Xo Cos wt. At arbitrary moment, a small ball drops on the piston surface from the height H without initial velocity.

2) How high will a ball raise after first collision with the piston? In this case, consider the collision as absolutely elastic, and H<Xo.

3) After a great number of collisions, the system "forgets" initial conditions. Determine maximal possible and average height of the ball raising after a great number of collisions. Don't take into consideration ball and piston destructions during collisions.

4) We have now a ceiling above the piston at some distance H'. In this case, it is possible to obtain stationary solutions. Find some of them and investigate their stability. For numerical values, consider H'=1, m,H*prime*>>Xo,g=10 m/s2 and ratio of relative velocities after and before collision is equal to K=0.8.

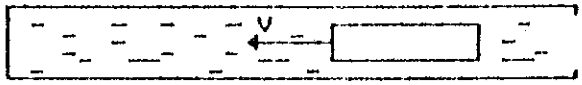
5) *"The Planet"*. What is the maximal volume of the cubic planet?

6) *"Evaporation—condensation"*. There is some water inside a U-shaped glass tube (pic. 2). If initially there is difference H of water levels in two vertical parts of the tube, after time passing two levels become equal. Define velocity of equilibrium restoration at given H and temperature T (T = const) in two cases.

   a) There is no air in tube.

   b) There is some air at standard pressure in the tube.

Pic. 3



7) *Cylinder in a tube"*. Cylinder moves with constant velocity within a long tube, filled by water towards the closed edge of the tube (Pic. 3). The inside diameter of the tube is D, diameter of the cylinder is d and its length is 1. D-d=h<<d,1>d. How force of resistance to movement of the cylinder depends from velocity? Compare theoretical predictions and experimental results.

8) *Segner's wheel"*. Segner's wheel in water is rotated by reactive forces of water jets running out of the wheel. Will the wheel rotate or not in reversal regime, when water is sucked in the wheel?

9) *"Franklin's wheel"*. Rotation of a metallic wheel with needles on it in a well-known experiment—***Franklin's wheel***—is explained by the existence of the so-called "electrical wind". Explain why this wheel is rotating, if it is situated between plates of a plain capacitor charged by continuous electrophorese. Will a dielectrical disk rotate or not, if it is situated in a plain capacitor instead of Franklin's wheel?

10) *"Electret"*. 150 years ago, M. Faraday predicted electrets as electrostatic analogy of permanent magnet. Produce electret and investigate its properties.

11) *"Colours of clouds"*. Explain observable colours of clouds.

12) *"Cloud's boundary"*. Observable cloud's boundary is often rather sharp. One can observe it best from an airplane. Determine the width of cloud's boundary.

13) "*Cloud of cosmonauts*" or fantasy with physical significance. A "cloud of cosmonauts" is formed of a great number of cosmonauts in space. Initially everyone has a football. At any moment, cosmonauts begin to exchange these footballs (not a ball is lost in this process). Describe evolution of "cloud of cosmonauts." We don't want to limit your fantasy. Choose yourselves initial conditions, rules of exchange and other characteristics of the "cloud." The selection of all conditions must be logically proved; conclusions must be grounded by numerical estimations and amount of described variants can't be more than two.

14) "*Fractal?*" An old woman reels up wool thread into a ball. How does the mass of the ball depend upon its diameter?

15) "*Light in the tube*". Look at some light source through a glass tube (diameter of the tube is about 5 mm and its length is about 25 cm). Explain the nature of rings observed in the tube.

16) "*Interference*". If two transparent glass plates are put tightly together, one can observe interference stripes. If one puts them on the tables and presses in the middle of the upper plate with his finger, interference stripes transform into concentrical rings. When one takes off his finger, rings begin to move from the middle to the edges. Make this experiment and explain the observed phenomena. Estimate theoretically velocity of rings' movement after the removal of the loading.

17) "*Scientific labour organization*". Suppose you intend to drive 1,989 identical nails 50 mm long and 2.5 mm in diameter into a wooden beam. What hammer will you select to do this job fastest and with a high quality (what is hammer mass and the length of its handle)?

    a) For pine beam

    b) For oak beam.

Problems were prepared by T. D. Korneeva, A. Y. Kusenko, M. Y. Nikolaev, A. V. Rahmanov, M. V. Stolyarov, M. M. Tsypin, S. D. Variamov, E. N. Yunosov.

Please send applications for your participants to:

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