Problems for the 12th IYNT 2024

The time you enjoy wasting is not wasted time.
Bertrand Russell

Main Problems for Science Fight 1

1. Inverse clepsydra
Connect two bottles together and fill them with water and light particles (e.g. plastic toy bullets). How much time does it take for the particles to ascend to the top, if the 'hourglass' is turned upside down?

2. Marinated meat
Marinades are used to tenderize meat. How do properties of meat samples depend on the time of exposure and the chemical composition of marinade?

3. Ice cubes and soup
A sensational trick is to use ice cubes to remove fat or excess oil from hot soup. The fat cools down and sticks to ice in this demonstration. Reproduce this experiment in controlled conditions to support or dismiss the effectiveness of the method.

4. Caffeine in tea leaves
If dry tea leaves are heated under a cold glass (in optional presence of magnesium oxide), small crystals of caffeine are formed on the glass. Compare the yield of this technique to other easy methods of extracting caffeine from tea. What sorts of tea have the highest caffeine content?

5. Liquid umbrella
A thin liquid dome is formed if water is ejected through parallel plates or falls on a spoon. The dome may serve as an umbrella and prevent water droplets from falling through. Investigate the effectiveness of such a liquid umbrella.

6. Cyclotron train
A metal ball rolls freely on the rails which form a closed horizontal ring. If one or several coils are installed along the ring and powered at right moments of time, the ball may be given push after push and keep rolling. Investigate the dynamics of the ball. How does its instant speed depend on relevant parameters?

Main Problems for Science Fight 2

7. Anodic dissolution
A hole may be drilled in a metal plate by anodic dissolution. What is the maximum thickness of the plate that can be drilled by using an AA battery?

8. Parallax
A potential method for estimating distances with a naked eye is using the parallax effect. Look at a distant object with one eye and line up a thumb with the object. If looked with another eye, the thumb appears shifted. Collect quantitative data on how accurate this method is in comparison to other methods where only naked eyes are used.

9. Radiated heat
A human can feel the presence of a warm object nearby, e.g. a hand or a cup of coffee. Perform experiments in controlled conditions to estimate how accurately a volunteer may judge the distance and the temperature of such an object.

10. Oil spot photometer
A paper card with an oil spot is placed between two light sources. Depending on the position of the card, the spot appears either brighter or darker than the surrounding paper. The spot visually disappears when the card is in one specific location. Is this effect suitable to measure the luminosity of a dim (e.g. a glow stick or the Moon) or a very bright (e.g. the Sun) light source?

11. Two ends of a rope
A piece of a rope is dropped on the floor. Investigate and explain the distribution of distances between the two ends of the rope.

12. Rotating beam
A long beam can freely rotate in the horizontal plane. If a small rotor is mounted on one end of the beam far from the pivot, the beam may start turning. What happens if two rotors are mounted? Explain and investigate the motion of the beam.

Problems *Invent Yourself* for Science Fight 3

13. Invent Yourself: Myopia
Myopia is common in the World and among IYNT participants, in particular. Propose a study that would introduce quantitative parameters describing image perception by myopic humans.

14. Invent Yourself: Precipitates
If a chemical reaction product is insoluble, precipitation occurs in the solution. Some of precipitates are chunky, others cause a clear liquid to become cloudy, and others appear as solid sediment at the bottom of the test tube. Suggest a problem to investigate the factors that affect the appearance of precipitates in chemical reactions of your choice.

15. Invent Yourself: Transcribing texts
If someone is asked to copy a text, various language and spelling differences may appear in the handwritten copy. Linguists may judge from such discrepancies which undated manuscript is an older original and which is a more recent copy, and when each of them was written. Collect quantitative data on how handwritten copies diverge from the texts written and printed in the past (e.g. 100, 200, or 300 years ago). Formulate a problem focused on a specific human language.

16. Invent Yourself: Magnetic music
Objects that wobble in a magnetic field may create unusual sounds. Design a sound source or a musical instrument that uses a strong magnet and formulate a problem about specific aspects of your design.

17. Invent Yourself: Rainbows
Propose a problem about an unusual demonstration in which rainbow colors are formed.

The problems are authored by Nikita Chernikov, Artem Golomolzin, Ilya Martchenko, and Evgeny Yunosov. Selected, prepared, and edited by Ilya Martchenko and Evgeny Yunosov. This official set of problems for the 12th IYNT 2024 is approved by General Council of the IYNT and can be used only at the events endorsed by the General Council of the IYNT.
Released in Bobek-Almaty on August 26, 2023.