# IPT 2015 Problems

**1. Thermal clock**

Construct the most precise clock that uses a periodic change of temperature of one of its components as a timer. It should use a continuous heat supply and the working substance may be air or water in any form. The device should not have any moving parts (such as pistons or gears).

**2. Vortex cannon**

Vortex cannons can be easily constructed to create smoke/air rings:
http://www.youtube.com/watch?v=4b2SV3ASUxY .
What factors influence the range of the rings? How can this range be maximized?

**3. Wet rocks**

It's well known that many materials (asphalt, cloth, etc.) change their color on wetting. Describe the processes that lead to such a spectrum change for reflected (or transmitted) light. What properties of the material/liquid influence the process and how?

**4. Tuning fork connection**

Develop a setup for data transmission that uses tuning forks as the transmitter and receiver. The tuning forks should be 440 Hz and may include a resonator and small features to change the frequency. How does the maximum data transmission rate depend on the distance between the forks?

**5. Ping-Pong-Panda**

Sometimes Ping-Pong players "chop" the ball in such a way that it changes direction after hitting the table. Estimate the maximum angle of deviation from the ball's initial direction (i.e. a plane formed by the normal vector of the table and the velocity of the ball before bouncing) and determine what parameters it depends on. How will the answer change for a super ball?
http://youtu.be/ppT6wbep7AM

**6. "Superconductivity"**

There exists a phenomenon where neodymium magnets levitate a round graphite plate at room temperature. Explain the effect. Propose a setup with minimal mass that will stably levitate a 1 g graphite plate.
http://youtu.be/K9lpykPcdS0

**7. Entropiemeter**

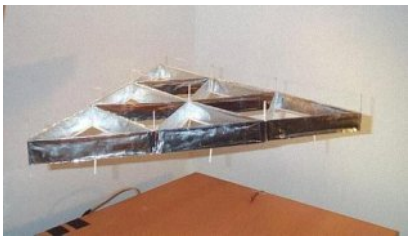
Propose a setup to directly measure the entropy (or its linear function with coefficients that do not depend on system state) of a system containing a small volume of a) gas (air), b) liquid (water), c) a solid body with a lattice (iron). The setup should work in conditions not extreme for humans.

**8. Jalousies**

A strong air flow passing though jalousies make them oscillate and produce a specific sound (it's most often seen in horizontal models). Describe this phenomenon and explain the dependence of the oscillation characteristics on the setup parameters. Obtain the threshold (conditions) at which the oscillations start.

**9. Reactive balloon**
An untied balloon, if released, flies along a complicated spiral trajectory. Why does the balloon spin? What does the spiral period depend upon?

**10. "Vegetable cell"**
Some fruits and vegetables can be used as natural souce of electricity. Is it possible to use this property to determine the vegetable 'readiness' when being cooked (boiled/fried)?



**11. Lifter**
Construct the most powerful Lifter possible with the surface area below 0.1 $m^2$.http://jnaudin.free.fr/lifters/howto.htm

**12. The angry salt**
When sea salt is heated in frying pan it begins hissing and jumping. Explain this phenomenon. Find the relationship between the distribution of salt grains and the jumping height.

**13. Trampoline dad**
When two people bounce on a trampoline it is possible for them to time their bounces such that most of the energy is transferred to only one person. Determine what influences the maximum bounce height of a person under these circumstances.

**14. Earth charge**
Measure the electric charge of the Earth. Explain your experimental procedure in detail, prove its correctness and estimate its error. Ideal solution - measure the charge using several different approaches, calculate it and show that results coincide. Does your measured charge depend on time? If yes - how?

**15. Curly ribbon**
Why do ribbons curl after being scored with a blade? What is the typical size of the curl? How do the ribbons parameters influence the effect?

**16. Prince Rupert's drop**
Prince Rupert's drops are objects obtained by dropping hot glass into water. They can be destroyed by breaking off a piece of the thin tail. The destruction process moves from the tail to the opposite side with some speed.
Calculate this speed and investigate how the speed depends on the environmental conditions during the drop formation and the properties of the glass. **Be careful carrying out the experiments for this problem!**

**17. Beer battle**
If you tap a beer bottle with the bottom of another one, the beer will spill out like a geyser. Explain this phenomenon and estimate the amount of liquid that can be removed from the bottle via this method. What are the important parameters for this effect to occur?

Many thanks to all the people who contributed to the problem list and helped with the problem selection!

In case of any questions do not hesitate to contact Vladimir Vanovskiy, the IPT Secretary
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