

50th International Chemistry Olympiad

A Bronze Medal for Switzerland

Prague, Czech Republic and Bratislava, Slovakia

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The 50th International Chemistry Olympiad (IChO) took place from July 19th to July 29th, 2018 in Prague, Czech Republic and Bratislava, Slovakia. This double location was chosen in memory of the first IChO, which was organized in 1968 in Prague, then Czechoslovakia. Later on this country was split into two independent nations, Slovakia and the Czech Republic, which is why the 50th jubilee 2018 was split between their capital cities. After a common start with the opening ceremony in Bratislava, the students took their exams in Bratislava while the mentors stayed in Prague before being reunited for the closing ceremony in the Czech capital city.

In 2018, 300 students from 76 nations took part in the competition, which was very challenging. The Swiss delegation had the following members:

- Chantal Balmer, Kantonsschule Solothurn
- Fabian Hollinger, Kantonsschule Alpenquai, Luzern
- Lennart Horn, Kantonsschule Solothurn
- Carole Zermatten, Lycée-Collège des Creusets, Sion.

These candidates were accompanied by two active mentors, Karin Birbaum and Patrik Willi, and two retired teachers as observers, Maurice Cosandey and Jochen Müller, who came in recognition of their activity for Switzerland since its first participation in 1987 (Fig. 1).

The theoretical exam lasted 5 hours, with 8 problems counting 56 pages in total. The practical exam had 3 problems lasting also 5 hours. At the end of the competition, a final ranking was made.



Fig. 1. The Swiss team at the 50th IChO. First row, from left to right: Fabian Hollinger, Carole Zermatten, Chantal Balmer, Lennart Horn. Behind, from left to right: Patrik Willi, Jochen Müller, Karin Birbaum, Maurice Cosandey.

Roughly, the top ten percent of the students got a gold medal. The next twenty percent got silver medals, and the next thirty percent got bronze medals. Switzerland was happy to get a bronze medal, thanks to Lennart Horn, from the Kantonsschule Solothurn. The overall winner was Qingyu Chen, from China.

Apart from the competition itself, the students had a lot of opportunities for socializing with other delegations, as a rich program of activities was organized for them before and after the competitions. During those activities, they could visit old mines, had sporting events or took part in guided city tours in Bratislava and Prague.

Because of their length, the theoretical problems will not be described here. Only the practical problems will be shortly presented. All problems are to be published on the organizers' website after the end of the competition.

Before ending, we will express our gratitude towards the financial partners of the Swiss Delegation, without whom this participation would never have been possible, and specially to the Metrohm Stiftung, the Ernst Göhner Stiftung, the Fondation Claude et Giuliana, and the Swiss Industry Science Fund (SISF).

Practical Problem 1. Organic Synthesis

0.500 g 2-acetonaphthone in EtOH is treated by a small amount of bleach (NaClO). Thereby, about half of it is oxidized into 2-naphtoate, which is extracted as 2-naphtoic acid after neutralization and filtration. The remaining organic solution, containing the rest of 2-acetonaphthone, is reacted with 2,4-dinitrophenylhydrazine (DNPH) to the hydrazone in acidic solution, filtered and dried. Both derivatives are weighed and analyzed by TLC. The yields and melting points determine the points. See Fig. 2.

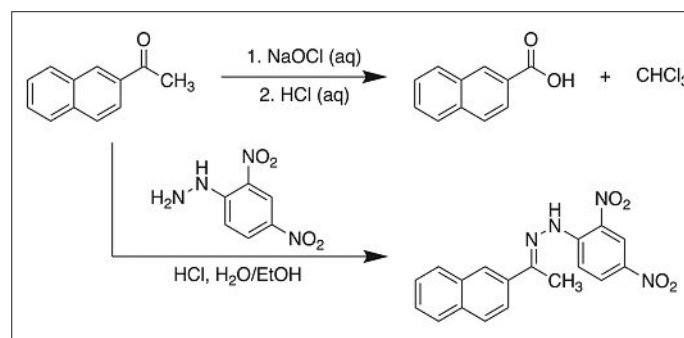


Fig. 2. Practical problem 1.

Practical Problem 2. Kinetics of the Cysteine Oxidation by H₂O₂

Cysteine and its copper complex are slowly oxidized by H₂O₂. The kinetics of this reaction with the copper complex can be indirectly observed, because it liberates free Cu²⁺ ions, which can then catalyze the photoluminescence of luminol. So, if cysteine, Cu²⁺ ions, luminol and H₂O₂ are mixed at t = 0, a blue flash due to the luminol oxidation will suddenly appear once all the cysteine has been consumed.

The student had to prepare two solutions with [Cu²⁺] = 2 mM and [Cys] = 3.3 mM, but with [H₂O₂] changing from 14 mM to 8 mM. At 25 °C, the flash is seen after 86 s and 126 s respectively.

Comparing these two values, the order of the reaction with respect to H_2O_2 can be calculated, which should be 0.42.

Practical Problem 3. Analysis of a Mineral Water by Resins and EDTA

A sample of 5 mL cation exchange resin in water is treated by 50 mL mineral water. The total amount of the acid so released is back-titrated by NaOH, and found to be 1.76 mmol H^+ . So

the concentration of positive ions in the water corresponds to 35.2 mM. Then the total content of Ca + Mg ions in the mineral water is determined by EDTA, and found to be 15 mM. So the final composition of the water should be found as such: $[\text{M}^+] = 15 \text{ mM}$, $[\text{M}^{2+}] = 5.2 \text{ mM}$.

Of course, the ion exchange capacity of the resin should have been determined by a preliminary experiment using an excess of NaCl, and by titrating the released H^+ so obtained.

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