AQA

A-LEVEL
CHEMISTRY

7405/1 Inorganic and Physical Chemistry
Report on the Examination

7405
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General Comments

Examiners were pleased with the performance of students on this first paper 1 for the new A-level Chemistry Specification. The paper differentiated well between students of differing ability. There was no evidence from scripts to suggest that students were short of time to complete the paper. All questions were answered correctly by some students. The best students showed a depth of understanding beyond the demands of A-level.

Students failed to gain marks for equations if they failed to check that they balanced in terms of the number of atoms and the charges, especially the charges on complex ions. Handwriting was often difficult to read, introducing the possibility of ambiguity, especially with some state symbols in equations.

Students should be reminded to cross out work that has been replaced, so that contradictions between answers are not seen. Often answers which had not been crossed out on the script were contradicted by answers given on additional sheets, and this caused marks to be lost.

Question 1

01.1 The definition was only given by the best students. Some students gave definitions of other enthalpy changes, particularly the enthalpy of formation of a substance. Many students missed the idea that a solid was being formed and some thought that the solid ionic lattice was formed from one mole of gaseous ions.

01.2 Many students were uncertain about the sign of the enthalpy change for lattice formation and +869 kJ mol^{-1} was a common wrong answer.

01.3 Many students understood that the lattice was not perfectly ionic and had some covalent character. Linking the covalent character with stronger bonding eluded all but the strongest students.

01.4 The reagent silver nitrate was well known, and this was generally followed by the correct colour of the precipitate. Some students used a more reactive halogen as the reagent and this was given full credit; however, observations for this were less well known.

Question 2

02.1 This question was answered well by many students. A common incorrect answer was 0.958, where students had re-arranged the expression upside-down.

02.2 Although 34.4% of students scored full marks, the question differentiated well overall. Common errors involved either failure to add/subtract the correct amount in moles of sodium hydroxide or to add/subtract the wrong way round.

Question 3

03.1 This question was answered well (89.5% correct).

03.2 Many students scored both marks here, although some did not give the answer to two decimal places and thereby lost a mark; some students failed to take the square root of K_w.

03.3 The answer to this question was generally well known, although some students appeared to believe that a pH of 7.27 was not sufficiently alkaline.

03.4 This question differentiated well. Many students failed to appreciate that calcium hydroxide is dibasic and an answer of 12.65 was common. Some students used $K_w = 1.00 \times 10^{-14}$ and a few students failed to give the answer to two decimal places.

03.5 The idea that magnesium hydroxide is less soluble than calcium hydroxide was appreciated by only a few students. Many thought the pH value should be the same. Some who gave a lower pH followed this with a discussion about the magnesium ion's greater polarising power.

Question 4

04.1 This was generally well answered, though a few students added the abundances incorrectly.

04.2 Most students gave the correct equation, but some used the wrong state symbols or omitted them. The identity of the isotope was well known but some students lost a mark by using the symbol for the atom rather than the *m/z* value.

04.3 The most common error was a failure to convert from grams into kilograms.

04.4 Only the best students gained all three marks. All marks were available, even for those students who had not answered question 04.3, or who had the wrong answer for it. Some students were unable to re-arrange the equation. Students who appreciated that the distance travelled was common to both ions usually went on to get the correct answer, but a large number of students scored zero or one mark.

Question 5

Most students calculated ΔS correctly and gave the correct expression for ΔG. Many students then went on to calculate the value of ΔG correctly. Some students failed to convert the temperature to a value in kelvin, some failed to convert the energy into kilojoules, and some did not give the value of ΔG to the required precision.

Question 6

06.1 Students generally scored the mark for the equation (78.8% correct), though some students used P_2 or gave P_2O_5 as the product and lost the mark.

06.2 Many students failed to realise that water was all that was required; those students who used water mostly went on to give a correct method for testing the solution.

06.3 Most students answered this well, but "simple covalent" was a common incorrect, incomplete answer for sulfur dioxide.

06.4 Most students understood that covalent bonds were broken for silicon dioxide and that intermolecular forces were overcome for sulfur trioxide. Some students lost marks because they thought intermolecular forces were also overcome in silicon dioxide. There were only a few examples where students got the type of bonding completely wrong.

06.5 Many students struggled with the equation here and gave the products as potassium oxide and sulfuric acid.

06.6 Many students found the formula of magnesium phosphate challenging and hence could not write a correct balanced equation. Often, students failed to pick up on the information that magnesium oxide was in excess and gave magnesium hydrogenphosphate as the product.

06.7 Many students found this question quite challenging; sulfuric(VI) acid was often thought to be the product. Very few students gave a correct fully displayed formula.

Question 7

07.1 63.7% of candidates answered this correctly.

07.2 Students usually answered this correctly (71.2%); a common incorrect answer was that chloride ions did not have lone pairs.

07.3 The colour of the solution formed was better known than the equation; many students could not give a correct ionic equation and $[Cu(NH_3)_6]^{2+}$ was a common incorrect product.

07.4 78.1% of candidates answered this correctly.

07.5 This question was generally answered well, with 59.4% of students gaining at least one mark. Hydrochloric acid was often given as the reagent; chlorine was the most common wrong answer. Equations were often unbalanced. A common incorrect product was $CuCl_4^-$

07.6 Students could often state that the electronic configuration was d^{10}, but the effect on electron transitions was less well known. Students often failed to realise the importance of visible light being absorbed. Some students scored the mark by stating the complex was colourless.

Question 8

08.1 Many students gave incomplete reagents or the wrong formula. Barium itself was an occasional wrong answer. Most students gained the observation mark for potassium sulfate, but not for potassium nitrate.

08.2 Good answers to this question were rarely seen. Sodium hydroxide was the most common correct reagent, but students then failed to realise that an excess of sodium hydroxide was needed to distinguish between the two metal ions. A few students suggested sodium carbonate as the reagent but then failed to give full observations.

Question 9

09.1 Students answered this question quite well, with a good awareness of the range of temperatures and pressures needed. Most students failed to describe the information given in the graph; only the best students noted that the yield plateaued over about 850 °C. The relationship between pressure and rate was often missed and this also limited students' marks. Many students discussed conclusions that could be drawn from using *Le Chatelier's* Principle; this was not what the question was asking.

09.2 Only a few students did not understand what was being asked for; most errors were either arithmetic errors or rounding errors.

09.3 Many completely correct answers were seen (48.9% of students). Some students, however, could not calculate the total number of moles or could not calculate the partial pressures of the gases. Most students could write the expression for K_p but some forgot to square the partial pressure of hydrogen. Units were sometimes incorrectly given in moles.

Question 10

10.1 The oxidation states were well known, with 92.2% of students gaining both marks; +7 was the commonest wrong answer for the nitrate ion.

10.2 Just under half of students could identify the weakest reducing agent.

10.3 Unfortunately, due to a printing error on the question paper, this question had to be discounted. **All** students were awarded two marks.

10.4 "Nitrate ions" was a common insufficient answer, and sulfuric acid a common incorrect answer. Only the very best students scored mark point two; the common incorrect answer was that the $E^\ominus$ for NO_3^- was more positive than the $E^\ominus$ for copper. The equation was often unbalanced, but the cell emf was generally calculated correctly.

Question 11

This was a challenging question with students finding most parts of it difficult.

11.1 Only the best students got to the end of the calculation. Many students scored the first four marks, and some of these then realised that they needed to multiply by ten because of the dilution used. Very few students appreciated that the amount in moles of ethanedioic acid had to be taken away from the total amount in moles of ethanedioate ions to find the amount in moles of sodium ethanedioate. Those students who did, usually went on to get the right answer.

11.2 Students often failed to give a balanced equation; charges on the complex ions were often incorrect, and many did not give water as one of the products. Many students understood that the same number of bonds were broken and formed, but few could also state that they were the same type of bonds. Some stated that the bond enthalpies were similar, but could not explain why.

11.3 Many students struggled to draw the displayed formula; those who got close often omitted the carbon atoms from the ligand. Most students knew the bond angle, but some incorrectly gave 120° or 109.5°. The most common incorrect type of isomerism given was stereoisomerism or cis/trans.

11.4 Common answers that did not score here included references to ethanedioate ions being indigestible, or being so firmly chelated to iron ions already that they were not free to be absorbed.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

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