REPORT ON THE CHEMISTRY OLYMPIAD ROUND 1 PAPER 2009

This year we were delighted to see a huge increase in the number of scripts sent to us: we received over 2165 papers, up an impressive 60% on last year's entry. This is very encouraging, and shows that there definitely is a need for Chemistry papers such as this which are really interesting and really demanding. We hope that the 'Olympiad Support Booklet' which the committee has written (and was sent free to all schools), the presentations we have done at the ASE conference, and the mentoring schemes that we have set up are beginning to bear fruit. Perhaps also the slightly 'easier' paper we set this year together with the message that even relatively low marks in this competition represent real achievement which should be recognised are beginning to be noticed.

It was certainly a testing paper but there was a good distribution of marks. The top mark was an amazing 57/64, and we awarded 9% of candidates gold certificates for marks over 37, 19% silver certificates for marks 27 – 36, and 27% bronze certificates for marks of 20 – 26; less than 10% candidates scored less than 10 marks.

An encouraging number of scripts were received from students in the Lower Sixth again this year: in fact four of the top-performing students invited to take part in Round 2 were at this stage of their schooling. We want to continue to encourage even more entries from talented Lower Sixth applicants in the future, and to help this we will invite the best performers in the Lower Sixth to Cambridge for a short course later this year to reward and spur them on to apply again next year. This scheme has been operating successfully for several years now.

Comments on individual questions are given below.

Question 1: Environmentally friendly fireworks

We thought that this question would be a nice easy starter, which good Lower Sixth candidates should have been able to do, but in fact it proved to be not as easy as we thought. Many candidates thought that dihyrazinotetrazine would be very stable because of the strength of the N=N double bond (said to be 'the strongest bond in the universe'!) rather than by noticing the similarity between its structure and that of benzene. Although strong candidates scored very high marks on this question the weaker ones found it very difficult to work out a molecular formula given a structural formula, often missing out carbon completely; this needs to be practised. Too many candidates wrote down an incorrect answer to (b) i) by misreading the question and not calculating the <u>difference</u> in bond angles.

Question 2: Unnecessary production of carbon dioxide

This question turned out to be easier than the first one and many students scored high marks. Most students failed to realise, however, that the equilibrium pressure exerted by a volatile liquid does not normally depend upon the amount of liquid present, so part (a) v) caught many out. Another common error was a 90^0 or 180^0 bond angle around the S in ethyl mercaptan or ethanethiol. We would encourage students to be careful with units (confusing kg with g for example) and to check to

see if their answer makes sense: some students thought that the Olympic flame burning for 16 days produced less CO_2 than a patio heater!

Question 3: Matches

Many candidates got the first two equations correct but then failed to realise that the oxygen produced by the $KClO_3$ would have to 'balance' that needed by the P_4S_3 so did not get the right answer to (a) iii). Candidates who got the correct full equation often calculated the mass ratio needed in a match, but some gave the mole ratio instead. Part (b) was generally well done with many students recognising the symmetry in these interesting structures; they clearly realised that they did not need to know about ^{31}P NMR to do this.

Question 4: Imodium

Many students scored encouragingly high marks on this question. One can do this, of course, just by piecing the structures together like a 'jig-saw puzzle' even though the precise reactions may not have been met before. Part (a) was surprisingly difficult, with few candidates realising that the amine N will be the most basic group present, so this will be protonated rather than the amide N, or the Cl, or the =O. We expected the cyclic structures to be the most difficult to predict, but D was often well done. Part (e) ii) was the most difficult question on the paper and we secretly expected no-one (not even the assessors who check the paper!) to get the correct structure for the cyclic bromide salt. A significant number cyclised with the N lone pair which is understandable but in fact does not happen; the NMR information should have helped, however. One student did get the right answer, so well done to him!

Question 5: Arsenic

Too many students thought that AsH_3 would be trigonal planar. The other early parts of this question were either very well done (the equation for the partial combustion of AsH_3, the formula for arsenic(III) oxide, and the oxidation number calculation) or were done badly (the equation for the reaction of arsenic oxide with zinc and sulphuric acid, and the structure of the $HAsO_4^{2-}$ ion which often contained H-As bonds or O-As-O triangles). Some students carried out the mathematical calculations in parts (d) and (e) efficiently.

Question 6: Revealing a van Gogh painting

The material in this beautiful question would be very unfamiliar to most students (and teachers) but many candidates who read the question and worked through it carefully scored well; this is impressive. The first part was well done (-13.6 eV), but not everyone realised that the energy of the electron would tend to zero as the atom becomes ionised. Those students who persevered right to the end of the paper picked up some 'easy' marks right at the end, even if their earlier calculations were not always correct.

We are grateful to many teachers who wrote to the committee after their students had sat the paper. Some complained that the paper was ‘too hard’, while others congratulated us on setting such an imaginative and thoughtful paper which they will use in future years in their teaching. Naturally we are sorry if any student found the experience demoralising; the problems were difficult, since they required candidates to think carefully and not just recall what they had been taught already, and this needs practice. But we warmly congratulate all those students who rose to our challenge and used their intelligence and did well.

The UK is hosting the International Chemistry Olympiad Competition this year from 18 – 27 July. We hope that the final team of four will do very well indeed, and that success in this will make even more students take our Round 1 paper next year.

Tim Hersey
Chairman of the UK Chemistry Olympiad Selection Committee