

## PROBLEMS FOR THE 9th INTERNATIONAL YOUNG PHISICISTS' TOURNAMENT

### 1. Invent yourself

Invent and solve yourself a problem concerning the ozone holes

### 2. Paper clot

Crumple arbitrarily a sheet of paper A4 in your hand. This clot can be approximated by a sphere. Making many of this clots and measuring their average diameters a histogram of distribution of diameters can be plotted. Try to explain the result obtained. Make more comprehensive investigation of the dependence of the average diameter of a clot on the parameters which you consider important

### 3. Cycle racing

According to the forecast of specialists two very strong and "absolutely identical" sportsmen had to show equal time in a highway race for 100 km. But, alas, one sportsman lagged behind. Later it was found out that some malefactor adjusted a nut of mass 5 g to the rim of the rear wheel of his bicycle. For what time is the victim late?

### 4. Self-formation of a pile

A horizontal rigid plate vibrates vertically at a frequency of the order of 100 Hz. A cone-shaped pile of fine dispersed powder (e.g. Licopodium or talc) which is heaped up on the plate remains stable at small amplitudes of the vibration. If the amplitude is increased the cone decays. Further increase of the amplitude yields a distribution confined by a sharp border and at still higher amplitudes a pile appears again. Investigate and explain this phenomenon

### 5. Auto oscillations

Produce and investigate auto oscillating system containing thermistor as a single non-linear element

### 6. Water generator

If some volume of water is frozen from one side, a potential difference appears cross the ice-water frontier. Measure this potential difference and explain the phenomenon.

### 7. The Sun

In the center of the Sun an extra quantity of energy is produced which is equal to the energy emitted by the Sun per year. How will the parameters of the Sun observed on the Earth change during one year?

### 8. Surface Information

Develop a method for transferring information by the waves on the surface of water. Investigate the angular characteristics of the emitter and the receiver (the antennas) which you constructed

### **9. Floor-polisher**

A device stands on two identical disks lying flat on a horizontal surface. The disks can rotate in opposite directions at a given velocity. Investigate how the value of a force providing a uniform motion this device along a horizontal plane depends on the velocity of this motion and the velocity of rotation of these disks.

### **10. Soap bubbles**

Dip the ring of a children's toy for blowing out soap bubbles into a soap solution and blow on the film formed in the ring. At what velocity of the air flux blown into the ring will the bubbles form? How must the velocity of the air flux be adjusted to produce the bubble of maximum size?

### **11. Candle**

Some candles twinkle before dying out. Investigate and explain this phenomenon

### **12. Motor car**

A car driven at constant power moves onto a wet section of a straight road. How will its speed change when the thickness of the water layer increases slightly and linearly with the distance?

### **13. Grey light**

Construct a source of light which would seem to be grey

### **14. Coherer**

It is known that a glass tube with two electrodes and metallic filings between them (coherer) has different resistance in d.c. and a.c. circuits. Investigate the frequency dependence of the coherer's resistance

### **15. Salt water oscillator**

A cup with a small hole in its bottom containing salt water is partially immersed in a big vessel with fresh water and fixed. Explain the mechanism of the observed periodical process and investigate the dependence of its period on different parameters. To visualize the process, the water in the cup should be coloured

### **16. Hail**

Explain the mechanism of hail formation and propose your own method to event the hailing

### **17. Gloves**

Some people refuse to wear gloves in winter because they suppose to feel colder than without gloves. Others prefer to wear mittens instead. What is your opinion?