

UK Chemistry Olympiad 2023 Examiners' Report, Round 1

We would like to thank teachers for their support in promoting and administering the Round 1 paper this year and encouraging students to participate. Again, this year we asked for the paper to be administered on a fixed date, to try to maintain the integrity and security of the paper. 1326 schools registered for the paper this year and we were delighted that an all-time record of 11838 students' scores were submitted to the RSC.

Members of the working group are always pleased to receive letters and emails from teachers about the administration, content and demand of the Round 1 paper and take on board this welcome feedback, including making some alterations to the versions of the paper and mark scheme that will be put online for future use.

The paper this year was out of 86 marks. A clerical error on the paper was noted during the marking window, where question 4 was out of 21 rather than 20. The online versions of the paper for students and teachers that are uploaded to the RSC website have been edited to correct this error.

It was pleasing to see a correct response to every question during the moderation process. Again, it is worth reminding students in future papers to attempt at least parts of each question set and therefore attempt some of the more accessible marks.

We were especially pleased to see that 199 schools had participated for the first time, and we look forward to seeing them continue to participate in future years. Whilst the paper has always been written with upper sixth form students in mind, we encourage ambitious lower sixth form students to enter if they have been able to cover the required topics in their independent study. This year 57% of entrants were in year 12 or equivalent, 41% in year 13 or equivalent, with a small number in Year 11 or below participating. We encourage these students to sit the C3L6 Cambridge Chemistry Challenge later in the year. The top moderated score was 83 out of 86, and one of the students achieving this was a year 12 student.

We have again made a conscious effort to add more accessible parts to the paper this year, so the majority of candidates were able to get some questions right and hence come away with a greater sense of satisfaction after taking the paper. The mark distribution indicates this was achieved. This year 16.2% of candidates scored from 0-10, whereas in 2022 this was 47.0%. This was reflected in slightly higher boundaries for medals, and we set these boundaries so that roughly similar percentages of students were awarded each category as in previous years. The gold threshold was 38 out of 86.

49% of entries received were from male students and 47% from female students, with the remaining 4% other/blank/prefer not to say. Male students (mean 23, median 20) performed better than female students (mean 18, median 17) and other/blank/ prefer not to say (mean 18, median 16) overall.

Question 1

The examiners felt that this was a straightforward opening question centred around lower sixth thermodynamics. It was well attempted by students of all abilities. State symbols were not required to score marks for the equations and multiples and fractional coefficients are acceptable in balancing equations. Although working is not required for marks to be awarded it is recommended that students set out their calculations clearly so that they avoid errors such as not multiplying values when needed.

Question 2

Despite the unfamiliar equation at the start of this question, parts (a)-(e) were very well answered by many students who read the information provided and were able to apply it to the question. The author of the question hopes that the question will be able to be used in teaching sequences, to overcome the misconception that ionic, covalent and metallic bonding are distinct. As is common in Olympiad questions, later parts are not directly related to earlier questions, and those students who persevere with the questions are then able to find questions such as part (g) accessible.

Those students who attempted part (h) often did very well. We are aware that unit cells are not common to many UK specifications, whilst being relatively common to Olympiad papers. We recommend that students are directed towards the Olympiad support materials to independently study such topics e.g. <https://edu.rsc.org/uk-chemistry-olympiad/what-are-unit-cells-chemistry-olympiad-explainers/4014383.article>

Question 3

This was designed to be a more accessible question centred around the topic of acid/base chemistry and an extension of metal coordination chemistry. Where the authors thought that ideas may be less familiar, explanations were provided to help students to access the questions. In part (g) it was noted that many students did not correctly give the number of electrons for the ions in the complexes - those who did, often scored full marks on this question, showing the arrangement of electrons and they were able to calculate the spin moment for each complex.

Question 4

Recognising the increase in vaping in the UK, the authors were inspired to write a question to encourage students to consider some of the toxic products produced in this practice. Part (a) and (b) of the question were designed to be accessible. Students were then introduced to the Wittig reaction, which is beyond A-level and equivalent specifications, and asked to apply their understanding to predict the products of the reaction. Many students were able to use the information in this question to determine the products successfully. Parts (d) and (e) were designed to be challenging and differentiating. Although mechanisms are not typically included in Olympiad questions, part (e) was included to interrogate mechanistic understanding.

Question 5

We hope you enjoyed the humour in this question as much as we did. With the 2023 IChO hosted by Switzerland, a question about Swiss cheese was an obvious choice. We hope you appreciated the state symbol for cheese, (ch), which coincidentally is also the country code for Switzerland. This question tested students' application of mathematical skills, in familiar contexts such as $pV=nRT$ and acid/bases and less familiar contexts. It was pleasing to see that candidates of all abilities, including lower sixth, were able to pick up marks in parts (a), (c), (d), (e) and (f) of the question, and this echoes the advice to persist throughout the paper in order to find more accessible marks.

The distribution of scores for Round 1 of the UK Olympiad is shown below.

