AS LEVEL
CHEMISTRY

7404/1 Inorganic and Physical Chemistry
Report on the Examination

7404
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General Comments

This third examination of the new specification highlighted some key points for teachers going forward. Students need to:

- show working out clearly with a clear explanation for each step of their calculation;
- be very familiar with all the practical procedures contained in the specification and, very importantly, understand *why* they carry out the procedures that they do in practical work, rather than just know *what* to do;
- understand how to convert numerical values to take into account different units;
- be able to deduce the shape of a molecule;
- be able to explain how the different types of intermolecular forces arise.

Section A

Question 1 Atomic Structure

01.1 Most students understood that electrons are now arranged in energy levels, although many didn't make reference to sub-atomic particles in their answer. Students did not always make a comparison and it was not always clear which model they were referring to in their responses.

01.2 Almost all students (91.3%) were able to write the correct electron configuration in terms of shells and sub-shells, although a few students made no reference to sub-shells.

01.3 Many students were able to identify that the two elements were nitrogen and beryllium but many were then unable to write the correct formula of the compound formed between them.

Question 2 Sodium Fluoride

02.1 Almost all students were able to give the correct M_r for sodium fluoride but many became confused by the different units involved in this question. Students should be advised that they should explain their working for each step in a calculation. When only numbers were provided in an answer, it was not clear what students were calculating in each step.

02.2 A good number of students (39.9%) were able to determine the maximum mass of sodium fluoride that a 75.0 kg person could swallow without reaching a toxic concentration, although a few struggled with the conversion to mg.

02.3 Many students completed this calculation with the figures upside-down and so were unable to score. A surprisingly high proportion of students (16%) made no attempt whatsoever at this question.

02.4 Many students were unable to identify the correct relative sizes – many stated that both ions were the same size because they had the same number of electrons, without considering the impact of the protons. Other students did not appreciate that both ions were isoelectronic.

Question 3 Hydrated Salt

03.1 Most students that were successful in this question completed it using the first method. A good number, however, were unable to determine the mass of water lost during the reaction whilst many also got the masses the wrong way around. A number of students did not quote their answer to two decimal places as asked for in the question.

03.2 This was answered reasonably well (46.3% of students gained the mark) but a common misconception was the idea that there would have been heat loss during the process. Additionally, some students just listed reasons why an answer may not be correct in a practical without considering the specific context of this procedure.

03.3 This question was also completed well with many students (40.1%) scoring both marks and explaining how the experiment could be improved. A few students attempted to refer to changing the apparatus which was prohibited by the question.

Question 4 Identification of Inorganic Compounds

04.1 Students found this challenging and did not always express their ideas clearly. Many approached this question as if they already knew which compound was which. A good number did not appreciate that the compounds were solids and so they should make them into solutions. The best students realised that acid should be added first to identify the sodium carbonate and that this solid can then be discarded from further tests. A large number of students realised that silver nitrate would be the best reagent that could be used to determine which solid was sodium chloride and which was sodium fluoride. Additional use of ammonia solution was not necessary in this case. Equations were well written, although did not often include state symbols as required. A high number of students felt that concentrated sulfuric could be used to determine which solid was which despite the fact that all three solids would give very similar observations. The question discriminated particularly well.

Question 5 Equilibrium

05.1 Most students answered this question well, with just over half of students scoring both marks, although many thought that the time that equilibrium was achieved was the point that the concentrations of SO_3 and O_2 were the same as each other.

05.2 Many students were able to sketch accurate curves although they didn't always appreciate that the SO_2 and O_2 concentrations would be in the ratio 2:1.

05.3 This proved to be demanding for many students (62.7% scored zero). Explanations and predictions in terms of Le Chatelier's Principle were often vague and did not refer to a shift in the position in equilibrium. A good number of students also confused rate arguments with equilibrium arguments when giving an explanation.

Question 6 Ideal Gases

06.1 Most students were able to calculate the M_r of the unknown volatile liquid correctly. Many students, however, did not give a correct definition for relative molecular mass or confused this with the definition for relative atomic mass; a good number did not convert the data to take account of the different units. Pleasingly, 59.4% of students scored at least four marks.

06.2 This proved to be demanding for many students with well over half of them failing to score; many felt that that the calculated M_r would have been less than the actual M_r. Only a few students considered the impact that a lower volume of gas (using pV=nRT) would have on the calculation of the measured amount of moles.

Question 7 Chlorine

07.1 This was answered well – nearly all students (83.8%) were able to state two correct oxidation states.

07.2 Very few students were able give the first half-equation for the oxidation of chlorine whereas the second half-equation was more regularly correct.

07.3 Only some students (23.1%) were able to recall this equation from the specification.

07.4 Some students successfully calculated the mass of potassium iodide. However, many did not appreciate that this reaction was not 1:1 and so used the incorrect reacting ratio in their calculations. Many students stated incorrectly that the iodine formed would be observed as purple fumes or as a purple solution. This question discriminated particularly well.

07.5 Most students were able both to write the correct equation and calculate the enthalpy change. Only 8.4% of students were unable to score at least one mark.

Question 8 Time of Flight Mass Spectrometry

08.1 This question proved demanding for most students. A good number were able to calculate the mass of the $^{79}Br^{+}$ ion. Very few students realised that most of the quantities cancelled down during the calculation and took time to calculate the velocity of the $^{79}Br^{+}$ ion in order to then work out the kinetic energy. This velocity was frequently calculated well but the remaining marks then proved a challenge for students. Some completed numerous calculation steps only to give a time for the $^{81}Br^{+}$ ion that was the same as the time for the $^{79}Br^{+}$ ion.

08.2 Only a few students understood that when the ion reaches the detector it gains an electron, whereas many understood that the size of the current was proportional to the abundance of the ion.

Question 9 Shapes and Intermolecular forces

09.1 A good number of students realised that the KrF_2 molecule has three lone pairs around the krypton but few were able to appreciate that this is a linear molecule. Some students did not show any lone pairs on their diagrams.

09.2 Most students understood that lone pairs reduce the bond angle in a molecule so this was answered well.

09.3 A good number of students realised that the intermolecular forces were van der Waals' but were unable to describe accurately how these forces arise or why other intermolecular forces are not present between SiF_4 molecules. Only 4.9% of students gained full marks.

Section B

Question 10 Bonding in Ammonium chloride

The most common answer was incorrect. Students did not appreciate the presence of the ionic bond between the ammonium ion and the chloride ion. Only 12.8% of students scored this mark.

Question 11 Using Avogadro's constant

The most common answer (D) was incorrect and was the value that was twice the correct answer.

Question 12 Period 3 Properties

Most students (77.6%) could identify the correct trend.

Question 13 Volume of gases

The most common answer (C) was incorrect. Most students believed that the total volume of gas in the mixture at the end of the reaction was 40 cm^3, and did not realise that there would have been 10cm^3 of unreacted gas. Only 16% of students were successful here.

Question 14 Reduction of titanium(IV) chloride

The majority of students (74%) were able to recall correctly the reducing agent in this process.

Question 15 Barium sulfate

Many students (81.2%) got this correct and appreciated the use of barium sulfate in medicine.

Question 16 Reducing ability of halide ions

Many students (47.6%) got this correct although a significant number thought that bromide ions were reduced in the reaction of sodium bromide with concentrated sulfuric acid.

Question 17 Use of Group II compounds

Most students (69.2%) got this question correct but many confused the uses of magnesium hydroxide and calcium hydroxide.

Question 18 Ionisation Energies

Some students (38.8%) were able to identify the element with the highest first ionisation energy, although many students thought that sulfur had the highest first ionisation energy.

Question 19 Concentration of solutions

The majority of students (67.5%) answered this question correctly.

Question 20 Concordant titres

Only a minority of students (38.3%) answered this question correctly; many felt that washing the pipette with water between each titration helped to improve concordancy.

Question 21 Accurate titres

The majority of students (64.5%) appreciated that the conical flask should be rinsed with water between titrations.

Question 22 Uncertainty in titrations

Only 30.5% of students gained this mark, thus most students did not appreciate that a higher burette reading would lead to a lower uncertainty so less concentrated alkali should be used. Instead, the majority of students felt that the most appropriate way to reduce uncertainty was to fill the burette to the 0.00 cm^3 mark.

Question 23 Safety

The majority of students (76%) were able to suggest the most appropriate safety precaution.

Question 24 Indicator colour change at the end point

The majority of students felt that the end point when using methyl orange would be red to yellow rather than red to orange. Just under a third of students gave the correct answer.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.