

## Problems for the V-th International YPT

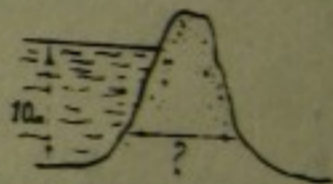
We draw your attention to the list of problems of the V-th International YPT. Traditionally such a list includes 17 problems. Here the problem #17 is traditionally susceptible to a humorous solution.

1. Invent it yourself. "Magnetic suspension" may be used in highspeed trains of the future. Design and make an experimental model of such a suspension.

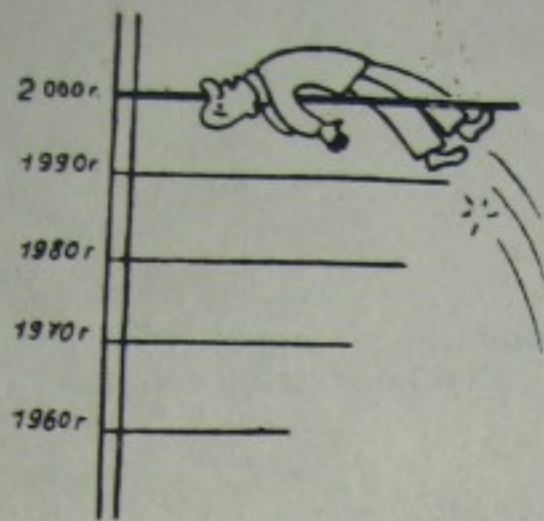


2. Monocycle. Circus actors often perform riding tricks on monocycles. There may be a range of wheel sizes. What is the largest possible diameter of the wheel?

3. The Dam. There is a saying in Russian "money goes like water through sand". However sand dams hold water. What should be the thickness of a dam in order to retain water, whose depth behind the dam is 10 meters?

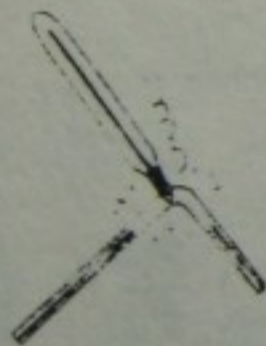
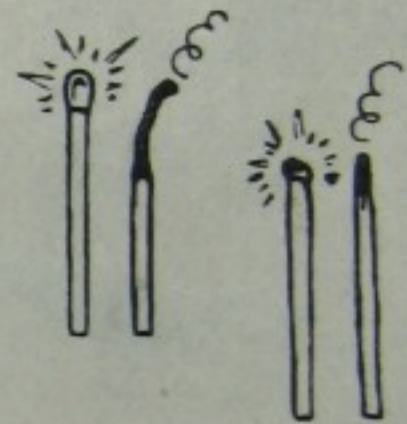


4. Swing. A special swing (trapeze) is used to train air and space pilots. This device is able to make a loop around horizontal axis around which it swings. What minimum time is necessary build up the motion of the swing from rest at the equilibrium position to an amplitude  $180^\circ$ ?



5. **High jumper.** There is saying in Russian "one can not jump over one,s head", but many high-jumpers can easily do it. Estimate the maximum height a man will be able to get over in the year 2000 both with a pole and without one.

6. **Matches.** What is the minimum necessary mass of "sulphur" in the head of match to make it to light?



7. **Steel Rod.** A steel rod 8 mm in diameter is bent at an angle  $90^{\circ}$ . What is the position and value of the maximum local temperature rise?

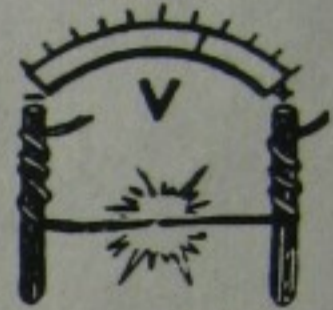
8. **Boiling.** A tall cylindrical vessel is partly filled with water and is put with its open end into a wide-mouthed vessel which is also filled with water. If we get the water to the boiling point and then cool it down, the level of water in the cylinder will change. Find experimentally the correlation between the height of the water column in the cylinder and the temperature under repeated heating and cooling. Explain the phenomena observed.





9. **Fountain.** There is a fountain called "Samson" in Peterhof. Water spurts out of it to a height of more than 20 meters. Suggest how to construct a fountain, which we will name "YPTon", which could provide the maximum height of the spurt if the pump power is 1 kW?

10. **Fuse.** A thin brass wire can be used as a fuse. Find the correlation between the current of the wire and its diameter.



11. **Hopfield model.** Devise the algorithms for storing pictures in a computer memory and for distinguishing between them.

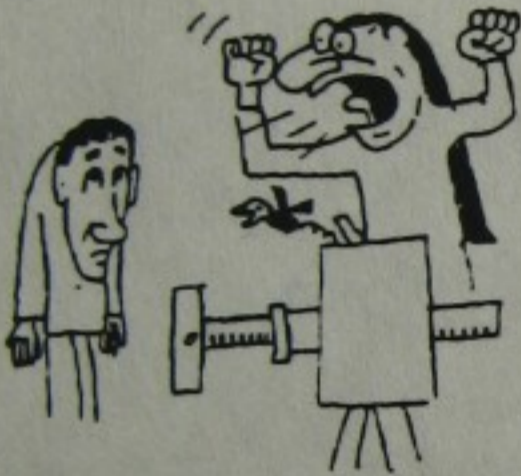
12. **Butterflies.** Butterflies find each other by smell. Estimate the transmitter strength and the receiver sensitivity of butterflies.



13. **Topsy-turvy world.** Some medical publications state that 0-2 months old babies see the world around them up side down. Give your arguments "for or against".

14. **Laser.** A laser beam is directed perpendicularly to the wall of a transparent glass tank (aquarium) filled with water. If the beam passes through the tank above or below the level of water we can observe a spot on the screen behind the tank. If the ray passes along the level of water we observe a vertical line. Explain the origin of the line and calculate its parameters.

15. **Incandescent lamp.** Estimate the amplitude of variations of the temperature of the spiral filament of a light bulb when powered by an alternating current.



16. **The depth of focus.** Find experimentally the dependence of the depth of focus of a camera on its aperture diameter (or the stop number: 16, 8, etc). Give theoretical explanation of the dependence obtained.

17. **Rain bubbles.** Some people suppose, that if there are bubbles on the surfaces of pools during the rain, the rain will last a long while but others think they are a sign of the rain stopping. Who is right?

