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Examiners' Report
Principal Examiner Feedback

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In Chemistry (4CH0) Paper 1C

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Question 1

As expected most candidates scored well in this question but some did not give symbols as required in (a) and (b).

Question 2

In (a) the first two parts were well answered but many could not give the correct states for ethene and poly(ethene). The majority of answers to part (b) were correct.

Question 3

Most candidates scored at least one mark in (a) usually for describing the change in appearance of the water, but many simply described the crystals as dissolving, which they had already been told in the stem of the question. Others thought that the colour would come out of the crystals as they dissolved in the water and that they would become white. In (c)(i) an acceptable response was often seen but a number failed to gain the mark by not making their response comparative when describing how the change differed in hot and cold water. Some thought the crystals would melt in hot water. In (c)(ii) Many candidates scored the first mark recognising that particles gain (kinetic) energy when the temperature increases. However too many then seemed to go into autopilot giving general points about rates of reactions instead of referring to the actual situation involving the dissolving crystals in the question.

Question 4

In (a) the points were generally accurately plotted but the standard of curves was mixed, with too many using a ruler to join the dots, with others drawing multiples lines or lines which were too thick to be acceptable. In (b) large numbers of candidates lost the first mark as they did not correctly extrapolate their curve but instead altered the direction of their curve to make it go through 10,30. In (c) many read their graph correctly but often did not halve the value to take into account that the volume had changed to 50cm^3. Some tried to do some odd calculations, often subtracting 50 from their graph value.

Question 5

In (a) heating was often correctly given, vaporising less so. A common suggestion was filtering or other proposed purification method, and some gave descriptions of cracking. In (b) it was surprising how many different ways candidates found to answer a simple question. The majority of these answers were correct although others indicated a decrease in temperature. Roads was a much more common correct answer than in roofs for a use of bitumen in (c), but it was surprising that some proposed using gasoline as aircraft fuel or as fuel for ships. A few carelessly lost the mark by not using the four examples in the diagram, and simply stated *for cars* and not specifying that it is the *fuel*. Whist many correctly gave bitumen in (d), quite a few opted for refinery gases and some for fuel oil. Part (e) was a straightforward question that required just the term *boiling point* as the answer but often candidates felt the need to write much more detailed answers requiring extra space.

Question 6

In (a) X was well answered with HCl being the common wrong answer. Y proved more difficult with quite a few candidates suggesting potassium oxide. Z was well answered but a variety of incorrect answers were seen, many of which were not acids. In (b) it was disappointing that many candidates did not know that iodine exists as diatomic molecules whilst others gave Na_2I or NaI_2 as the formula for sodium iodide. In (b) the test for iodide ions was well known by many but marks were lost through failure to add nitric acid or simply stating *acidified silver nitrate*, and sometimes an inappropriate acid was suggested. A few gave silver chloride or sodium hydroxide as a reagent whilst others gave an incorrect colour for the precipitate or gave the correct colour but omitted stating it was a precipitate. Very limited numbers tried to suggest an alternative method and although credit was given, candidates should be advised in future to use the halide test given in the specification.

Question 7

In (a) many candidates scored very well, although some lost marks by failing to round numbers accurately or by rounding to only one significant figure. Some weaker candidates did not gain any credit as they divided the percentages by atomic numbers or inverted the fractions. In (b)(i) many correct answers describing sulfur gaining oxygen were seen. Explanations involving electrons were not

considered appropriate in this context and were ignored. In (ii) it was surprising to see so many errors in the equation considering the formulae of all the required compounds and also oxygen had been given in the question. Many tried to used copper sulfate rather than copper sulfide and others used monatomic oxygen. In (c)(i) most gave a correct answer, but a variety of incorrect answers were seen including sulphide, hydroxide and various other anions. Part (ii) was usually correct but some suggested litmus went blue and others did not use litmus at all and so could not gain any credit. In (iii) many correctly suggested *fizzing* or an equivalent term but fewer proposed gave *disappears* or an equivalent answer. Many confused the situation with magnesium burning and thought that there would be a white residue left or that there would be a white flame seen.

Question 8

Most scored both marks in (a) or were awarded one mark for a correct subtraction following an incorrect reading. In (b)(i) the first mark was for a factor involving the metal and correct references to size or surface area of metal were seen. Answers just involving mass or volume of metal were ignored. For the other two available marks there were several possibilities, and all were seen often, especially concentration/volume *of acid*. Less candidates than expected gained the mark in (ii) usually because they failed to give a relationship between the reactivity of a metal and the temperature rise. This was possibly a language understanding issue as some just made a statement of which metal was the most reactive. Part (iii) was often well answered but there were some who did not relate to the actual situation in the question and simply stated *gold is unreactive* which was insufficient.

Question 9

Many gave the two correct answers in (a), but some wrote *strontium* on the first line and a correct anion on the second and were awarded one mark. In (b)(i) two possible alternative ions and reasons why those ions were possible were required to score the two marks. However, many candidates gave incomplete answers, but were often able to score one mark. Unfortunately, others seemingly failed to grasp the requirements of the question and gave arbitrary responses and so did not gain any credit. Less than expected numbers of candidates gave the correct single test required in (ii), with too many trying a scattergun approach and putting down almost everything they could see from the information in the question. Part (c) was often well answered with candidates giving a commendably concise answer involving simply the

use of magnesium chloride solution. However, rather as in (ii), others tended to repeat much, or all of the information contained in the question and so gave unstructured and unclear answers.

Question 10

The correct alternatives of pipette and burette were given by the majority in part (a), with measuring cylinder the most common incorrect answer, but it was not unusual to see other suggestions such as beakers. Part (b)(i) proved challenging. It was apparent from many answers that candidates did not recognise the result was a lower than expected temperature and so possible mistakes had to reflect this. Hence an answer such as *incorrect volume of acid used* was not sufficient. Similarly, ambiguous answers such as *too much or too little acid used* were not accepted. Some candidates did not seem to understand the continuity of the experiment, and so seemed to be unaware that each addition of nitric acid went into the same reaction mixture. They often gave incorrect answers relating to the volume of potassium hydroxide used. Part (b)(ii) was usually well answered, although some candidates suggested 31^{o}C even though this was the result they had been told was anomalous. The calculation in part (c) was often well done; the most common error being to use 25g instead of 50g for the mass of mixture. A few candidates used 1g and there were a few random temperature changes, most commonly 10 ^{o}C, but most candidates who attempted the question gained some credit.

Question 11

Part (a)(i) was only worth one mark as a helpful diagram had been given. Most candidates mentioned either delocalised electrons or referred to electrons moving or the equivalent, but unfortunately too many did not mention both ideas in their response and so did not gain the mark. In (a)(ii) more candidates gained the second mark for stating that atoms/ions slide or layers slide. Many fewer scored the first mark for stating that it is atoms/ions in the layers. As the diagram gave the names of the particles, candidates could not gain full credit for just using the general term *particles*. Some, despite the diagram, gave answers involving the wrong type of particles such as protons. Part (b) proved challenging as expected with only the strongest candidates scoring high marks. Many incorrectly tried to explain both melting points in terms of intermolecular forces. Some, having correctly indicated that TiO_2 had a giant structure then proceeded to contradict this idea by discussing the existence of intermolecular forces. Disappointingly small numbers of candidates identified $TiCl_4$ as having a simple molecular structure, although the mark for indicating this

substance has weak intermolecular forces was quite often awarded. Despite having been told that both were covalent compound there were numerous answers involving ions whilst others gave spurious arguments based on how many electrons were in the covalent bonds. In (c)(i) good candidates were able to construct a correct equation and scored both marks. However, many candidates could not give the formulae of some of the substances even though those of the two titanium compounds had already been given in a previous part of the question. Also, monatomic chlorine was very prevalent. The equation in (ii) proved more accessible.

Question 12

Part (a)(i) Strong candidates answered concisely and correctly. There were fewer than usual references to Le Chatelier's principle but some confused equilibrium and rate. Part (ii) was less well answered with some candidates referring to temperature instead of pressure and many suggested a low pressure would produce a higher yield. Part (b) proved too difficult for all but the best candidates. Many just described a catalyst and others discussed the forward rate equalling the backwards rate at equilibrium. Some were close to gaining the mark by stating that the catalyst increases the rate of the forward and backwards reactions but unfortunately did not include the idea of increasing these rates equally. Parts (c)(i) and (ii) were surprisingly poorly answered. Many did not manage to complete the profile and of those that did, only some of them labelled the product line. In attempting to show the enthalpy change, many drew lines which were insufficiently accurate at the top and/or bottom, with some showing arrows pointing the wrong way, whilst others drew lines without a suitable label. Some just omitted part (ii), and many others just labelled the top of the curve as E. Some, who seemed to have the right idea, drew arrows which were far too short or were pointing to the left of the top of the curve. In (iii) many did not read the question and instead explained how a catalyst works with references to lowering the activation energy and providing an alternative reaction pathway but made no reference to the effect on the enthalpy change.

Question 13

It was pleasing to see the calculation in (a) often correctly done, although with more answers being given in grams than might have been expected. When working in grams, most did not use standard form for the large numbers involved and this sometimes gave rise to errors in the numbers of zeros. In (b) many knew the chemical name of slaked lime although some candidates gave chemical equations

rather than the name as the question asked. The mole calculation in (c)(i) was often correctly answered. The most common error was not dividing by 1000 or incorrectly using 100 instead. Good candidates correctly used their answer to (i) to calculate the minimum mass in part (ii) but many did not use the given equation correctly and so missed the necessary division by 2 or multiplied by 2 instead. In (d) many candidates knew that lime water reacts with carbon dioxide, which is in the air. However, some did not make it clear that a reaction occurred, and many thought that it was oxygen or air that reacted. Whilst some mentioned calcium carbonate, and even gave correct equations for the reaction, they did not specify that the calcium carbonate was the precipitate/solid/insoluble. Some thought that the white precipitate was calcium oxide.

Question 14

The multiple choice parts were usually well answered with parts (c) an (d) proving the most difficult. Many correctly suggested UV light in (e)(i) but some just suggested sunlight and others incorrectly referred to various temperatures, pressures and catalysts. In (ii) there were many correct structures shown but some made careless errors with bonds, some just showed butane and other structures involved bonds to HBr or Br_2.

Question 15

Many correctly identified the Haber process in (a), albeit with various spellings! Part (b) was often fully correct, whilst some were awarded one mark for giving the correct gases but the wrong way around. Those who did not know gave a completely random pair of gases. Part (c) was often poorly answered with just references to condensing gases or turning gases into a liquid, without specifying ammonia. Fewer than expected knew that the catalyst was iron with other substances known to be catalysts such as phosphoric acid and vanadium (v) oxide often being suggested. Too many answers to part (e) were vague, especially references to cost and waste. The most common correct answers referred to more ammonia being produced with fewer suggesting savings of raw materials and energy. Many gave correct numerical or descriptive answers to (f)(i) but 200^0C and 450atm were common incorrect answers. The most common incorrect answer to (ii) was 56%. Part (iii) proved too difficult for most with discussions of compromise temperatures and pressures and ammonia being lost to the atmosphere amongst many incorrect suggestions.

Question 16

In (a) many of those candidates who realised that this was about removing water of crystallisation failed to explain that *all* the water had to be removed. Many just repeated or rewrote the question while others suggested a fair test or improved accuracy as the answer. Parts (b)(i) and (ii) were often correctly answered but sometimes reversed and sometimes (b)(i) was given as 5.6g. Many correct calculations were seen in (iii) from correct answers to the previous parts. Credit was also given to correct methods using incorrect previous values. In (c) there were rather many references to hydrous rather than hydrated copper sulfate. Relatively few candidates scored both marks with many not mentioning the exothermic nature of the reaction.

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