Questions matter

A-level

Chemistry

7405/1 Inorganic and Physical Chemistry

Report on the Examination

7405
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Question 1

In part 1, 38% of students scored all three marks: plum-pudding model was a common insufficient answer. Some students failed to gain marks as it was unclear, in their explanation, which model they were referring to: the question asked about the modern model. Few students scored both marks for the definition in part 2: mean (mass), mass or atom of ^{12}C were often crucially missed out. In the justification students failed to gain the mark by not being specific: Te has fewer protons was an insufficient answer. The equation in part 3 was well done. The calculation in part 4 discriminated well: 18% of students scored all the marks and over 85% of students scored at least 2 marks. Common errors included giving the mass of 1 atom rather than the mass of one mole on the answer line and not realising that the mass number should be an integer. Part 5 was answered well.

Question 2

Students found parts 1, 2 and 3 challenging; fewer than 40% were successful on each of these parts. In part 1 many students suggested that the strontium hydroxide had fully dissolved or was in excess, not realising that a saturated solution was needed. Common insufficient answers in part 2 included removing the undissolved strontium hydroxide so it didn't affect the titre, but students did not state that the titre would be larger. In part 3, very few answers referred to the solution reacting with carbon dioxide in the air; common incorrect answers stated that the solution would react with oxygen/air. Evaporation of the strontium hydroxide (solution) was accepted in the mark scheme and seen quite regularly as an answer. Answers to part 4 were very good. 33% of students gained all the marks in part 5: the question discriminated extremely well. Most students calculated the average titre: some used 3 or 4 values rather than the two concordant values. Other common errors included multiplying by 2, using an incorrect M_r and failing to multiply by 4.

Question 3

In part 1 most students knew they needed an octahedral shape and bidentate ligands for the complex, but could not draw the ethanedioate ligands correctly: errors included missing C or O atoms or including C=C. Many students could not recall the chelate effect in part 2: some students stated that the complex formed is more stable because stronger bonds were formed. Part 3 discriminated well: 23% of students gave a level 3 answer and most gained 1 or 2 marks by drawing a graph with labelled axes. Incorrect curves on the graph included a straight line down, a horizontal line at the start then a curve down of reducing steepness. The repulsion between the negative ions was well understood by many students but the attraction between iron(II) ions and persulfate ions was only stated by the more able students. The idea that variable oxidation states are important for transition metal catalysis is usually well known but few students stressed this in their answers. The equations were often partially recalled with errors in balancing; SO_4^- was a common incorrect formula for the sulfate ion. Invalid references to autocatalysis and heterogeneous catalysis were sometimes seen. Many students gave the correct answer to part 4: common incorrect answers included $Fe(NH_3)_2(H_2O)_4$ and $Fe(OH^-)_2(H_2O)_4$. In part 5 the colour of the precipitate was known quite well: some students gave effervescence as an observation with or without the precipitate and therefore could not score. In the equation many students incorrectly attempted to give acid base reactions. 31% of students gave a correct equation in part 6: common errors included unbalanced equations or giving Na atoms as a product. CO_3^- was often seen for the carbonate ion in both parts 4 and 5.

Question 4

Part 1 was answered well. 52% of students gained the mark in part 2: incorrect answers included the same number of reactants and products rather than referring to the amount, in moles, of reactants and products. 'The units cancel' was a common response but was insufficient for the mark. Part 3 was answered well. The calculation in part 4 was well done: errors included omitting the conversion from mole fraction into partial pressures or by giving incomplete units (kPa). Some students failed to gain a mark for the expression by omitting a symbol for partial pressure, or by using square brackets.
In part 5, 73% of students gained the mark.

Question 5

67% of students gave a correct equation in part 1. The equation in part 2 proved more difficult: errors included HCl or HOCl as the product and a few students who had all the species correct failed to balance the equation. In part 3 most students gave the first equation. Errors in the second equation included not balancing the chlorine atoms, putting H^+ on the wrong side of the equation and omitting the electrons. In the third equation $5Cl_2$ or $7Cl_2$ were common errors. A few students missed the charge on the chlorate(V) ion. In part 4, 39% of students scored both the marks: errors in the identification of the role of the chloride ion included acid, oxidising agent, reducing agent and catalyst. Students found part 5 challenging: errors included shapes with 0, 1 or 2 lone pairs or four chlorine atoms. In part 6, 24% of students gained both marks. Many students who gave the correct bond angle did not give a correct explanation: many responses referred to lone pairs repelling more than bond pairs.

Question 6

In part 1, 15% of students scored both marks. Very few students answered in terms of the $E^\ominus$ of Zn^{2+}. Many students referred to the $E^\ominus$ of Zn and could not gain any marks. Students who wrote about $E^\ominus$ of Zn^{2+} compared it to the $E^\ominus$ of VO^{2+} and not to the $E^\ominus$ of V^{3+}. There was a lack of understanding of the concept that while Zn is the reacting species, the electrode potential refers to the reduction of Zn^{2+}. Part 2 was well answered. Most students scored the mark for the cell EMF in part 3. In the cell representation, the order of VO^{2+} and V^{3+} were often the wrong way round or the Pt electrode was missing. The half-equation was often the wrong way round. The calculation in part 4 proved challenging but 34% of students managed to score all the marks. Many students used the reacting ratio correctly but then went on to use a second reacting ratio to calculate the amount, in moles, of vanadate(V) and lost the second mark. Some students used an incorrect M_r in the calculation.

Question 7

Answers to part 1 were generally good. Some student gave an incorrect expression for K_w: common errors included charges outside square brackets, using K_c instead of K_w or writing $K_w = [H^+]^2$
Errors in the calculation included forgetting to take the square root and not giving the answer to 2 decimal places. In part 2, 48% of students scored all the marks, and nearly all scored some marks. The question differentiated very well. Errors in the calculation included missing the subtraction step, and not converting the amount, in moles, into a concentration. The majority of students were able to convert $[H^+]$ into pH even if previous working was incorrect.

Question 8

Answers to part 1 were generally good: errors included confusion between ions, atoms, and molecules. 49% of students gave both correct equations in part 2: errors included missing state symbols, missing mole ratios, and missing charges. Another common error was O^-(g). Many students did not give 0.5 mol of O_2(g) in the equation at the start of the cycle. The calculation in part 3 was challenging: common errors were only including 1 mol of Na in enthalpy of atomisation (1 x 109), only including 1 mol of Na in first ionisation energy (1 x 494) and halving the enthalpy of atomisation of oxygen (confusing this value with bond dissociation enthalpy). Students found part 4 challenging: only 31% of students gave a correct answer. Many students identified that an electron was added to an O^- ion but did not state that there is repulsion between them. There was a common misconception that electrons were being removed and the repulsion made it easier to remove the electron. In part 5 many students confused the electrostatic attraction in ionic compounds with covalent bonds and intermolecular forces. Other errors included reference to the charge density of atoms or molecules. 59% of students answered part 6 correctly: common incorrect answers included +1541 and –1541. In part 7 very few students knew that sodium oxide reacts with water: common incorrect answers included sodium oxide being insoluble in water or the reaction was too difficult to measure. The calculation in part 8 was well done by most students: common errors included using the wrong units for entropy change and not subtracting 273 to convert Kelvin into Celsius.

Question 9

Errors in answers to part 1 included more shielding or more orbitals: these are correct statements but insufficient for the mark as they do not explain the increase in atomic size. The equation in part 2 was generally good: errors included missing state symbols and MgO(aq) or MgO(g) as a product. Some students gave magnesium hydroxide as a product. In part 3 most students knew that electrons were easier to lose from barium and/or that barium sulfate is insoluble. Very few students stated that a precipitate would form a layer on the barium and stop the reaction. 38% of students scored all the marks in the calculation in part 4 and most students gained a few marks. Errors included incorrect rearrangement of the equation and not using the correct mole ratio. An answer of 59 was common using a 1:1 ratio but this meant that 124 could not be subtracted and the metal could not be identified. The equation in part 5 was generally correct: errors included using H instead of H_2. Very few students realised that there was ionic bonding in the compound and described metallic bonding or intermolecular forces. The correct equation in part 6 was given by 47% of students: common errors included using one mole of NaOH or not balancing the equation. 19% of students gave the correct half-equation in part 7. $Li^+ + e^- \rightarrow Li$ and $Li^+ + CoO_2 \rightarrow LiCoO_2$ were common incorrect answers. Many students identified that the reaction is reversible in part 8: some students confused the cell with a fuel cell and stated that reactants could be continuously supplied.

Mark Ranges and Award of Grades

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