



# International Chemistry Tournament Hungary 2022

- Problem set -



## 1) Make Mandalore Great Again

During the times of the Mandalorian Wars, the beskar mines of the Mandalorian people were full, and due to the ore's abundance, they were able to produce pure beskar armour for whole armies. This metal alloy is the hardest one in the galaxy with the unique property of withstanding blaster bolts and lightsaber strikes. This technology enabled them to conquer most of the known universe. Sadly, the ore is overmined by now, resulting in the Mandalorians having weaker armour, and no longer being able to fight Jedi one on one. Propose a way of creating protective clothing that is extremely hard and resistant to the brutal heat of plasma, so the Mandalorians can once again conquer the galaxy. Also, elaborate on what structural properties cause your material to be heat resistant.



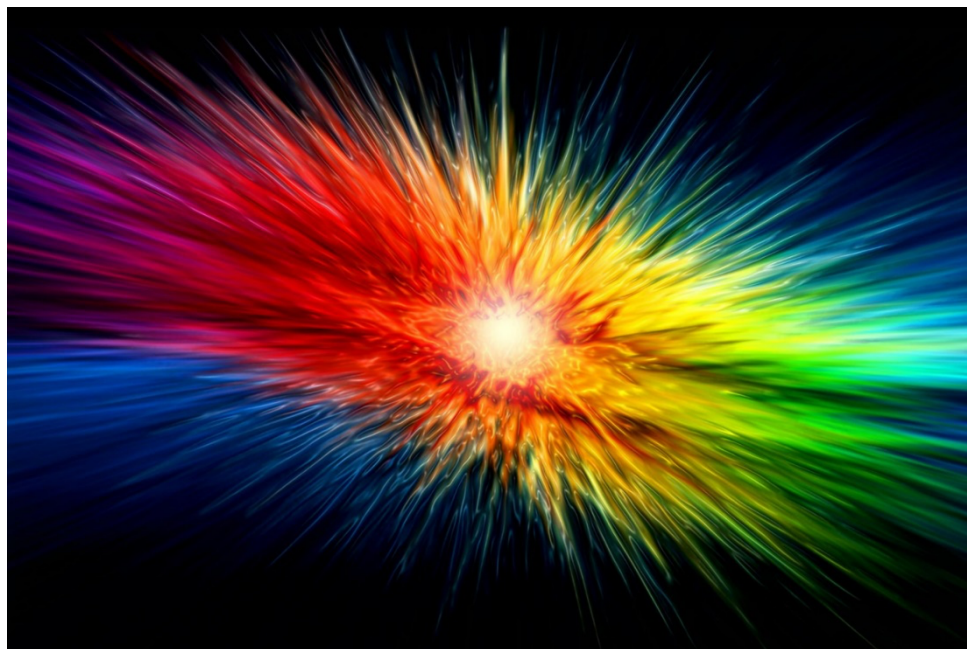
## 2) Blue makes me blue

Cyanotyping is one of the oldest photography techniques that was first developed in 1842. Its chemistry is relatively simple, the image arises as photoreduced Fe(II) ions create a blue precipitation with  $\text{Fe}(\text{CN})_6^{3-}$ , which will be trapped between the fibres of the paper. These images can have stunning levels of resolution and possess a mesmerizing deep blue colour. However, if you don't like blue, it is possible to recolour the images in a process called toning. Your task is to propose some cyanotype toning processes that can create as many significantly different coloured photographs as possible and results in a final image that does not contain organic material apart from the paper.



### 3) Fail-safe chemicals

It is well known that mixing cleaning products is highly dangerous. Based on the starting compounds chlorine gas, chloroform, hydrochloric acid, chloramines, organic peroxides or even peracetic acid may form. Even though professional cleaners are trained to be aware of the dangers, every year many people die or suffer life-changing injuries due to the mismanagement of chemicals. Devise a system where every major cleaning product is spiked with a substance that produces a visible colour change or other warning signals of your choice when mixed with an incompatible cleaning agent. This safety mechanism must stay intact for at least the shelf life of the product.



#### 4) Cool explosion

Although each and every explosion is cool in one sense, as everyone enjoys the sound, the shockwave and the visual effects (unless they happen to be the safety officer of the lab), those things are usually associated with high temperature and evolution of heat. But how can the visitors of the imaginary planet Arodnap, where the temperature is around 60K and does not fluctuate too much between day and night, be able to observe natural chemical explosions? Come up with a plausible mechanism that generates the effects mentioned above without a significant temperature rise. At what pressure would this reaction undergo?



### **5) Break the mould**

The term mould refers to a wide range of fungal species which are often associated with spoiled food. The damage done by them to agriculture and the food industry is immense, as these fungi are capable of producing a wide range of toxins, collectively referred to as mycotoxins. These toxins can cause harm by damaging the liver, the nervous system and some are even carcinogenic. Therefore, the neutralisation of mycotoxins is an important public health issue. Propose a chemical treatment on a food item of your choice which could be used to eradicate toxic compounds generated by a mould of the genus *Aspergillus*. After the treatment, the food must be suitable for consumption, with no significant change to its taste.