Problems for the 2nd SYNT

1. Buffon's needle

Draw a series of parallel equally spaced lines on a horizontal surface. Pick a bunch of sticks (e.g. matches or needles) slightly shorter or longer than the separation between the lines, and randomly drop them on the surface. It is claimed that the number of times the sticks cross the lines allows estimating the constant π to a high precision. What accuracy can you achieve?

2. All roads lead to Rome

Open a random Wikipedia article and click on the first link in the article. Keep clicking on the first link of each following article. It is argued that you will quickly end up on the page Philosophy. Investigate whether this is true. How can one describe such an observation?

3. Annoying foreground object

Look at a flat photograph. What methods allow you to tell which objects were closer and which were farther from the camera when the shot was taken? Design and create a photograph that violates the intuitive judgment of relative distances.

4. Making quark

Quark, cottage cheese, and similar varieties of white acid-set cheese can be produced from milk. Investigate this process experimentally and study the properties of the resulting product.

5. Collision

A highly elastic Super Ball collides with a rigid surface. How can one determine the collision time? Propose various techniques and compare the experimental results.

6. Eye color

In certain human populations, genetics allows predicting inheritance of eye color among family members. In other populations of the present day World, nearly everyone has the same eye color. What information is it possible to determine about the eye colors in both distant and close ancestors, descendants, and relatives of one living person?

7. Worms

Earthworms change the mechanical properties of soil and make the soil more porous. Investigate this process and introduce quantitative parameters.

8. Fair coin

In many cases, disputes are resolved with a coin toss. It is presumed that this procedure gives equal chances of winning to both sides. Investigate how the chances depend on the tossing mechanism and the coin properties.

9. Bottle tone

Take an empty bottle and blow air across its mouth to produce a sound. Now fill the bottle with some water and study how the sound changes.

10. Greenhouse

A hot object placed in the open air would gradually cool down. We can slow down this process by containing the object in a greenhouse. Compare different mechanisms of heat loss by the object and explain how the presence of a greenhouse affects them.

11. Fame

Some people in the modern World are considered 'famous' since they frequently appear in the news, TV, and social media. Suggest a quantitative parameter of such 'fame', and build lists of persons that are sorted according to this parameter.

12. Occulted stars

Investigate the optical effects that can occur when the Moon passes in front of a star.

13. Invent Yourself: Blood pressure

Study the accuracy of various methods to measure blood pressure. Propose an interesting study involving blood pressure and pulse.

14. Invent Yourself: Dendrochronology

Annual growth rings of trees are often used to date important historical events or environmental conditions of the past. Suggest and perform an investigation using various tree rings samples.

15. Invent Yourself: Laser pointer

Suggest an interesting optical study involving a beam from a laser pointer.

16. Invent Yourself: Granular materials

Suggest a study involving properties and behavior of granular materials.

17. Invent Yourself: Chronophotographic gun

Étienne-Jules Marey pioneered the use of time resolved photography to study physiology of humans and animals, and in particular their postures and locomotion. Propose a quantitative study of important physiological functions or parameters that would require analysis of similarly taken videos.