

CATALYZER

NO.12

ICHO2022

2022/09/18



Beginning of Summer

It is the seventh of the twenty-four solar terms

Beginning of Summer (simplified: 立夏), pronounced as *Lì Xià*, falls on May 5, 6 or 7 each year.

This is an important solar term which marks the coming of the peak growth season of diverse things. After the Beginning of Summer, the sunshine increases, the weather gradually warms up, and the thunderstorms become more frequent--enabling the crops to thrive. In this solar term, frogs croak the arrival of summer, earthworms are busy helping farmers to loosen the soil, and the wild vegetables in the land of the countryside, as if competing against each other, get out of the earth and grow rapidly day and night.

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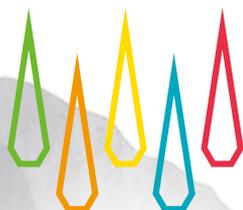
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Academy of Science,
President of Chinese Chemical Society



CHEN Jun

Academician of Chinese
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IChO



54th IChO 2022
International Chemistry Olympiad

TIANJIN, CHINA

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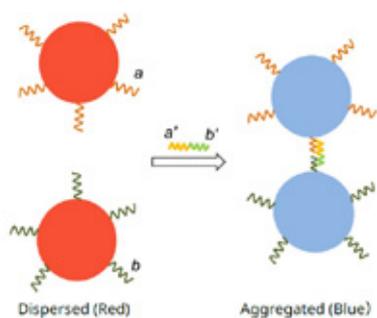
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Analysis of Theoretical Problems

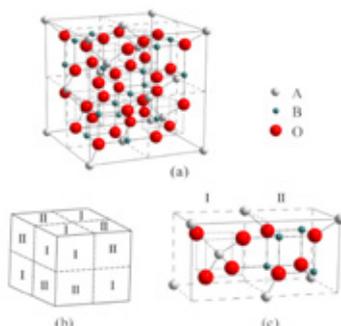
Q1. Rapid and Visual Nucleic Acid Testing for COVID-19

COVID-19 pandemic has spread around the world over the past three years, causing more than 0.5 billion infections and 6 million deaths.



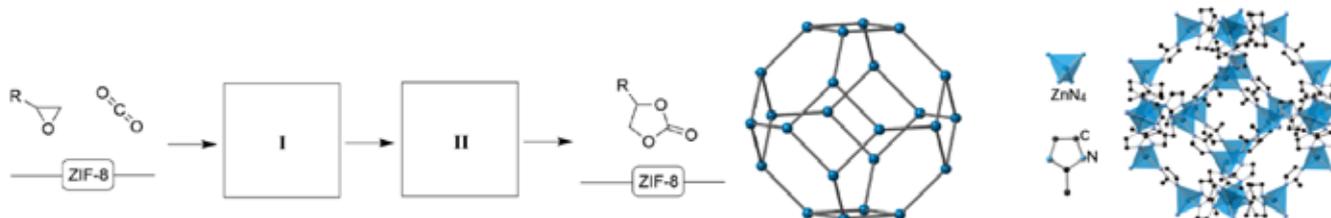
Problem 1 proposes a testing technique for nucleic acid detection based on gold nanoparticles. In the presence of target nucleic acids collected from the infected individuals, the probe DNA-modified gold nanoparticles will aggregate to cause a color change from red to blue, allowing qualitative and quantitative detection of COVID-19 nucleic acids. This problem involves the relationship between color and absorption wavelength, Lambert-Beer law, and the standard addition method in analytical chemistry.

Q2. Chromium in Ancient and Modern Times



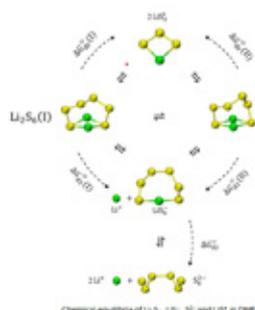
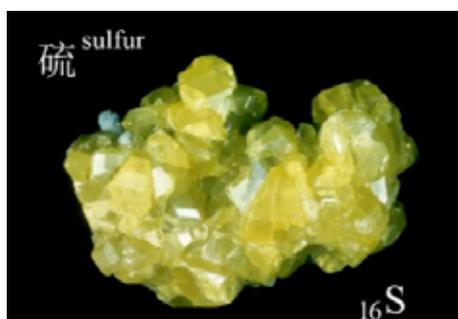
Problem 2 is about the chemistry of Chromium. 1000 years ago, the smart Chinese people made use of chromium ingredients for black glaze to produce beautiful porcelains. In modern times, chromium-based materials have been used as pigments and catalysts. This problem deals with the variation of the oxidation states of chromium in reactions and catalysis, along with the change of colors and coordination modes. Fundamental knowledge about structural chemistry and crystal field theory are essential to solve this problem.

Q3. Capture and Transformation of Carbon Dioxide



Climate change is one of the most critical global challenges nowadays. At the 75th session of the United Nations General Assembly, China proposed to achieve carbon peaking before 2030 and carbon neutrality before 2060. In Problem 3, the basic principles on the capture and transformation of CO₂ has been tested, and the fundamental knowledge about zeolitic imidazolate frameworks and their application is introduced.

Q4. A New Journey for Ancient Sulfur



Sulfur has been known and used since the ancient times.

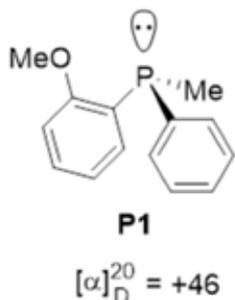
Problem 4 starts from the preparation of elemental sulfur and examines the back-titration method for quantitative analysis of SO₂. By calculating the operating time of an ideal lithium-sulfur battery, the prospect of the battery is demonstrated.

Q5. Interconversion among Nitrogen Oxides

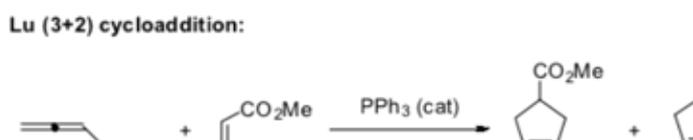


Problem 5 is about the interconversion among nitrogen oxides. The chemistry of the NO_x released from anthropogenic sources contributes greatly to the formation of smog. The thermodynamics and kinetics of the interconversion among NO_x in problem 5 is very important to the understanding of the formation and alleviation of these severe environmental problems.

Q6. Enabling Phosphines

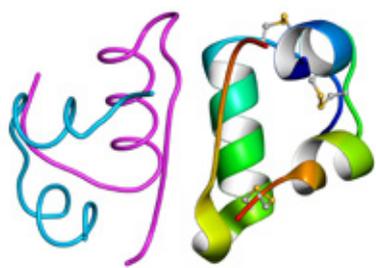


Problem 6 shows you a different side of the tertiary phosphines in catalysis. In the past two decades, phosphines have exhibited robust catalytic activities as nucleophilic catalysts.



By choosing the Lu (3+2) cycloaddition reaction as a typical example, you have seen how a phosphine catalyst works, how an asymmetric reaction can be realized, and how useful a phosphine-catalyzed reaction is in the synthesis of natural products.

Q7. Organic Molecules in Life



Structure of bovine insulin

Problem 7 deals with the synthesis and modification of proteins. The synthesis of proteins provides a unique perspective for exploring the secrets of life.



Stamp issued on the 50th anniversary (2015) of the first synthesis of crystalline bovine insulin. On September 17, 1965, Chinese scientists synthesized crystalline bovine insulin artificially for the first time, marking a landmark step in protein synthesis.

Q8. Amazing Chiral Spiro Catalyst

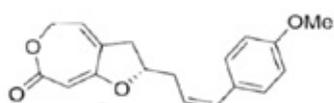


Problem 8 describes chiral ligand induced enantioselective synthesis. Chiral compounds are important for human health. Professor Zhou Qilin at Nankai University developed a series of chiral spiro catalysts with high activity which have been widely used in pharmaceutical industry. These catalysts yield up to 99.9% ee and 4.5 million turn over number, raising the efficiency of asymmetric synthesis to a new height.

Q9. Total Synthesis of Capitulactone



Curculigo capitulata



Capitulactone (1)

Problem 9 describes the total synthesis of Capitulactone which can be isolated from a plant called *Curculigo Capitulate*, a Chinese medicinal herb.

COLUMNS OF CATALYZER AND EDITORS' WORDS



Eight Cuisines and Tianjin Cuisine



China has a distinctive diet system -- diverse cooking techniques and food processing methods, which not only contains the accumulated experience of the Chinese people but also reflects their pursuit of life quality.

However, how to present the delicacy and complexity of the dishes with words and pictures requires careful consideration. In learning about the dishes, I gradually realized the wisdom hidden in the food. In the famous dishes, it can even be said that each cut has its meaning, either to add color or flavor. Countless attempts and improvements have formed the unique Chinese food culture.

Chen Yanjin, a 2020 undergraduate, is the editor of the column of Twelve Zodiac Signs, Eight Cuisines, and Tianjin Cuisine.

CHEN Yanjin

Editor's words: I have been interested in food since I was a child. When I was assigned to edit this column, I realized my experience in eating and drinking for more than ten years finally could help. I am from Sichuan and Chongqing regions. Although foods in these places are spicy, they are also salty and fresh. This makes me interested in all kinds of food. Whether it is the fried crispy and fragrant snacks encountered in the alley or the golden and oily dishes on the table, I will never forget them. I gained a lot and learned many cooking techniques in the whole process. I may have a try in my spare time. I hope that this column in Catalyzer can impress friends from other countries with the charm of Chinese cuisine.

Twelve Chinese Zodiac Signs



Ideas about the origin of the Zodiac differ in folktales and books. In order to avoid controversy, we chose to directly display them through lines of Chinese ink-and-wash painting to bring readers intuitive visual feelings. Zodiac, as an important part of Chinese culture, not only functioned as a measurement of years in ancient times, but also displayed hope of human to live a better life throughout Chinese history with the quality it presented and the underlying meaning.

Introduction of Belt and Road and City Clusters of China

Many foreigners may only know about a few cities in China, such as Beijing and Shanghai. This column introduced several cities and city clusters in China to international friends based on the well-known 'Belt and Road' initiative. In addition to these cities which have profound historical ties with Belt and Road, to show China's rapid development in recent decades, we chose four city clusters across the country to deepen their understanding of China's urban development. Great effort has been made in compiling this column. To ensure the



FU Yingjie

preciseness of the content, we selected the data and statements released by the government as much as possible and finalized it after repeated revisions. As long as the spirit of cultural exchange and mutual development represented by the 'Belt and Road' can be conveyed, the hard work is not in vain.

The editor of the two parts—Twenty-four Solar Terms and the Belt and Road and City Clusters of China--is Fu Yingjie, a 2020 undergraduate from the College of Chemistry, Nankai University.

Editor's words: I am honored to participate in the compilation of Catalyzer. It took me three full months from the initial preparation to the submission of the final issue. At last, I feel very fulfilled when I see the finished product of the publication. I also hope readers can learn more about China.

The Twenty-four Solar Terms



My initial impression of the solar terms was merely from the songs of the 24 solar terms to be memorized in the primary school textbooks. I know nothing more than what the 24 solar terms are and their order--let alone the origin of the names of these solar terms or the stories behind them. To introduce Chinese traditional solar terms to international friends, I gathered a lot of information. In obtaining the knowledge that is not readily accessible in my daily life, I felt the broadness and profundity of Chinese culture. I believe that even the Chinese students will benefit a lot from it.

Evolution of Chinese Characters



JIANG Yaru

One of the aims of Catalyzer is to strengthen cultural self-confidence and advocate the traditional culture. Chinese characters, as treasure of Chinese culture, are appreciated by people around the world and known for a memorable history of their evolution. This column enables friends around the world can understand the evolution of those beautiful Chinese characters and appreciate the attractive forms of the inscriptions on bones or tortoise shells, bronze script, big seal script, small seal script, cursive script, regular script and semi-cursive script. In addition, the writing forms of more than 100 characters in the periodic table of elements in Chinese version also have close correlation and laws among one another. To illustrate these, we use pictures and texts in an ingenious way so that people in different countries can learn more about these characters.

Jiang Yaru, a 2018 undergraduate majoring in applied chemistry at Nankai University, is responsible for editing the Tribute to the 27th IChO and Evolution of Chinese Characters.

Editor's words: I was very lucky and honored to witness significant events including the 100th anniversary of the establishment of both Nankai University and its chemistry discipline, and the 54th IChO organized by it. I feel a great sense of accomplishment after leaving my own footprints and making modest contributions to these significant events, and I wish the Chemical College of Nankai University will remain vigorous and create greater glories!

Tribute to the 27th IChO



54th IChO 2022
International Chemistry Olympiad
TIANJIN, CHINA

In 1995, the 27th IChO hosted by Peking University was a great success. After 27 years, the 54th IChO was once again held on China's mainland, this time organized by Nankai University, Tianjin. The publicity group interviewed some people involved in the 27th IChO, listened to their stories with IChO, and reviewed that unforgettable event. Academician Wang Kui shared his message to IChO, encouraging participants to scale new heights; Duan Lianyun and Wang Yingxia from Peking University, organizers of the 27th IChO, shared the splendid moments of the grand event in 1995 and interpreted the Chemical Olympiad spirit; Jiao Yuchen, the participant in the Chinese team in 1995, and Edina Roata, the participant of Hungary, also shared their experience and personal feelings. Interviews with organizers and participants of the IChO in 1995 evoked our memory and emotional resonance of the IChO held for the first time in Beijing, China. Both the emblem design of IChO 2022 and interview embody the link between this event and the 27th IChO.

Featured Activities



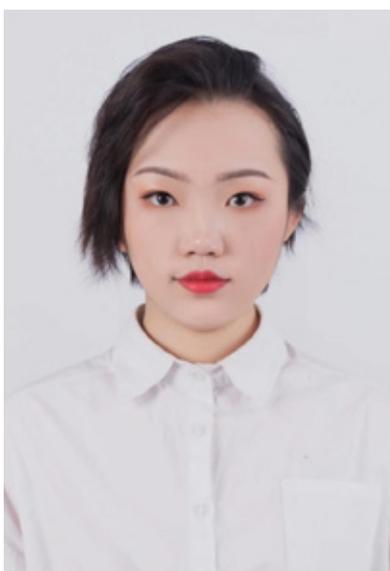
JIANG Ziyi

Each issue highlights the features of the activities to arouse considerable interest in Nankai University, Tianjin, and China, so that the participants will feel the charm of China in the new era in an authentic, three-dimensional and comprehensive manner. Besides, the column aims to encourage the young to pursue scientific value and spirit relentlessly, sparking the fire of starting a new chapter in advancing technology for social good and promoting innovation and creation.

The editor of the column is Jiang Ziyi, a 2020 undergraduate majoring in applied chemistry in the College of Chemistry, Nankai University.

Editor's words: I'm so honored to be a volunteer for the publicity group of IChO2022. During the event, I participated in all the featured activities online with other students, experiencing traditional culture, specialties, and modern innovations of China. They help convey the idea of 'Change Creation Fusion', the IChO2022 slogan. I do hope that students can learn more about Nankai University, Tianjin, and China through these interesting activities.

Theoretical problems



LI Mingrui

The theoretical problems selection of the 'Preparatory Problems & Original Problems Expansion' column is knowledge expansion, which aims at explaining thoroughly the technology and medicine with Chinese characteristics or Chinese tradition in the background of the problem. As an ancient civilization in the world, what China can show here is only the tip of the iceberg of Chinese culture lasting for 5,000 years, but hopefully you can become interested in it, and welcome to come to China to experience and explore the mysteries of Chinese culture for this two columns.

The editor of the Scientists and Knowledge Problem column is Li Mingrui, a 2020 undergraduate majoring in chemical biology in the College of Chemistry, Nankai University.

Editor's words: I am honored to participate in IChO in this way. I would like to thank the teachers and classmates who have worked side by side with me and helped me over the past three months. I wish the participants can make achievements in the field of chemistry in the future, and promote the sustainable development of human society! In the Daily Quiz column, our selection of topics is mainly based on some fun knowledge. In addition to the tension of the competition, the participants can relax and keep in good state through fun questions.

Distinguished Scientists

The 'Distinguished Scientists' column mainly introduces the eight chemists who have made outstanding contributions in the history of modern chemistry and the chemical industry in China. Among them, Fan Xudong, Hou Debang, and Yang Shixian are pioneers and founders of the chemistry and chemical industry in China from scratch. Xu Guangxian et al., the other five chemists, are winners of the State Preeminent Science and Technology Award of China. One of them, Tu Youyou, won the Nobel Prize in Physiology or Medicine in 2015. By advocating the spirit of scientists in the new era, this column is designed to encourage and guide young students to explore constantly, pursue the truth and scale new heights.

COLUMNS OF CATALYZER AND EDITORS' WORDS



Popular Science Column and Angewandte chemie Lecture Series



LI Yawen

Catalyzer specially opened up two popular science columns. 'Energy Storage and Conversion' Column introduced the development and achievements of China's energy storage and conversion in the past decade, which enabled the readers to have a deeper understanding of the frontier development in the field of new energy and encouraged more young people who love chemistry to contribute to the solution of energy problems; 'Organic Asymmetric Synthesis' Column introduced the meaning of chiral molecules that exist widely in living organisms and the research results of ultra-efficient chiral spirocyclic catalysts in asymmetric catalytic reactions, stimulating the students' interest in exploring chiral catalysts.

During the international competitions, the IChO2022 Organizing Committee, Angewandte Chemie Editorial Department and College of Chemistry Nankai University jointly held four online lecture series, inviting experts and scholars who participated in previous IChO to exchange ideas and share insights. Eva Pluhařová, a young researcher from J. Heyrovsk Ā Institute of Physics and Chemistry, Academy of Sciences of Czech Republic, Cafer T. Yavuz, professor of chemistry from Department of Physical Science and Engineering at King Abdullah University of Science and Technology, Saudi Arabia, Emily Tsui, assistant professor from Department of Chemistry and Biochemistry at Notre Dame University, and Cao Xiaoyu, professor of the College of Chemistry at Xiamen University, China, were invited to share their IChO experience and its impact on their academic development for middle school students and the public. They also talked about their own experience and academic research results, and introduced their respective research fields and achievements. The wonderful academic reports impressed every participant.

The editor of this column is Li Yawen, a 2020 undergraduate studying in the College of Chemistry of Nankai University.

Editor's words: I am proud to be a volunteer in the publicity group of IChO2022 which allowed me to meet many excellent teachers and students. Through one lecture after another, I gained a deep understanding of the meaning of Change, Creation, Fusion. I hope that these activities can attract more people to fall in love with Tianjin, chemistry and China.

COLUMNS OF CATALYZER AND EDITORS' WORDS



Photographer



I feel very honoured to show the world my photos through Catalyzer! As a 2021 graduate student in the College of Chemistry as well as a young journalist having achieved some renown in the Publicity Department of Nankai University, I joined this long-awaited “dreamt interaction” to help promote an international event organized by the College of Chemistry. Whether it was the very first promotional trip to the Science and Technology Museum with Kem, our mascot, or the subsequent days and nights at the Haihe Laboratory, I had the opportunity to be the recorder of what was happening. This period of work also taught me a lot about the detailed process behind the scenes of the IChO. I am grateful to the teachers and students who worked side by side, all of whom were the greatest designers, and brought collaboratively a wonderful event to all chemistry lovers in the world.

WANG Haocheng

Chemzone



WANG Yue

As an online community designed specifically for IChO2022, Chemzone aims to offer users an experience as if they met each other in the physical world. The open-world games enable us to see landscapes from afar by breaking through the geographic constraints. In addition to enjoying the views, I could experience the unique charm of different regions when playing games on each island, and acquire knowledge about chemical elements in the competitions with other players. Although we were unable to get together to share interesting stories in learning chemistry due to the pandemic, we could chat in the small online community and exchange ideas, through which all the participants, hopefully, can gain knowledge and happiness.

The editor of the column is Wang Yue, a 2020 undergraduate of the Boling Class, College of Chemistry, Nankai University.

Editor's words: I have been an admirer of IChO and its participants since I began to take part in chemistry competitions in high school, so I feel privileged to be a volunteer for IChO2020. I would like to express my gratitude to all the teachers, students, and staff who have helped and supervised me during the competition, whose endeavor makes me realize that the success of IChO2022 is attributable to the tireless efforts of numerous people. I hope that IChO and Catalyzer can leave a lasting impact on the students who love chemistry, and help them learn more about the discipline of mystery and beauty.

COLUMNS OF CATALYZER AND EDITORS' WORDS



Examination News & Daily Schedule



YU Tongyan

The Examination News & Daily Schedule column in Catalyzer introduces the timeline of the event, and conveys and displays the important processes to related personnel in a timely and detailed manner. In the preparatory stage of the event, the Catalyzer working group sent off personnel to attend the meetings of the examination working group and the featured activity group, so as to obtain and make sure of the schedule. At the same time, the group was committed to providing real-time follow-ups and timely updates of examination news and scheduled activities. In order to have a deeper understanding of the news details and ensure the objectiveness and informativeness of the content, the editors of this column, except those in the publicity group, participated in such work as invigilation and follow-up, in which they communicated with photographers, clarified the requirement for pictures, developed the news theme and enriched the reading experience.

The editor of the column is Yu Tongyan, a 2020 undergraduate majoring in Chemistry in the College of Chemistry, Nankai University.

Editor's words: As a student of Nankai University who has embarked on the road of chemistry because of the National Chemistry Olympiad, I am honored to have contributed to IChO2022, a significant chemical event. I am grateful to the teachers, classmates, and all the behind-the-scenes staff who offered me help and guidance at work, tolerated my fledgling ignorance, and gave me selfless care. At the same time, I hope that through IChO2022 and Catalyzer, more young people who are interested chemistry will come closer to, and finally enter the field of chemistry.

CLASSICAL CHINESE POETRY

鹿柴

王维【唐】

空山不见人，
但闻人语响。
返景入深林，
复照青苔上。



A Secluded Forest Scene

WANG Wei [Tang Dynasty]

Not a single soul is seen
in the empty mountain —
save some whispering,
the echoing sound as of
a human voice — where
a wandering shaft of light,
through lacing boughs of
the forest, is flickering and
trickling down, broken and
subdued to soft light,
before falling full upon
the green moss aground.

translated by : Prof. ZHANG Zhizhong

WANG Wei (693—761), a native of Shanxi Province, and a distinguished poet and painter in Tang Dynasty. Landscape poems are his staple writing and, together with Meng Haoran, they are called “Wang-Meng” for their shared pastoral poems. As a devotee of Buddhism, Wang Wei is known as a “Buddhism-poet”, and he now has over 400 extant poems.

The poem describes the remote and secluded scene in the forest of an empty mountain at eventide.

Quietude is enhanced through the description of action, which contributes to the naturalness and freshness of the poem. Reclusive quietude is described through whispering of human voices, which is followed by

reclusive depth enlightened by a slanting beam of light. The forest and the moss, in the vignette, are two perspective points which intermingle with each other, thus giving birth to the artistic conception of emptiness and substantiality. With the ear of a musician for music, the sensibility of a painter for light, and the sense of a poet for language, the author successfully portrays the reclusive quietude which is heightened through depicting the echoing voice in the empty valley and the lingering light at dusk, thus providing much food for thought.



55TH INTERNATIONAL
CHEMISTRY OLYMPIAD
SWITZERLAND 2023

ICHO 2023 - International Chemistry Olympiad 2023

Welcome to Switzerland, where the IChO 2023 is taking place next year from 16 - 25 July. The Swiss Chemistry Olympiad Association (SwissChO) and ETH Zurich have been chosen to host the event in Switzerland. Besides the two chemistry exams the participants will experience a wide range of cultural activities, Swiss innovations and lifestyle as well as the picturesque landscape of Switzerland.

“Finding solutions” is the main theme of IChO 2023. The wordplay is intentional. On one hand, a solution in chemistry is a homogeneous mixture consisting of two or more chemically pure substances. No chemistry competition would be possible without the help of solutions, of solutes and solvents.

On the other hand, a solution is what is needed to accomplish a task or problem. Finding the optimal approach to the issues that affect our world is key. Passionate young chemists will help us find solutions to the challenges of our time and will improve the lives of generations to come.

Our mascots Tina Tube and Earl Myers will accompany you all the way to the event. See you next year in Switzerland at ETH Zurich!



Please follow us on Youtube “International Chemistry Olympiad 2023 Switzerland” and Twitter @IChO2023 - and explore our website www.icho2023.ch for useful information and videos.



Main building

© ETH Zurich / Gian Marco Castelberg



Aerial view, ETH Zurich, Zentrum

© ETH Zürich / Alessandro Della Bella

A LETTER TO THE MENTORS

Dear mentors,

Hope all is well.

We have chosen a few gifts to you to express our sincere gratefulness for your support and help for the 54th International Chemistry Olympiad, 2022 in China, hope you would like them.

First of all, is the mascot Kem, a symbol represents IChO2022, secondly is a wonderful present from our generous partner HUAWEI, at last, is the painting by a well-known artist of China, Professor Fan Zeng, from Nankai University.

This painting named 'Laozi Chu Guan Tu' (simplified: 老子出关图), which depicts the appearance of Laozi in China 2500 years ago, who is going out of the pass to the west and giving lectures. Laozi, was the founder of ancient Chinese Taoist. The painting is presented with Chinese ink painting technique, and displayed on the porcelain. The long white beard, blown forward by the wind, seemed like a feeler for exploring the way, pointing to the unknown world.

Although IChO2022 is already in the past, we hope to use the opportunity which IChO has brought to us, keep in touch and go out and strengthen interaction and communication with you, exploring the unknown world in the post IChO2022 era through chemistry together.

Let's stay in touch, my dear friend, and thank you once more.

All the best,
IChO2022 Organizing Committee



MEDALS OF IChO2022 HAVE BEEN SENT

The medals, certificates and souvenirs of the 54th International Chemistry Olympiad are being sent from Tianjin. The mail numbers have been sent through email. Please pay attention to check the package. The package includes medals, certificates, mascots, bags and souvenirs.



Medals



Certificates



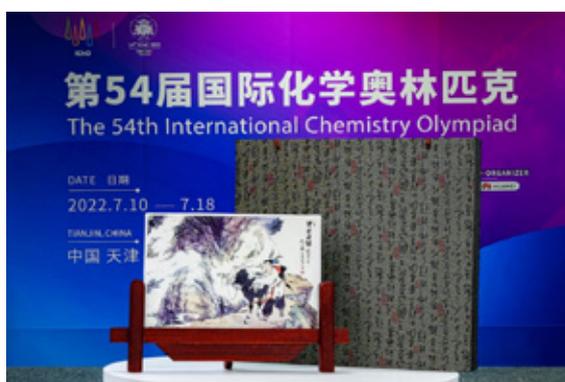
Mascots



Bag



The organizing committee staff are packing the package



Souvenir

If there is any question, please feel free to let us know. Our email address is contact_us@icho2022.cn.



ANSWER FOR Q10

A10. China. Tungsten has the highest melting point among all pure metals. Tungsten has numerous applications, including incandescent light bulb filaments, superalloys, radiation shielding, and many high-end alloys for aircrafts and high-speed trains.

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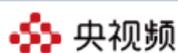


海河实验室
物质绿色创造与制造



天津市华星学校
Tianjin Star Light Elementary and Middle School

SUPPORTING ORGANIZATIONS AND MEDIA PARTNERS



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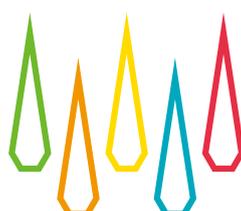
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ICHO



54th IChO 2022
International Chemistry Olympiad

TIANJIN, CHINA

Grain Buds

It is the eighth of the twenty-four solar terms.

Grain Buds (simplified: 小满), pronounced as *Xiao Man*, falls on May 20, 21 or 22 each year. 'Grain Buds' is a solar term that signifies changes in phenology. At this term, the grains of crops that ripe in summer, such as the wheat, become full but not yet ripe, thus the name. The bitterly tasted vegetables grow luxuriant, and some of the soft branches began to wither in the strong sun; the wheat begins to mature gradually.



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戌猪



THE TWELFTH PLACE OF THE CHINESE ZODIAC
Years of dog: 2031, 2019, 2007, 1995
1983, 1971, 1959, 1947