Problems for the 11th IYNT 2023

To solve an interesting problem, start by finding a problem that is interesting to you.
Eric S. Raymond

Main Problems for Science Fight 1

1. Chemical countdown
If solutions of potassium permanganate, oxalic acid and sulfuric acid are mixed, the mix discolors after a time interval. Is it possible to adjust the amounts of reagents so that the mix discolors after the time interval specified by your opponent at a Science Fight?

2. Knots
If a piece of rope is attached to the end of another rope with a knot, the knot may still fail to hold, break, or unravel under certain conditions. Investigate the factors affecting the knot strength.

3. Chirping sounds
Investigate experimentally and theoretically the chirping sound of crickets or grasshoppers. Does the sound depend on environmental factors? How to tell a cricket from a grasshopper by their sound?

4. Colorful lines
If a line is drawn on a rough surface with a piece of iron sulfide, the line has a different color than the mineral piece. Investigate this phenomenon. What other minerals show similar properties?

5. Dark side of the Moon
Determine experimentally and theoretically how dark is the side of the Moon facing away from the Sun. Does the illumination of this side depend on the lunar phase?

6. Buzzing ribbons
If the free end of a ribbon is placed near a vacuum cleaner hose pipe, the ribbon will flutter in the airflow and produce a loud buzzing sound. Explain this effect and investigate the parameters which affect the characteristics of this sound.

Main Problems for Science Fight 2

7. Stormglass
A stormglass is supposed to help judging the weather by observing the appearance of a sealed ampoule containing liquid and crystals of various shapes (one recipe is to dissolve potassium nitrate (2.5 g) and ammonium chloride (2.5 g) in distilled water (33 mL), dissolve camphor (10 g) in ethanol (40 mL), slightly heat and mix the two solutions together). Produce one or several stormglasses with various recipes and study their behavior in different weather conditions over sufficiently long time.

8. Shower head
A handheld shower head is hanging freely on a long hose. Turn the water on and observe the head deviating at a certain angle. What parameters does this angle depend on?

9. Flowers and ammonia
If exposed to ammonia, viola flowers wilt and discolor. How does ammonia affect colored flowers of other plant species? Investigate the chemical and biological processes occurring in this experiment.

10. Ferments
Investigate whether oxidizing ferments are present in apples, potatoes, onions and other fruits or vegetables. Which of them has the most active ferments? Analyze the effects of temperature on the action of the ferments.

11. Soot mirror
If an object is covered by soot (e.g. with a candle flame) and next submerged under water, it appears as if the object reflects light like a mirror. Explain and investigate this effect.

12. Jumps
A human can jump with straight legs, however so called squat jumps and countermovement jumps may be higher. Investigate the influence of starting postures and jumping techniques on the maximum height of the jump.

Problems *Invent Yourself* for Science Fight 3

13. Invent Yourself: Non-Newtonian fluids
There is a broad variety of fluids which do not necessarily have a constant viscosity. Suggest a problem concerning an interesting effect observed with a specific non-Newtonian fluid.

14. Invent Yourself: Proxy variables
It may be impossible to directly measure the number of attendees at a music festival or climate conditions millennia ago. However, these two variables may be determined indirectly from cellular connections or isotope composition of ice cores. Suggest a problem focused on reconstructing a variable of interest from an unusual proxy variable.

15. Invent Yourself: Genetics
Propose a problem to put a law of transmission of genetic traits to direct experimental test.

16. Invent Yourself: Boiling salt solutions
The boiling temperature of aqueous salt solutions is variable and may be higher than 100 ºC. Formulate a problem requiring theoretical and experimental studies with chemical compositions of your choice.

17. Invent Yourself: Elastic balls
Suggest a physics problem concerning an intriguing effect observed if one or several highly elastic balls collide (one against the other or with other surfaces.)

The problems are authored by Artem Barat, Nikita Chernikov, Alena Kastenka, Ilya Martchenko, and Evgeny Yunosov. Selected, prepared, and edited by Ilya Martchenko and Evgeny Yunosov. This official set of problems for the 11th IYNT 2023 is approved by General Council of the IYNT and can be used only at the events endorsed by the General Council of the IYNT.

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