Provisional Problems for 21st for IYPT, Croatia 2008

1. ***Tipcat:***
   Place a small wooden stick over the edge of a desk. Hit the end of the stick overhanging the table so that it flies away. How is the flight distance related to the relevant parameters? What is the condition for a maximum horizontal distance?

2. ***Winged seed***:
   Investigate the motion of falling winged seeds such as those of the maple tree.

3. ***Pin-hole Camera***:
   Study the characteristics of a pin-hole camera and find the conditions for the camera to achieve optimum image quality.

4. ***Cymbal***:
   Discharging an electronic flash unit near a cymbal will produce a sound from the cymbal. Explain the phenomenon and investigate the relevant parameters.

5. ***Voltaic cell***:
   Make a voltaic cell using paper tissues as a salt bridge. Study and explain how the electromotive force of this battery depends on time.

6. ***Liquid stain***:
   When a drop of liquid such as coffee dries on a smooth surface, the stain usually remains at the edge of the drop. Investigate why the stain forms at the edge and what parameters affect the characteristics of the stain.

7. ***Making a Splash***:
   A solid object is dropped into water from a height of 50 cm. Investigate the factors that would minimize the splash.

8. ***Astroblaster***:
   When a large ball is dropped, with a smaller one stacked on top of it, onto a hard surface, the smaller ball will often rise much higher than it would if dropped onto the same surface by itself while the larger ball hardly bounces at all. Investigate this phenomenon and design a multiple-ball system, using up to 4 balls, that will reach the greatest elevation of the top ball.

9. ***Flute***:
   Drill a hole into the side of a tube that is open at one end and produce a sound by blowing the open end. Investigate the pitch and timbre of the sound of your flute and how they depend on the position and the

diameter of the hole.

10. ***Kaye Effect***:
    When a thin stream of shampoo is poured onto a surface, a small stream of liquid occasionally leaps out. This effect lasts less than a second but occurs repeatedly. Investigate this phenomenon and give an explanation.

11. ***Gutter***:
    When a thin layer of water flows along an inclined gutter different wave patterns are sometimes observed. Study this phenomenon.

12. ***Geyser***:
    Support a long, vertical tube containing water. Heat the tube directly from the bottom and you will observe that the water erupts. Arrange for the water to drain back into the tube to allow repeated eruptions. Investigate the parameters that affect the time dependence of the process.

13. ***Spinning ice***:
    Pour very hot water into a cup and stir it so the water rotates slowly. Place a small ice cube at the centre of the rotating water. The ice cube will spin faster than the water around it. Investigate the parameters that influence the ice rotation.

14. ***Faraday Generator***:
    Construct a homopolar electric generator. Investigate the electrical properties of the device and find its efficiency.

15. ***Gelation***:
    Hot gelatine solution becomes a gel upon cooling. Investigate the electric conductivity as a function of temperature as it gels. Explain the results obtained.

16. ***Black spoon***:
    Blacken a spoon using a candle flame. If you immerse the spoon in water it appears glossy. Investigate the phenomenon and determine the optical properties of such a “mirror.”

17. ***Heat engine***:
    Build a heat engine powered only by the difference between the day and night air temperatures without using direct sunlight. Determine its efficiency.