IYPT 2005 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.

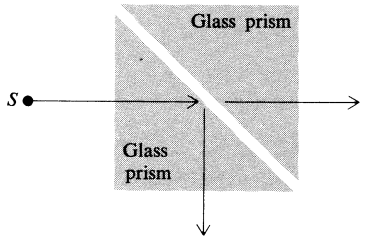
11. **Water droplets:** If a stream of water droplets is directed at a small angle to the surface of water in a container, droplets may bounce off the surface and roll across it before merging with the body of water. In some cases the droplets rest on the surface for a significant length of time. They 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 tunnelling:** 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.