

# Problems for the 15th IYPT

## 1. Heat engine

A tall glass cylinder is half-filled with hot water and topped up with cold water. A small ampoule, containing a few drops of ether or alcohol (and closed off by a rubber pipette cap), is then put in. Describe the phenomena occurring in the system. How does the motion of the ampoule change with time?

## 2. Spider's web

A spider's thread looks like a string of pearls. What is the reason for this? Make experiments to investigate the relevant parameters.

## 3. Flying colours

Why do flags flutter in the wind? Investigate experimentally the airflow pattern around a flag. Describe this behaviour.

## 4. Hazy

The colour of a distant forest appears not green, but hazy blue. What is the minimum distance at which this phenomenon is observed? How do weather conditions affect this? Is it possible that a forest can appear grey?

## 5. Pond skater

It is known that unwettable small bodies can float on water due to the surface tension force. Construct a floating raft based on this principle and determine its static and dynamic parameters.

## 6. Stop and start

Sometimes a flow of traffic can experience sudden stops and starts for no apparent reason. Build a physical model to explain why this occurs.

## 7. Ohm's Law for a liquid

It is said that electric current "flows". Is this the only analogy between electric current and the flow of a liquid? Investigate theoretically and experimentally other analogies between these two.

## 8. Charged sand

Fine, well-dried quartz sand is poured out of a short thin tube into a conical metallic vessel connected to an electrometer. Investigate the behaviour of the sand stream as the vessel fills up. What changes if the stream is lit by a UV-lamp?

## 9. Chromatography

Put a drop of coloured liquid on a piece of absorbant paper. Describe quantitatively the observed phenomena.

## 10. Sound cart

Construct and demonstrate a device that can be propelled solely by sound. Investigate its properties.

## 11. Equilibrium

Fill a glass with water up to the point where a convex meniscus is formed. Place a table tennis ball on the surface of the water. Investigate and explain the stability of its equilibrium. Repeat your experiment with other liquids.

## 12. Electroconductivity

How can you measure the electroconductivity of salt solutions without using direct contact electrodes? Analyse the problem and demonstrate your device.

### **13. Spinning ball**

A steel ball of diameter 2-3 cm is put on a horizontal plate. Invent and construct a device, which allows you to spin the ball at high angular velocity around a vertical axis. The device should have no mechanical contact with the ball.

### **14. Torn sail**

Determine the dependence of the efficiency of a sail on its degree of perforation. What would be the effect of using a fishing net as a sail?

### **15. Pulsating air bubble**

Trap an air bubble of radius 1-2 cm under an inverted watch glass beneath a water surface. Introduce alcohol into the bubble through a thin tube, controlling and adjusting the rate of flow until the bubble pulsates rhythmically. Study the phenomenon and explain your observations.

### **16. Elastic pendulum**

Study and describe the behaviour of a pendulum where the bob is connected to a spring or an elastic cord rather than to a stiff rod.

### **17. Bottle battle**

Take two opened glass bottles of cola and knock one against the other. After a short while, the cola spurts out of one of the bottles. Investigate and explain the phenomenon.