Examiners' Report/
Principal Examiner Feedback

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Pearson Edexcel International GCSE
Chemistry (4CH0) Paper 1C
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## Examiner's Report International GCSE Chemistry 4CH0 1C

### Question 1

Part (a) was well answered in contrast to (b), where answers were not always well expressed. Most candidates gained at least one mark in (b), usually for recognising that the particles lose kinetic/potential energy when a liquid condenses. Many candidates tried to answer the change in arrangement of particles in terms of forming a more regular arrangement, but they did not always mention the key component of the particles getting closer together. Some candidates gave descriptions that would have been more applicable to the arrangement of particles in a solid. The final part of (b) was surprisingly poorly answered by a number of candidates who failed to recognise the most obvious change that the particles would be moving more slowly. Many candidate gave the response of 'particles move less' without qualifying it with less freely or less quickly or less randomly.

### Question 2

Surprisingly few candidates seemed to identify argon, in part (a), as the element in air. In (b), the compound was often identified incorrectly, with an element such as oxygen, nitrogen or argon commonly given, as well the names of some pollutant gases such as sulfur dioxide.

In (c)(i), most candidates knew why the copper went black but, in (c)(ii), only the better ones seemed to know that gases expand on heating. In (c)(iii), most recognised that the small pile of copper did not turn black because all of the oxygen had been used up in reacting with the large pile, but some seemed to think that the copper in the small pile was not 'reactive enough' or that there was 'not enough' oxygen left for a reaction to take place.

The calculation in part (d) was well performed, although some candidates seemed determined to manipulate the data to achieve an answer of 20 or 21%, which they presumably expected to be the correct answer.

### Question 3

In (b)(i), the location of the original spot was the least well-known, with the label line often pointing to the lowest printed spot on the chromatogram. Even when the location was correctly identified as the baseline, some did not place the label in the centre of the line.

A common incorrect answer seen in (b)(ii) was 'three', presumably from candidates who had labelled the bottom spot as the original position of the spot in b(i). Some candidates did not score because they did not refer to spots or dots, but to dyes, or they just made a reference to different heights. Some correctly identified that there were four dyes but them failed to explain why.

### Question 4

Part (a) was generally answered well with many candidates scoring all six marks.

Part (b)(i) proved to be more challenging than expected, where some candidates did not seem to appreciate that a covalent bond is the attraction between a (shared/bonding) pair of electrons and the nuclei of the two atoms involved. 'Non-metals' was a frequent answer given in place of 'electrons'. Most candidates gave, in (b)(ii), a correct formula of $A_2D$ or its acceptable alternative $H_2O$.

## Question 5

Although candidates are used to providing appropriate precision for burette readings, many did not carry this idea forward to the thermometer readings in part (a), and hence lost one mark out of two for failing to include the trailing '0' for the first three readings.

In (b)(i), the majority of candidates were able to identify magnesium as the metal that produced the highest temperature rise, but far fewer stated, in (b)(ii), that the lack of a temperature rise with copper was the result of no reaction taking place. Many merely stated that copper was an unreactive metal; this was not considered sufficient.

Part (c) caught out many. Weaker candidates automatically went for a higher rise, because there was more acid to react with the magnesium. A small number of candidates appreciated that the magnesium was not in excess, so the overall energy released would be the same, but many then stated that there would be no change in temperature rise, rather than appreciating that a larger volume would not get as hot. A number of candidates thought, erroneously, that there would be increase in reaction rate and that this would then produce a greater temperature rise.

## Question 6

In (a)(i), the dot-and-cross diagram for the hydrogen molecule was drawn well by the vast majority of candidates, although some who used overlapping or touching circles failed to place the two electrons in the area of overlap, or where the two circles touched. These circles need not be included in a dot-and-cross diagram and candidates are strongly advised not to include them.

Many candidates found part (a)(ii) difficult with large numbers of them confusing intermolecular forces with covalent bonds. It might be useful for these candidates to consider what happens in a kettle: when water boils it turns into water vapour, not into hydrogen and oxygen. Others decided to mention both the covalent bonds and the intermolecular forces/bonds in their answer, and often then failed to state clearly which of the two were overcome/broken when hydrogen boils. A typical answer along these lines was 'Hydrogen is covalently bonded with weak intermolecular bonds, so little energy is required to break the bonds'. Since, in this answer, it is not clear which bonds are being referred to, the mark for 'little energy is required to break the bonds' cannot be awarded.

The explanation of isotopes in (b)(i) was answered well and precisely by the better candidates, but many did not refer to 'atoms' in their answer. A typical response was 'Isotopes are **elements** with the same atomic number but different mass numbers'. Such responses failed to score the first of the two marks available. Part (b)(ii) proved to be an easy three marks for most. The most common error was in the number of neutrons, with the numbers 1,2,3 being seen far too often.

In (c)(i), most candidates realised that it is an exothermic reaction in which heat energy is transferred to the surroundings, although some thought it was endothermic, and a minority came up with other suggestions such as redox. The equation in (c)(ii) produced the usual errors of monatomic hydrogen and oxygen, but a more common way to lose both marks was to give the formula of water as $H_2O_2$. The chemical and physical tests for water, asked for in parts (iii) and (iv), have been set frequently, but still some candidates decide to choose, for the chemical test, reacting the liquid with a reactive metal such as sodium and, for the physical test, adding universal indicator or litmus.

## Question 7

The answers to (a)(i) produced the usual range of responses associated with a reactive metal added to water, and the mark scheme allowed for any reasonable observations to be given credit. Many candidates, however, failed to take into account that this was calcium and so a number of observations that were applicable only to a Group 1 metal were seen; eg floats/gives a flame/moves around the surface of the water. This suggested that some candidates had not observed the reaction of calcium with water and hence extrapolated from reactions that they had seen. Some candidates also gave, as their only answers, two versions of the same marking point, eg bubbles and effervescence.

In (a)(ii), most candidates recognised that the solution would have a pH greater than 7, but some failed to score the second mark through lack of precision in their answer. Common imprecise answers were: 'OH' rather than $OH^-$; 'hydroxides are alkalis' rather than **metal** hydroxides are alkalis; 'hydroxide' is present rather than hydroxide **ions** are present.

Part (b) required candidates to identify substances. They should be reminded that, in such questions, either a name or a formula is acceptable, but if both are given, both must be correct. A large number of 'calcium chloride – CaCl' were seen for solution Y, which therefore failed to score. Solid Z was identified as calcium hydrogencarbonate by some, who perhaps did not appreciate that this compound would be present in solution, and not as a solid, had excess carbon dioxide been bubbled through the limewater.

## Question 8

The vast majority recognised that the hydrated copper(II) sulfate crystals required heating, but some placed arrows in rather odd places, the strangest of which was underneath the beaker containing the ice/water mixture.

Although candidates had the right idea in part (b), lack of precision in the answer resulted in them failing to score, with, for example, some referring to 'condensing the water' rather than condensing the water **vapour**. Other common unacceptable answers were 'to keep the water cold' or 'to stop the water evaporating'.

The calculation is (c) was done well, although it was common to see the 1:5 ratio of $CuSO_4$:$H_2O$ either not used, producing an answer of 0.18 g, or used twice giving 4.5 g as the answer.

## Question 9

In part (a), most candidates coped well with the different scales on the x-axis and y-axis, plotting the points correctly and then drawing two appropriate lines of best fit. The examiners would like to emphasise that it is important for candidates to have a ruler in the examination in order to draw straight lines on graphs. It is equally important that they follow the instructions - in this case, to make the lines intersect. Some did not extrapolate the two lines to make them intersect; instead they drew a curve or a straight line from the point at 10 $cm^3$ to the point at 15 $cm^3$ and hence could not score either of the two marks available in part (b).

Most were able to read correctly from their graph to produce a correct answer to (b)(i), but in (b)(ii), almost all candidates wrote down the **maximum** temperature reached, and not the **rise** in temperature.

Part (c) was well done on the whole, but some candidates just made vague references to 'cleaning' or 'removing impurities', rather than focusing on the exact

identify of the solutions that needed to be flushed out of the burette on each occasion.
The most common error in (d) was to suggest that solution Y was less reactive, rather than less concentrated, than solution X. Presumably these candidates were confusing the experiment with the temperature rises observed when metals of different reactivity are added to acid.

## Question 10

Part (a) was generally well answered with the most common mistake being to quote water, instead of hydrogen, as a product of the reaction between magnesium and hydrochloric acid.

In part (b), the test for chloride ions was generally well known. The solution was already acidic so it was unnecessary to add nitric acid, however this was not penalised. Some candidates confused this test with that for chlorine, so there were a significant number of 'bleaches litmus paper' given as answers.

## Question 11

Parts (a), (b) and (c) were well answered. Part (d) proved to be more discriminating, with many giving the molecular formula instead of the empirical formula. A few gave the general formula.

In part (e), most managed to give a satisfactory description of the term 'unsaturated', although some confused it with saturated. There were also many excellent descriptions of 'hydrocarbon' but some were confused as to the molecular nature of a hydrocarbon, referring to it as 'an element' or 'an atom'. Also, there were some who stated incorrectly that a hydrocarbon contains hydrogen and carbon **molecules**, rather than hydrogen and carbon **atoms**.

Many candidates gave a correct displayed formula in (f)(i), but some gave just a structural formula, which did not score. The condition of UV light/radiation was generally well known in (f)(ii), but there were a significant number of references to high temperature or high pressure or the use of a catalyst.

## Question 12

Questions on the calculation of an empirical formula, as in part (a), always seem to produce the same errors year in, year out. As before, there were some who had the initial expressions upside down and others who divided by atomic numbers instead relative atomic masses. Sadly, some candidates misread Ti as Tl, and then found it difficult to continue.

A majority of candidates scored both marks in part (b), although some thought that titanium was the element that was oxidised because it lost oxygen, with others thinking, rather strangely, that chlorine had been oxidised.

Part (c) was highly discriminating. The equation in part (i) was rarely correct with the formula of magnesium chloride often given as MgCl or $MgCl_4$. Answers to parts (ii) and (iii) lacked precision. In part (ii), there were many vague references to 'it' reacts with 'air', rather than magnesium/titanium reacts with oxygen/nitrogen. Similarly in part (iii), there were very few who identified that having the mixture in powdered form helped the **magnesium chloride** to dissolve faster. Far too many just stated 'to help **it** dissolve faster' without specifying what 'it' was. The weaker candidates merely stated that the mixture was powdered to increase the rate of reaction.

In (d)(i), most were able to state that a metal structure contained positive ions surrounded by delocalised electrons to score the first mark, but very few then went on to say that it was the attraction between these that produced the bonding observed. In (d)(ii), many recognised the role of electrons in electrical conduction, but some failed to score because they made no reference to the electrons being able to flow or move.

## Question 13

The chemical equation in part (a) produced the usual errors seen when diatomic molecules are involved. Hence there were a number of '$I + Cl \rightarrow ICl$' and also '$2I + Cl_2 \rightarrow 2ICl$'.

As always, equilibria proves to be a difficult topic for many candidates. In (b)(i), a majority were able to score the first mark for stating that the rate of both the forwards and backwards reactions are equal at equilibrium, but most failed to score the second mark. It was common to see statements about how the position of equilibrium moves when conditions are changed, rather than to concentrate on a feature of a reaction that is in equilibrium, such as the concentration/amount of reactants and products remains constant.

The answers to part (ii) produced vague references to reactions being 'favoured' or the reaction 'wanting to decrease the temperature' as a result of the increase in temperature. The use of Le Chatelier's principle is not helpful, as students regard it as a hard-and-fast rule, rather than a vague principle that also happens, on many occasions, to fail to give the correct answer. It is for these reasons that Le Chatelier's principle is deliberately omitted from the specification, and it would be to the candidates' benefit if they were not exposed to it. The model answer here is very straightforward: as temperature increases the mixture gets darker, so there must be more ICl present in the new equilibrium mixture; hence the equilibrium has shifted to the left. Therefore the forward reaction is endothermic, since an increase in temperature shifts the position of equilibrium in the endothermic direction.

## Question 14

The calculation in (a) was very straightforward, but candidates often lost marks for incorrect rounding, eg 0.058 instead of 0.059 for the amount of $K_2O$.

In part (b) many were able to identify equation 3 as the correct equation, although the explanations given would suggest that this may have been a guess for some. Very few recognised that the mole ratio of 0.08:0.04 is identical to that for $K_2CO_3$:$KHCO_3$ in equation 3.

## Question 15

Part (a) caused very few problems for the majority of candidates who correctly identified $\Delta H$ as representing the enthalpy change of the reaction. Those who chose to state that it was an energy change needed to qualify this with 'heat'; 'energy change' on its own is not sufficient.

The calculation in part (b) was also well done. The most common error was to use an incorrect mass in the calculation; both 0.725 (mass of the butane burned) and 200.725 (mass of butane + mass of water) were seen.

Most recognised, in (c)(i), that the negative sign for $\Delta H$ signified that the reaction was exothermic or that it released heat/thermal energy. A small minority chose endothermic as their answer.

Surprisingly few candidates were able, in (c)(ii), to link the formation of soot/carbon to the incomplete combustion of butane. The examiners had hoped that the candidates would have linked this observation to that made when the air hole of the Bunsen burner is closed when burning methane.

In (c)(iii), only the more able candidates were able to appreciate that less heat/thermal energy is produced when incomplete combustion takes place, and that is why the temperature rise is lower than expected, leading to a less negative value for the enthalpy change. Some, however, scored for stating that the carbon may have acted as an insulator and prevented some of the heat/thermal energy from being transferred to the water.

As the notion of 'heat energy' is a subtle one for many students, marking was more generous in part (iv), where any qualified reference to energy loss scored. However, many candidates went off on a tangent and considered why the value quoted in a data book might be inaccurate. Unfortunately, some candidates still insist on quoting mistakes that the student in the question, who is performing the experiment, may have made, rather than suggesting a possible procedural error in the experiment.

## Question 16

This experiment is one commonly used to investigate the rate of reaction of a reaction involving a solid reacting with a solution to produce a gas. However, the questions asked highlighted some fundamental errors in chemical thinking.

In part (a), despite the decrease in mass of the flask and contents, a significant number of candidates argued that the cotton wool stopped the gas from escaping.

Even more concerning was that the mass loss, in part (b), was frequently attributed to the marble chips dissolving into the acid or because 'the gas is lighter than the liquid'. Very few realised the gas was escaping, presumably because they thought the cotton wool was stopping it from escaping.

The graph in (c)(i) started well, but often levelled off either below or above the original curve. There were many fully correct answers provided in part (ii), with candidates remembering that it is not just more (successful) collisions, but more (successful) collisions in a given time that is significant. There will, of course, over the **total** time frame for the reaction, be just as many successful collisions taking place regardless of the concentration employed. Some failed to score the first mark by referring to atoms or molecules of hydrochloric acid. Disappointingly, others scored only the mark for 'increase in rate of reaction' since they referred to either the particles gaining energy or to them moving faster as a result of the increased concentration of acid.

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