



HUNGARIAN SELECTION ROUND



2025
Problem Set



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



tinyurl.com/HUCHTO



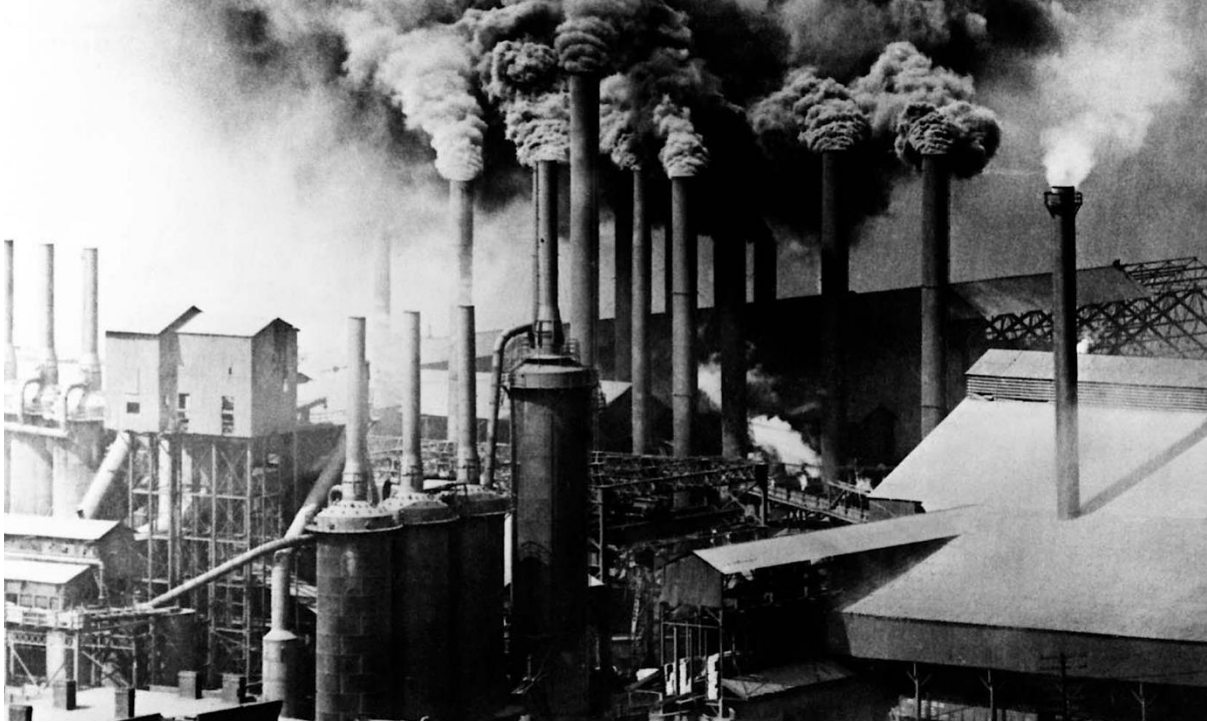
[https://kemiaitorna.
mke.org.hu](https://kemiaitorna.mke.org.hu)



Problem 1 - Greyscale

pH indicators such as bromothymol blue, are defined as halochromic compounds that rapidly change colour in response to pH change of their environment. However one can easily imagine the possibility of an indicator that produces a signal different than colour change.

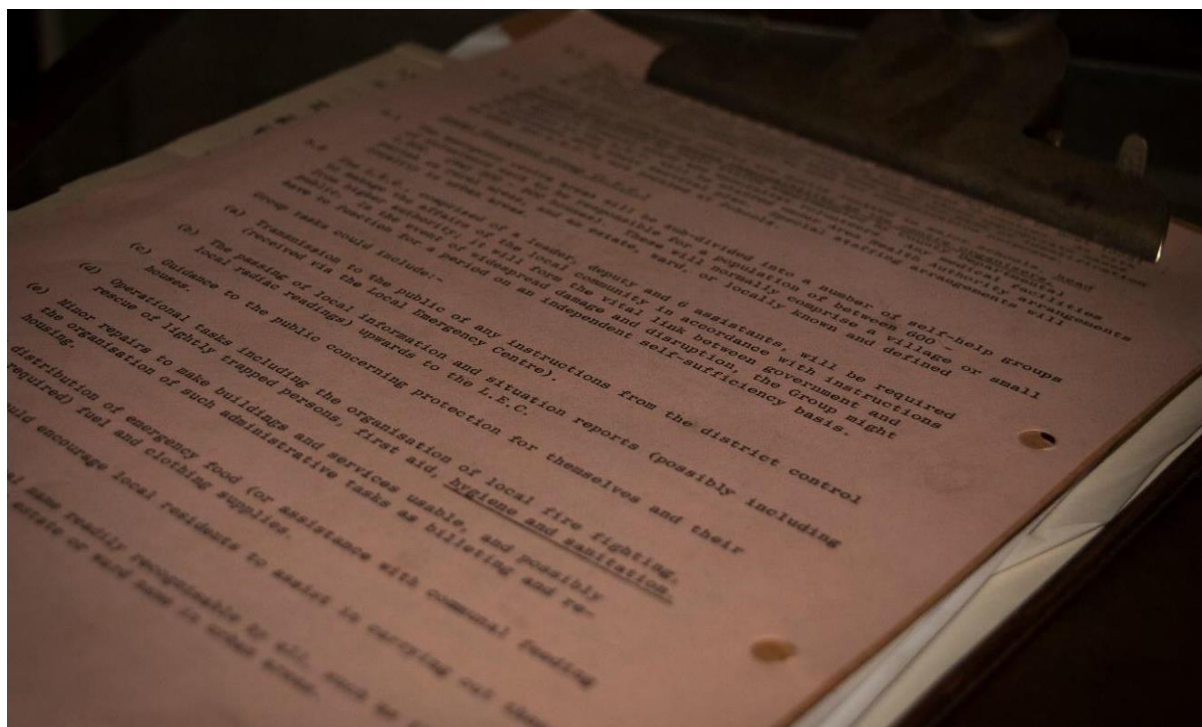
Your task is to design an indicator like this. In your solution please explain the proposed pH range it might work, as well as the sensitivity of your design. Please refrain from utilizing electronic devices such as a pH-meter - your solution should work like traditional indicators.



Problem 2 - Dusty Industry

The first industrial revolution markedly increased the demand for fossil fuels in Europe. The subsequent emergence of great factories gave rise to an unprecedented level of air pollution in industrial centres, affecting both nature and human lives. Exhaust gas emitted by such plants contains, among other things, carbon dioxide, water vapour, nitrogen oxides, sulfur dioxide, hydrogen sulfide, and a wide array of hydrocarbons. Modern factories are bound by regulations to build specialised ventilation and filtration systems for flue gas management, but initially this was not the case.

One might wonder how such pollution could have been avoided during the Industrial Revolution. Your task is to propose a method (or set of methods) to treat dangerous gases, aerosols, and solid debris found in the flue gas of early factories, in order to prevent emission of harmful compounds into the atmosphere. Your solution can only utilise materials, technology and infrastructure available by the end of the 19th century, however, you may make use of any currently available knowledge. Your method must be feasible, considering materialistic and human resources, time demand, and quantity of gas to be cleansed.



Problem 3 - Codebreaker

Hidden messages that need to be revealed are commonly featured in spy stories and historical fiction. Usually, there is some trick that the intended recipient of the document knows, which allows them to make the message visible. In the satirical novel 'Life for sale' by Japanese author Yukio Mishima, one chapter describes a peculiar way to send hidden messages. A diplomat deciphers the secret message sent to him by chewing on some carrots and smearing it on a piece of paper. It is suggested that some compounds in the saliva interact with the carrot to produce the effects.

Your task is to propose a similar two-component system that can be used to reveal hidden messages. Similarly to the story, one component has to be food-based, and the other has to be some kind of bodily fluid, but not necessarily saliva. Individually neither of the components should be able to work, only when mixed together do they make the invisible ink visible again. What would your ink be made out of? Is the material of the paper also important for the process? How specific would your solution be for your choice of food and bodily fluid?



Problem 4

A (not so) Sweet Business

Honey is humanity's oldest sweetener, with its first written records of beekeeping dating back to ancient Egypt. It has maintained undiminished popularity ever since. Even today, in the era of artificial sweeteners, who could say no to having a golden drop of summer in their tea or spread on toast? And although the industry has changed tremendously in the past 5,000 years, beekeeping has essentially remained the same, as it cannot be automated. So, producing honey remains a labour-intensive process, and that is reflected in its price. It is much more expensive than sugar, and thus sadly, it is a common practice to adulterate honey by diluting it with cheap sugary syrups and selling it at the original price. Unfortunately, unveiling such fraud is notoriously difficult.

Your task is to propose a method or kit that can be used safely and easily to detect adulterated honey, thus making it suitable for use by non-professionals. The solution should consider the range of adulterants that is possible to detect, the sensitivity and specificity of the method, as well as the material costs associated with testing.



Problem 5 - Sunflower

Perhaps the most well-known attribute of sunflowers is their tendency to face the Sun, turning their heads together as the day passes. One might wonder how to emulate this phenomenon in a more simple system. Propose a device that relies on chemical reactions to follow the position of the Sun in the sky. The device, or certain parts of it must be able to make a turning motion, and the whole system should be able to work without the use of electricity. How quickly would your device be able to respond? How often would you need to restock it with fresh materials? How sensitive would it be to light or moderate cloud coverage?