

# HUNGARIAN SELECTION ROUND



**2023**  
**Problem Set**



[www.facebook.com/  
hunchemtourna](https://www.facebook.com/hunchemtourna)



[tinyurl.com/HUCHTO](https://tinyurl.com/HUCHTO)



[ichto.hu@gmail.com](mailto:ichto.hu@gmail.com)



## 1. Another Shade of Blue

YInMn Blue is a beautiful, vibrantly coloured material, which after its discovery in 2009 was dubbed to be "the first new blue pigment in two centuries". Blue-coloured molecules are relatively rare in nature. Only a handful of different compounds are well-known to be blue, such as indigo or azulene.

Your task is to design a novel compound and prove that it is expected to be blue in its macrocrystalline form. Alternatively, find an already synthesised compound which has an unknown colour and prove that it is blue using computational methods.

Solutions that originate from describing non-colour enhancing modifications of well-described compounds or ones without theoretical considerations are not accepted.



## 2. Sweet Poison

There existed a wide-held tradition in the Ancient Roman Empire of keeping wine in lead containers. The reason for it was that people observed that upon longer periods of storage, the drink became noticeably sweeter. This effect was due to the formation of lead(II)-acetate, which is now known to be highly toxic. As sweeteners in antiquities were considered to be items of luxury, it's no wonder that the effectively costless lead sugar gained such popularity.

People often look back on the past, wondering what could have been done differently. It is an intriguing question (from the point of view of a chemist), what other artificial sweetener that lacks the toxicity, could have been produced back then?

Your task is to present such an artificial sweetener which is producible using materials available to ancient Romans.

When trying to find your solution, the one historical aspect that you should not be limited by, is the chemistry knowledge: one is permitted to use all the modern synthetic chemistry knowledge one wields.



### 3. Whippit

Nitrous oxide ( $\text{N}_2\text{O}$ ) is a gas that has a variety of uses in rocketry, medicine and the food industry. In addition to these applications, it is also used as a recreational drug as it can produce a brief high when inhaled. Users can obtain it quite easily, as it comes in small steel canisters sold as whipped cream chargers. The canister contains pure  $\text{N}_2\text{O}$  at high pressure which is potentially dangerous to users for several reasons. High concentrations of the gas can induce neurological damage, and the gas inhaled directly from the canister causes frostbite.

Suggest an additive or a mixture thereof that can be mixed into the canisters and potentially deter users from illicit use. The canister must stay suitable for making whipped cream therefore the additive cannot affect the texture or taste of the cream.



## 4. Three Wishes

The tale of Aladdin is beloved by people all around the world and is centred around a magic lamp that has the power to grant people their dearest wishes. The protagonist finds this lamp in a cave full of traps, and upon rubbing the lamp, a genie magically appears to help him out.

While such creatures of fairy tales are unknown in real life, it is certainly an interesting question to think about how such a lamp may function.

The task is to propose a device which is similar in size and shape to the magic lamp from the story, and which, upon rubbing its side is capable of generating spectacular effects akin to summoning a genie using a chemical reaction. The lamp must be able to produce these effects at least three times.



## 5. Deodorized Durian

Durian is a tasty fruit native to Southeast Asia and is featured in many traditional dishes of the area. Despite its wonderful taste, Durian's smell is quite repelling, limiting its commercialisation around the world. There have been multiple bioengineering approaches to remove this inconvenience with more or less success. However, due to their gene-modified nature, these are not available in most European countries. To make it commercially viable in Europe a different approach to removing the foul smell is necessary.

Identify the culprit behind Durian's odour, and suggest an additive to cancel or mask it, without significantly affecting the fruit's taste or health effects.