



IPT 2015 Problems



1. Thermal clock

Using a continuous heat supply, construct the most precise clock where the temperature of a part of it is changing periodically. As the working substance one may use 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 leading to such a spectrum change of reflected (or maybe transmitted) light. What properties of material/liquid influence the process and how?

4. Tuning fork connection

Develop the setup for data transmission using as the transmitter and receiver usual tuning fork (440 Hz, may be with resonator and different little features for change the frequency). How does the maximal data transmission rate depend on distance between forks?



5. Ping-Pong-Panda

Sometimes the Ping-Pong players “chop” the ball in such a way that it changes its direction after hitting the table. Estimate the maximal angle of deviation from initial direction (from the plane formed by the table normal vector and the ball velocity before the bounce) and determine on what parameters does it depend? How will the answer change for a super ball?

<http://youtu.be/ppT6wbep7AM>

6. “Superconductivity”

There is an experiment where other neodymium magnets levitates a round graphite plate at room temperature. Explain the effect. Propose a setup with minimal mass to levitate 1 g graphite plate.

<http://youtu.be/K9lpykPcdS0>

7. Entropiemeter

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

8. Jalousies

A strong air flow passing through jalousies make them oscillate and produce a specific sound (it's most seen in horizontal models). The assignment is: describe this phenomenon, obtain dependencies between setup characteristics and characteristics of the oscillations, obtain the threshold (conditions) on which this oscillations start.



9. Reactive balloon

A balloon, if released untied, 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 source of electricity. Is it possible to use that effect to determine the vegetable readiness when we are cooking (boiling/frying) them?



11. Lifter

Construct the most powerful Lifter with the surface lower than 0.1 m^2 . <http://jnaudin.free.fr/lifters/howto.htm>

12. The angry salt

When sea salt is being heated on the frying pan it begins hissing and jumping. Explain the effect. Find the distribution of salt grains on 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 is a bolduc ribbon curling after you stretch it with a blade? What is the typical size of the curl? How does the important parameters influence the effect?

16. Prince Rupert’s drop

Prince Rupert’s drop is a well-known body obtained by dropping hot glass into water. It can be destroyed by breaking off a piece of thin tale. The destruction process moves from the tale to the opposite side with some speed.

Calculate this speed and investigate how the speed depends on the environmental conditions of drop obtaining and the materials the drop consists of. Be careful on carrying on the experiments on this problem. It may be dangerous.

17. Beer battle

If you tap a beer bottle with the bottom of another one, the beer will spill out like a geyser. Explain the phenomena and estimate the amount of liquid that can be taken off the bottle with this method. What are the important parameters for the effect to occur?

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

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