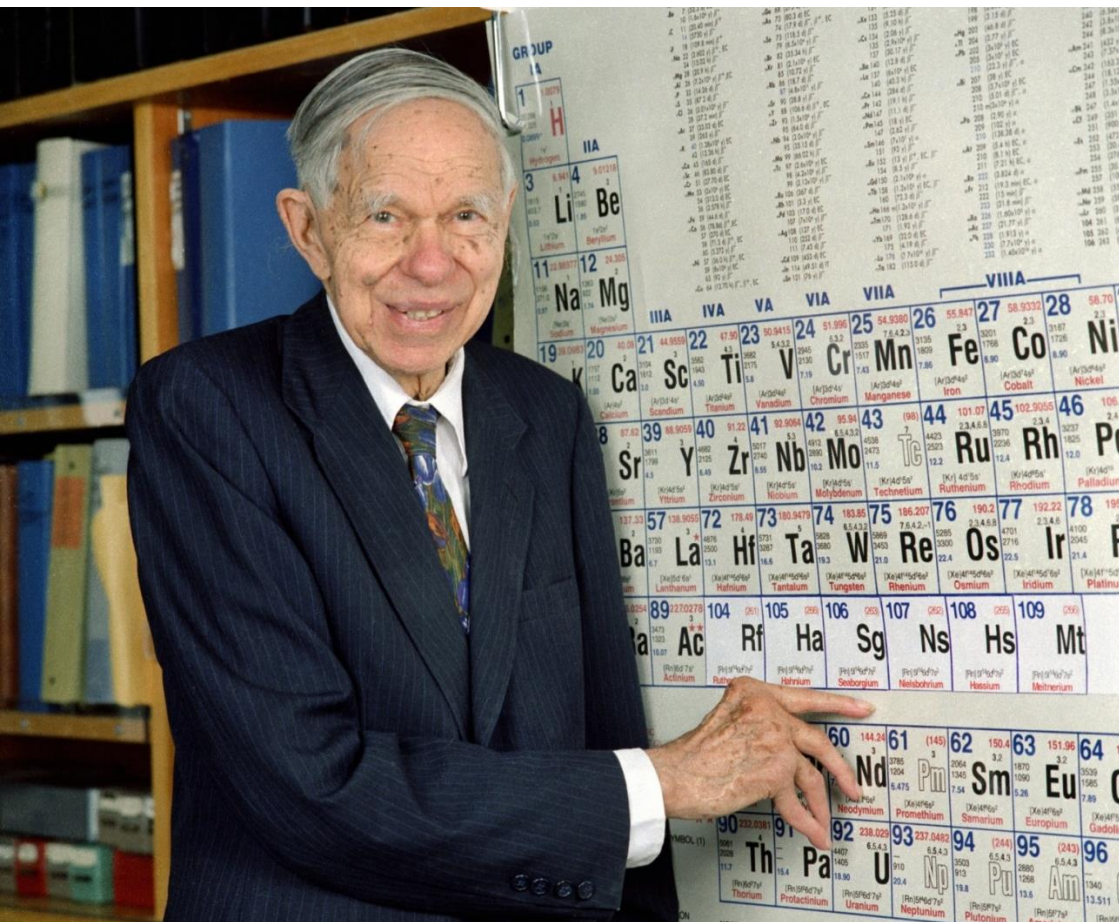


Problems of the International Chemistry Tournament 2017



**International
Chemistry
Tournament**



Problem 1. Colours of Seaborgium

Only a few seaborgium compounds are known to science. Because of its isotopes' short half-life, it is nearly impossible to study its compounds in natural state. But let us assume that seaborgium has a stable isotope. Estimate, what colour and chemical properties would its salts have.



Problem 2. Rechargeable Light Source

We all are familiar with rechargeable sources of electricity based on chemical reactions – accumulators and batteries. But is it possible to create a rechargeable source of light based on chemical reactions? Suggest such a mechanism and elaborate on its properties, including the recharging process and the limitations of the device (runtime and intensity of light).



Problem 3. All Colours of Rainbow

A character from the *Pleasantville* movie (1998, directed by Gary Ross) is known for creating black-and-white paintings during night-time. These paintings turn colorful in the morning. What kind of paint he might have used? Describe the composition and chemical properties of different paints corresponding to different colours. If possible, come up with such compounds for different colours so that they all change colour at the same rate.



Problem 4. Magnetic and Colourful Liquid

Ferrofluid is known for its distinct ability to change shape in presence of magnets and form spikes. But ferrofluid is, in most cases, pitch-black. Suggest a process of creating ferrofluid with other colours. Describe such process in detail.



Problem 5. The Skakoan

Skakoan is a fictional race in the Star Wars Universe. They are humanoid species from the planet Skako. They breathe methane and have to wear special pressure suits and gear. Describe the chemistry of skakoan breathing.



Problem 6. Solid-Phase Chemical Oscillation

Suggest a solid phase analogue for Belousov-Zhabotinsky reaction. Describe its mechanism. What is the cause of oscillations in your system?



Problem 7. Noble Chemistry

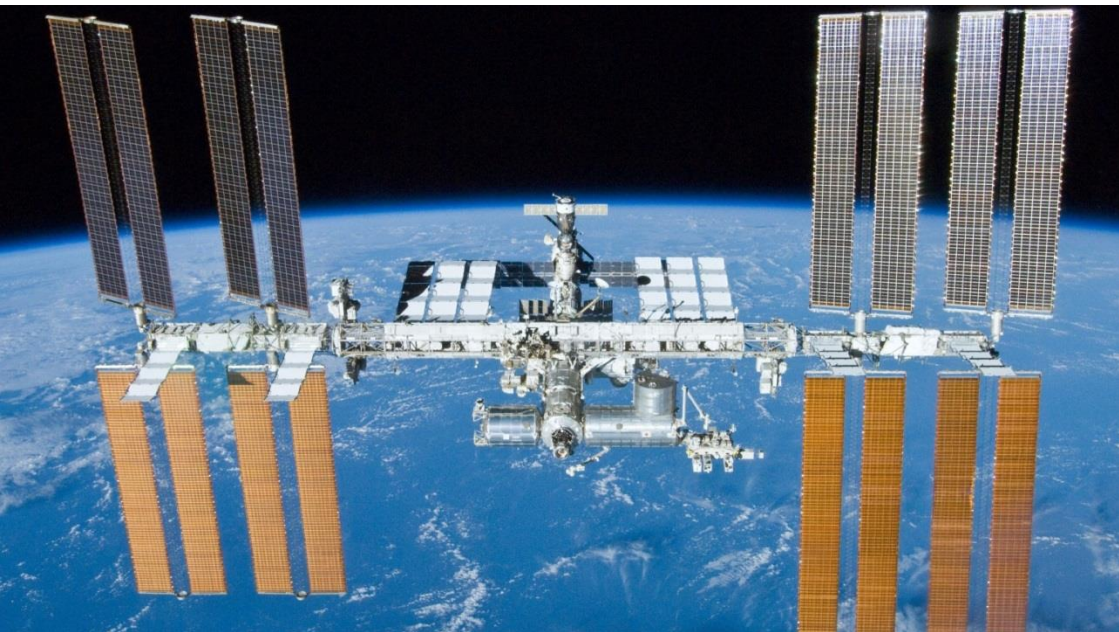
The compounds of Noble gases were first produced in 1962 by a British chemist, Neil Bartlett. Standard school chemistry course discuss this theme very briefly. Assume that you have to make a series of demonstration experiments with Noble gases. What reactions would you use to show the chemistry of this type of compounds? Provide a detailed description of such experiments. What kind of safety procedures and safety gear is necessary for those experiments?



Problem 8. Tea at 5'o Clock

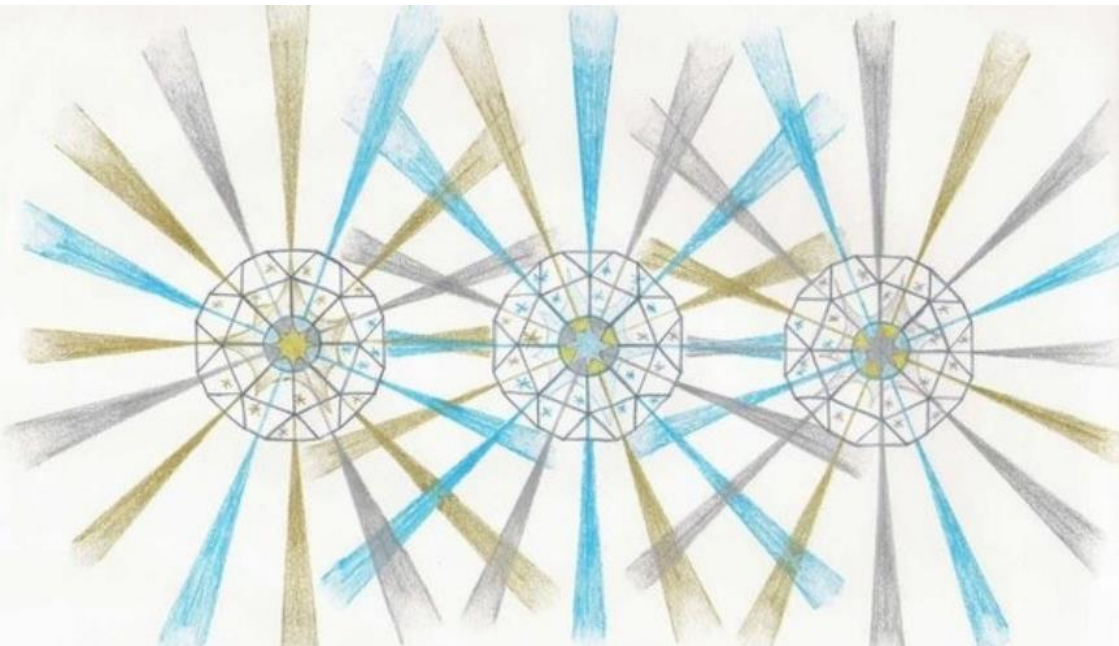
Tea is one of British scientists' favorite objects of research. They describe processes of tea brewing, proportions of milk and tea and the influence of sugar amounts on the taste of the tea. Some studies are dedicated to psychological aspects of tea consumption – why do people choose the same cup every time.

Have a taste of being British scientist. Make a research about tea brewing: how do pH and water hardness change the rate of brewing and the colour of the tea? You may choose several types of tea, from green to black and even hibiscus tea. Elaborate on results of your research.



Problem 9. Dye for Solar Cells

Currently ISS is using very expensive multi-junction solar cells to harvest energy from sunlight. Is it possible to replace them with cheaper dye-sensitized solar cells? What compounds may be used as dyes? List the criteria that such a compound has to meet. What are the main issues that make using dye-sensitized solar cells in space so difficult? Is there any way to overcome them?



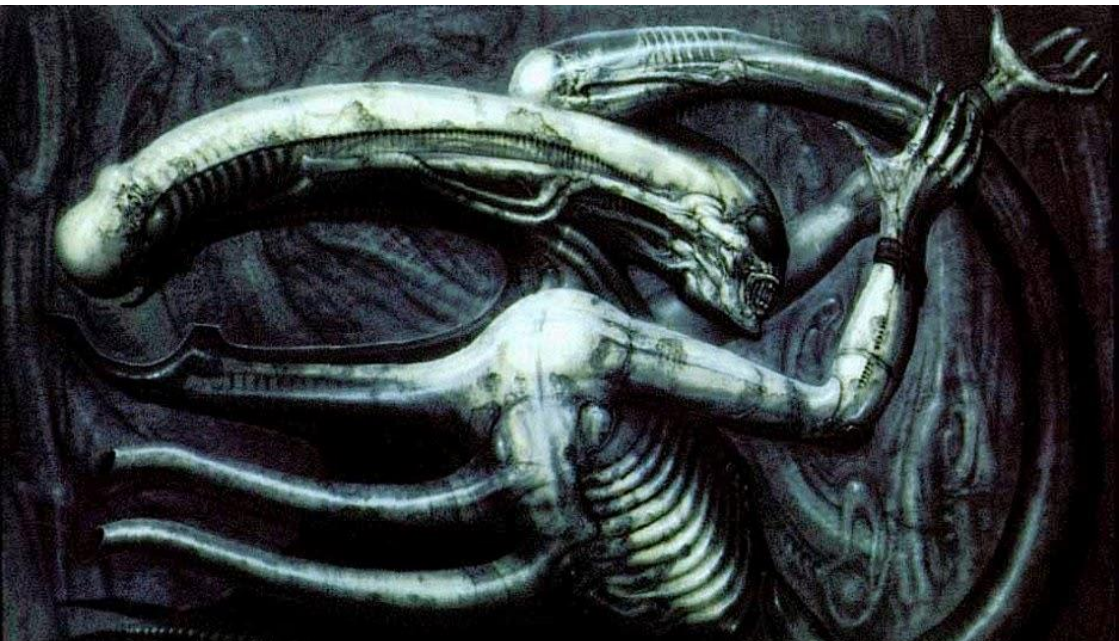
Problem 10. The Silmaril

British philologist J. R. R. Tolkien is known as the author of fantasy books about Middle-earth and its inhabitants. One of his books, *The Silmarillion*, is about creation of Middle-earth and three artefacts, Silmarils. This is how those artefacts are described:

As three great Jewels they were in form. But not until the End, when Fëanor shall return who perished ere the Sun was made, and sits now in the Halls of Awaiting and comes no more among his kin; not until the Sun passes and the Moon falls, shall it be known of what substance they were made. Like the crystal of diamonds it appeared, and yet was more strong than adamant, so that no violence could mar

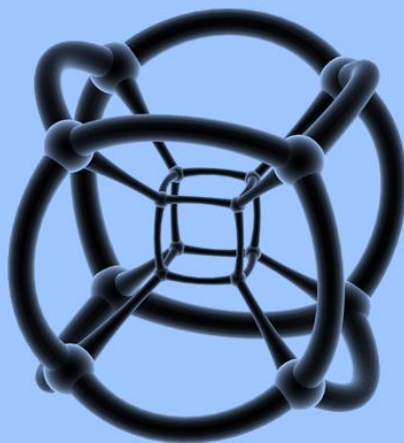
it or break it within the Kingdom of Arda. Yet that crystal was to the Silmarils but as is the body to the Children of Ilúvatar: the house of its inner fire, that is within it and yet in all parts of it, and is its life. And the inner fire of the Silmarils Fëanor made of the blended light of the Trees of Valinor, which lives in them yet, though the Trees have long withered and shine no more. Therefore even in the darkness of the deepest treasury the Silmarils of their own radiance shone like the stars of Varda; and yet, as were they indeed living things, they rejoiced in light and received it and gave it back in hues more marvellous than before.

Suggest the composition and structure of these Jewels. What is the mechanism of their glowing? What safety measures should be taken into account if one was to hold them in their hands, and which of them were neglected by Morgoth?



Problem 11. The Alien Blood

The terrifying race of alien xenomorphs was described in the *Alien* movie. Their blood is capable of dissolving biological tissues, metals, glass etc. Suggest an existing compound that can act in such way. What material could the blood vessels of a xenomorph consist of? Bear in mind that it should withstand the corrosion caused by this compound.



Problem 12. The Tesseractane

Chemists of the XX century synthesized a lot of highly symmetrical rigid hydrocarbons: prismane, adamantane, and alkanes corresponding to Platonic bodies – regular polyhedra. But regular polyhedra also exist in higher dimensions, for example, in 4D. A well known example is the hypercube, also known as tesseract. British mathematicians suggested a way of representation for such structures in 3D. In one of such projections the hypercube looks like a cube inside a cube.

Suggest an organic or organometallic molecule which may follow tesseract structure. Describe briefly the way to synthesize it and elaborate on chemical properties of such a compound.