UK Chemistry Olympiad

Examiners’ Report, Round 1 2024

We would like to thank teachers for their support in promoting and administering the Round 1 paper this year and encouraging students to participate. 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.

Again, this year we asked for the paper to be taken on a fixed date, to try to maintain the integrity and security of the paper.

1423 schools registered for the paper this year and we were delighted that an all-time record of 14915 students' scores were submitted to the RSC (a significant increase from 11838 in 2023). We determine the grade boundaries based on all scores submitted. We always encourage teachers to submit all scores of their students, even if they think the scores are low, so that no student misses out on an award.

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 are put online for future use.

The paper this year was out of 82 marks. It was excellent to see a correct response to every question during the moderation process. As we have said previously, it is worth reminding students to attempt at least parts of each question set and therefore attempt all the more accessible marks.

We were especially pleased to see that 175 schools participated in Round 1 for the first time, and we look forward to seeing them continue to participate in future years. 64% of schools entered were state schools and 36% were independent schools and colleges.

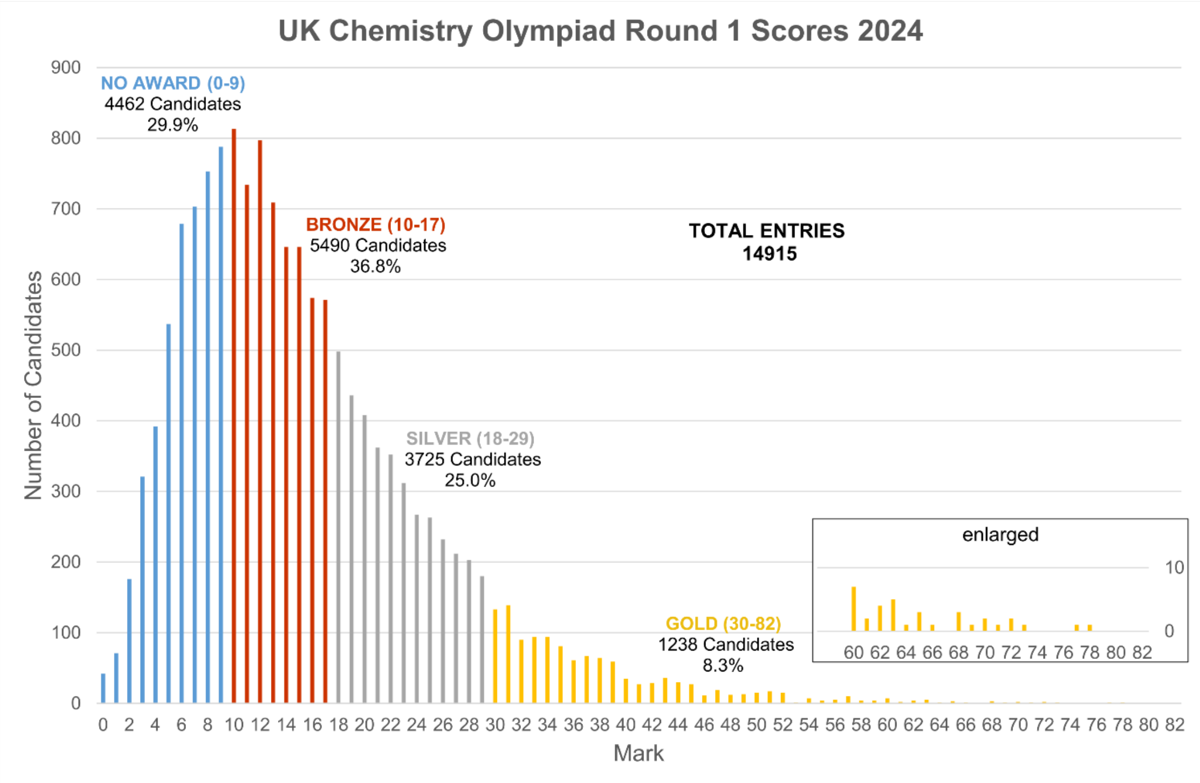
This year the proportion of year 12 (or equivalent) participating in the paper rose to 61% of entrants, with 36% in year 13 (or equivalent), lower than in previous competitions, and a small number in Year 11 or below participating. Feedback regarding this year’s paper indicated that it was generally perceived as more challenging than last year – and the scores reflected this. The substantial increase in the percentage of year 12 students taking the paper this year, has almost certainly also contributed to the lower grade boundaries.

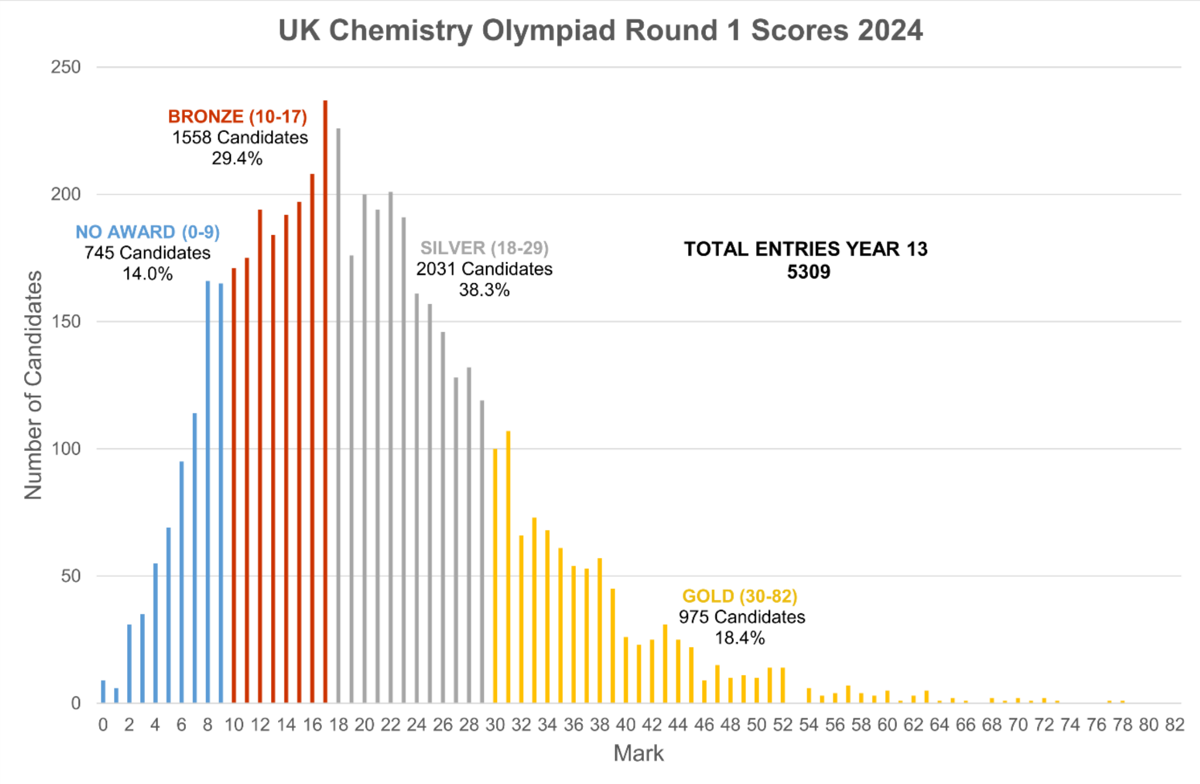
In addition to the overall results graph, we have also included results graphs for year 13 only, year 12 only, and year 11 and below to see the difference in results between the years. Understandably overall, the year 13 students performed best by a considerable margin, but it is pleasing to see many great performances from students in year 12, year 11 and below, as well.

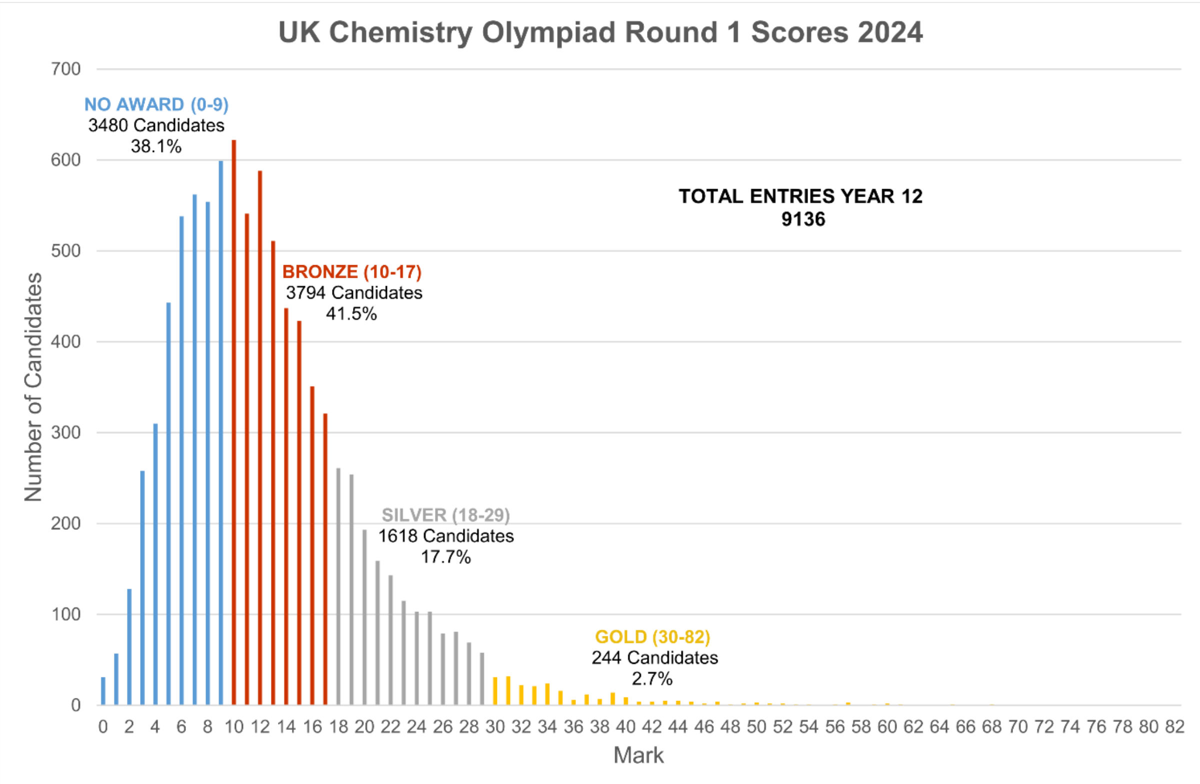
We encourage those year 12 and 11 students to sit the C3L6 Cambridge Chemistry Challenge later in the year to further extend their knowledge and appreciation of chemistry.

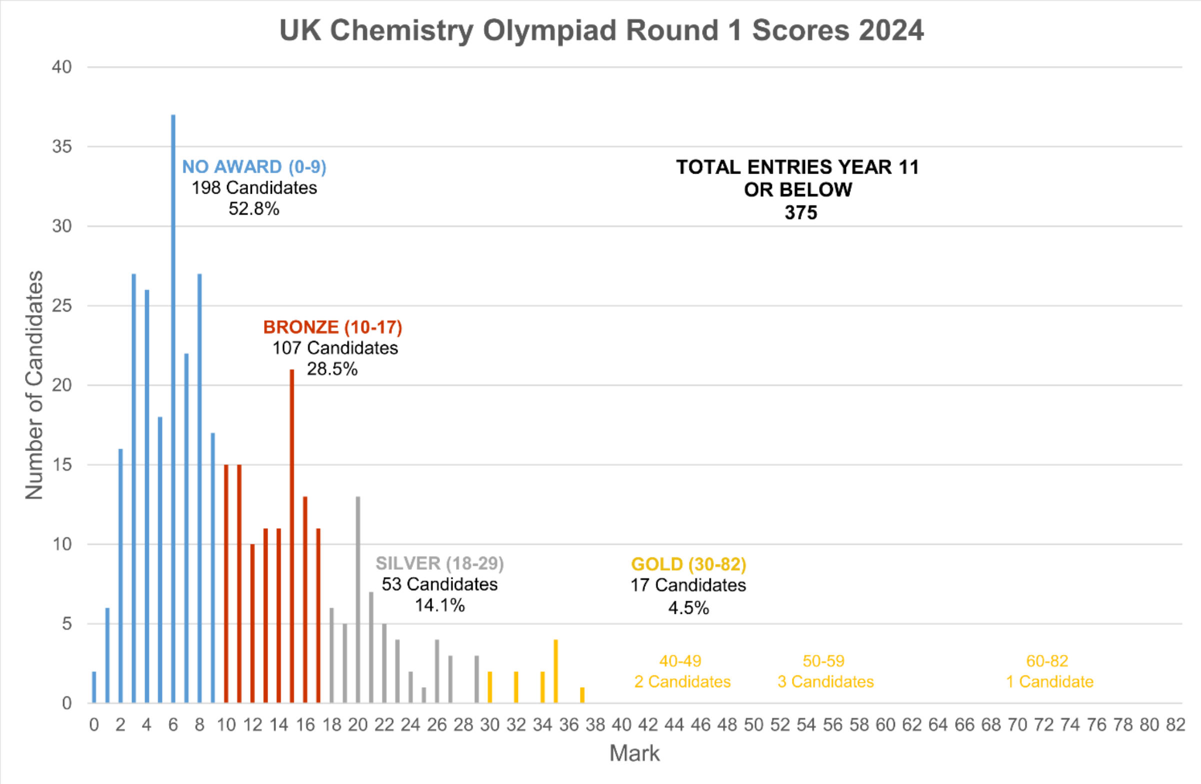
The top moderated score was 78 out of 82. We have again made a conscious effort to add more accessible parts to the paper this year, so most candidates were able to get some questions right and hence come away with a greater sense of satisfaction after taking the paper. The mark distribution indicates this was achieved.

We set these boundaries so that roughly similar percentages of students were awarded each category as in previous years. The gold threshold was 30 out of 82. The silver threshold was 18 out of 82. The bronze threshold was 10 out of 82. 50% of entries received were from male students and 48% from female students, with the remaining 2% other/blank/prefer not to say. Male students (mean 17, median 15) performed better than overall female students (mean 13, median 12) and students who had put other/blank/prefer not to say (mean 15, median 13). 34 students were invited to participate in Round 2 based on their performance in Round 1.




UK Chemistry Olympiad Round 1 Scores 2024
BRONZE (10-17)
1558 Candidates
29.4%
NO AWARD (0-9)
745 Candidates
14.0%
SILVER (18-29)
2031 Candidates
38.3%
TOTAL ENTRIES YEAR 13
5309
GOLD (30-82)
975 Candidates
18.4%
Number of Candidates
Mark
0
50
100
150
200
250
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82


UK Chemistry Olympiad Round 1 Scores 2024
NO AWARD (0-9)
3480 Candidates
38.1%
TOTAL ENTRIES YEAR 12
9136
BRONZE (10-17)
3794 Candidates
41.5%
SILVER (18-29)
1618 Candidates
17.7%
GOLD (30-82)
244 Candidates
2.7%
Number of Candidates
Mark
0
100
200
300
400
500
600
700
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82



The moderation went very smoothly, and the working group were very grateful to all the teachers for marking so accurately. It was particularly helpful to moderators where teachers marking their candidates' scripts had underlined/highlighted the student's answer so we could see where marks had or had not been awarded.

Question 1

This question was about Bronze. In the moderation process it was observed parts (a)–(c) were well answered. Most students were able to do part (d), although some left the answer as a decimal rather than writing it as a percentage and therefore were not awarded the mark. Similarly in part (e) some students lost marks for not writing the answer in cm as asked. Error carried forward was allowed for part (f) from part (e), and in part (g) from part (f).

A common error seen on part (g) was students counting five copper atoms rather than four. Error carried forward was allowed if five copper atoms were counted, so many students were able to be awarded one mark for this part of the question. Students should be reminded to sense check their answers for scale. The unit cell parameter, *a*, should be very small. Similarly, students should know the density of water as approximately 1 g cm^{-3}. Metals should be higher than this, however not *that* much higher. Some answers were 23 orders of magnitude too large for failing to use the Avogadro constant!

Question 2

This question was about iodate salts. Parts (a)–(d) were well answered on the whole. Candidates are advised to check the number of electrons when drawing dot cross diagrams and show them clearly in answers. There were many attempts for part (b) where charges were missing or weren't clearly represented.

Many candidates answered parts (e) and (f) well – disproportionation was commonly seen as an incorrect answer to part (e) (ii).

Error carried forward was allowed for parts (g), (h), and (i) where candidates balanced equations incorrectly or used the alternative value given in the question. Students and teachers may like to note that the reaction is a comproportionation (or synproportionation) not a disproportionation.

Parts (i)–(k) were more differentiating. Candidates should check chemical formulae correctly, e.g. SO_4^- , CO_3^- etc. were commonly seen as incorrect answers. Answers such as H^- were credited for (j), although it is worth pointing out to students that no naturally occurring mineral contains the hydride ion due to its high reactivity.

Students are advised to not to tick multiple boxes in multiple choice options as an additional incorrect selection meant that the mark for correctly identifying the ions could not be awarded.

Even if students could not complete the oxidation state calculations, there were other ways to determine the Cu^{2+} and OH^- ion answers for part (k), including just using molar masses, chemical intuition, and for those looking carefully, the characteristic colour of Cu(II) in the photo.

Question 3

This question was about fuel producing bacteria. Parts (a)-(b) were generally well answered. Some students lost marks for answers having the wrong sign, or for dividing by the wrong number of atoms in parts (b) (iii) and (iv). In part (c), many candidates were able to correctly draw the enolate ion which was pleasing to see; credit was given for the correct delocalised structure.

During moderation, we decided to not penalise students in part (d) if the 1st box was ticked in addition to the 4th box. This was in response to a feedback comment that if using the method of oxidation state counting (as in Q5) then the first statement would also be true. Whilst we did not give the students the value for iodine (and iodine is not higher than carbon on all electronegativity scales), we decided as long as students had ticked the 4th box, ticking the 1st box as well would not be penalised. Some feedback also suggested that the 6th box was correct. We disagree. The iodomethane is not a Brønsted acid and lacks a vacant orbital to behave as a Lewis acid. In general, students should be advised that selecting more than one option in the multiple choice questions often meant that the mark for the correct statement could not be awarded.

Compound B was correctly identified by many students. Compounds C, D, and E were significantly more challenging. Very few students identified the two correct steps in part (f) (ii), however, reduction was identified correctly by a greater proportion in part (g). A commonly seen incorrect answer for part (h) was water. Part (i) was well answered, highlighting how students were able to assimilate and apply new information to problem solving, which was great to see.

Question 4

This question was about the MRI contrast agent gadopiclenol and probably the hardest question on the paper. We hope you enjoyed the picture at the start.

Compounds C and D were commonly identified, and it was pleasing to see compounds A and B correctly identified by many students. A commonly seen incorrect answer to part (b) was where candidates circled the N atoms, rather than the stereogenic carbon atoms. Some candidates also (strangely) drew a circle in the middle of the macrocyclic ring, i.e., not around any atom.

Part (c) was more differentiating, but those candidates who attempted it often scored some marks. Compounds E, F, and G were more challenging to identify, and common errors were seen with candidates suggesting structures with the wrong number of hydrogen or nitrogen atoms, or nitrogen atoms bonded to four or five atoms.

Lots of students lost marks for careless errors adding up the molar mass of gadopiclenol in part (d). At moderation, a surprising number of candidates did not know that radio frequency is used in NMR/MRI experiments – no calculation was needed for this part.

The calculations in parts (f) and (g) were accessible to the very good candidates. Again, some lost marks for not quoting part (f) as a percentage as asked for. Students who tackled part (g) often realised the need to calculate the molar concentration of water.

Parts (h)-(k) were found be to very differentiating and the working group would like to say well done to all candidates who persevered here. For students looking to improve in this area, the ability to manipulate exponentials and logarithms comes up in many advanced areas of chemistry and is something students looking to stretch themselves should practice. Some students were able to solve part (i) using the given values, even if unable to get previous parts, rewarding their persistence.

Question 5

This question was about sulfur containing molecules in the atmosphere. This question also proved difficult, although we think a lot of students ran out of time to tackle this question due to the length of the paper. At moderation it was noted that a surprising number of candidates didn't score all marks on part (a), even with the guide in the question. This is a skill that is worth practising. Part (b) however was done well, although many students included the wrong coefficients in part (b) (i). In part (c) most students wrote down the corresponding acid, H_2SO_4.

In part (e) a lot of students ticked some boxes correctly. There were clearly multiple ticks needed here, but lots of students ticked 6+ boxes and so lost any marks they had obtained for correct answers. In part (g), substantial numbers of students got coefficient b correct but had trouble determining coefficient a. Not that many students had time to attempt part (h); for those that did many lost marks for incorrect units.

The working group appreciate that the number of marks on the paper and the time for the paper maybe meant latter parts of questions were not attempted and we will review the paper length for future years. In general, candidates are advised to work through parts of paper they can do to score marks and then go back to questions that they are less familiar with.

We hope that this feedback is helpful and look forward to seeing you in 2025!