

# IYPT 2005 in Winterthur, Switzerland

## Problems

### 1. Dragonfly

Propose a model of how a dragonfly flies. Investigate the major parameters and validate your model.

### 2. The two ball problem

Two balls placed in contact on a tilted groove sometimes do not roll down. Explain the phenomenon and find the conditions, under which it occurs.

### 3. Avalanche

Under what conditions may an avalanche occur? Investigate the phenomenon experimentally.

### 4. Hydraulic jump

When a smooth column of water hits a horizontal plane, it flows out radially. At some radius, its height suddenly rises. Investigate the nature of the phenomenon. What happens if a liquid more viscous than water is used?

### 5. Mirage

Create a mirage like a road or desert mirage in a laboratory and study its parameters.

### 6. Noise

When a droplet of water or other liquid falls on a hot surface, it produces a sound. On what parameters does the sound depend?

### 7. The bouncing plug

A bathtub or sink is filled with water. Remove the plug and place a plastic ball over the plughole. As the water drains the ball starts to oscillate. Investigate the phenomenon.

### 8. Windcar

Construct a car which is propelled solely by wind energy. The car should be able to drive straight into the wind. Determine the efficiency of your car.

### **9. Sound in the glass**

Fill a glass with water. Put a tea-spoon of salt into the water and stir it. Explain the change of the sound produced by the clicking of the glass with the tea-spoon during the dissolving process.

### **10. Flow rate**

Combine powdered iron (iron filings) with a vegetable oil. Connect two containers with plastic tubing and allow the mixture to drain through the tube. Develop an external mechanism to control the flow rate of the mixture.

### **11. Water droplets**

If a stream of water droplets is directed at a small angle to the surface of water in a container, droplets may bounce off the surface and roll across it before merging with the body of water. In some cases the droplets rest on the surface for a significant length of time. They can even sink before merging. Investigate these phenomena.

### **12. Ball spin**

Spin can be used to alter the flight path of balls in sport. Investigate the motion of a spinning ball, for example a table-tennis or tennis ball, in order to determine the effect of the relevant parameters.

### **13. Hard Starch**

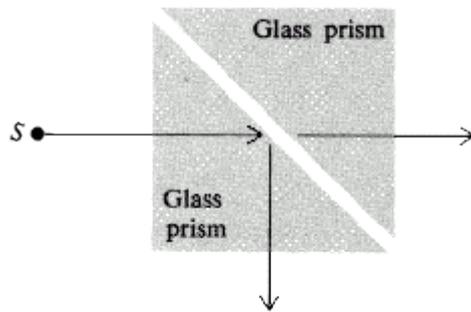
A mixture of starch (e.g. cornflour or cornstarch) and a little water has some interesting properties. Investigate how its "viscosity" changes when stirred and account for this effect. Do any other common substances demonstrate this effect?

### **14. Einstein - de Haas Experiment**

When you apply a vertical magnetic field to a metallic cylinder suspended by a string it begins to rotate. Study this phenomenon.

### **15. Optical tunneling**

Take two glass prisms separated by a small gap. Investigate under what conditions light incident at angles greater than the critical angle is not totally internally reflected.



### 16. Obstacle in a funnel

Granular material is flowing out of a vessel through a funnel. Investigate if it is possible to increase the outflow by putting an "obstacle" above the outlet pipe?

### 17. Ocean "Solaris"

A transparent vessel is half-filled with saturated salt water solution and then fresh water is added with caution. A distinct boundary between these liquids is formed. Investigate its behaviour if the lower liquid is heated.