Examiners' Report
Principal Examiner Feedback

January 2017

International GCSE
Chemistry (4CH0) Paper 2C

Pearson Edexcel Certificate in
Chemistry (KCH0) Paper 2C

January 2017
Publications Code 4CH0_2C_1701_ER

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Question 1

This proved to be a straightforward question for the vast majority of candidates, with many gaining all five marks.

Question 2

Parts (a)(i) and (a)(ii) required the candidates to extract information from the table in order to state two ways in which both the oxides of metals and the oxides of non-metals are similar to each other. Some candidates lost marks by failing to read the question clearly, giving only one similarity for each. Others lost marks by using information that was not in the table.
In parts (b)(i) and (b)(ii), marks were often lost by not referring to the **oxide** of phosphorus in their answer. Since the subject of the question was phosphorus, an answer in (b)(i) of ‘it is a solid’ was not sufficient, since ‘it’ refers to phosphorus and not to its oxide.
Part (c) proved to be more discriminating than expected with an almost equal number of two, one and zero mark answers. Those that did well recognised that the lamp would not light up and that this meant that phosphorus does not conduct electricity, and therefore must be a non-metal. Many of those who scored zero seemed to think that electrolysis was involved.

Question 3

The majority of candidates were able to score one mark in part (a) for obtaining the correct order of reactivity. However, the second and third marks were often missed, as answers repeated the information given in the question. To score these two marks it was necessary to state that the reaction between titanium and tin oxide showed that titanium **displaced** tin, and similarly the lack of reaction between titanium and calcium oxide showed that titanium **cannot displace** calcium.
The equation in (b)(i) proved to be more difficult than anticipated, with many failing to give the correct formula for either, or both, of iron(III) oxide and aluminium oxide. Common mistakes were, for example, Fe_3O_2 and FeO. There were also some candidates who gave $Fe_2$and Al_2 as the formulae of iron and aluminium respectively.
Part (b)(ii) was answered well, with the majority of candidates choosing to explain the oxidation of aluminium as the gain of oxygen. Some correctly chose ‘loss of electrons’ as their explanation, and there were a few who correctly chose ‘increase in oxidation number’, even though a knowledge of oxidation numbers is not required in the specification.
The answers to part (b)(iii) were varied in their accuracy. Just over forty percent of the candidates were able to obtain both marks for correctly stating that powders have a larger surface area and that this would result in an increase in rate of reaction. Those that were less successful in scoring the first mark gave rather vague descriptions such as ‘there would be more contact between the particles’. References to an increase in frequency of collision were often mentioned, but some candidates then failed to link this to the increase in reaction rate. Some candidates perhaps confused this question with that from a previous paper and stated that the larger surface area would allow the substances to dissolve more quickly.

Question 4

Part (a) was answered well, with the vast majority of candidates recognising that the ammonium ion is present.
There were not as many correct answers given to part (b), with some candidates thinking that the fluoride ion would give a yellow precipitate with silver nitrate solution.
Only sixty percent of the candidates recognised, in part (c), that the carbonate ion would produce a gas when dilute hydrochloric acid is added.
Part (d) was answered well, with just over three-quarters of the candidates producing the correct combinations for the colours of the precipitates.
Part (e), however, was not answered well, with only fifteen percent of the candidates recognising that the ion present must be a carbonate. Since the precipitate disappears when acid is added, the ion present cannot be sulfate, as many candidates thought.

Question 5

There were many correct answers to part (a). The most common reason for failing to obtain both marks was to show the electrons being shared between the two atoms, whilst some lost one mark for not showing the inner two electrons of the fluoride ion.
Part (b) was also answered well, with over sixty percent of the candidates scoring both marks. The most common reason for losing one mark was failing to include the non-bonding electrons on the fluorine atoms. Candidates should also note that if circles are used to represent the electron shells, then the bonding electrons must be contained within the overlapping area, or the touching area, of the two circles.
The question in part (c) has been asked in a similar form a number of times in the past, so it was surprising to see that there were so few (only five percent) fully correct answers. When explaining the high melting point of an ionic compound it is necessary to confine the answer to the strong forces of attraction between the ions. Far too often candidates referred to atoms or molecules as well as ions. The good electrical conductivity of a molten ionic compound is best explained by the existence of ions that are mobile in the liquid state. The statement 'has free ions' is not sufficient.
Many candidates appreciated that the low melting point of carbon tetrafluoride is a result of the relatively weak forces of attraction between the molecules. Some candidates mistakenly based their argument of weak covalent bonds being broken during melting. The poor electrical conductivity of simple molecular substances is best explained by stating that the molecules are neutral. Any reference to ions is irrelevant, but a reference to their being no delocalised or mobile electrons was accepted as an alternative explanation. The statement 'no free electrons' is not sufficient.

Question 6

Parts (a)(i) and parts (a)(ii) were both answered well, although most candidates scored the mark in part (i) for the acceptable answer that the yeast is the catalyst, rather than the better answer that it provides the enzyme zymase that acts as the catalyst.
Only half of the candidates were aware, in part (a)(iii), of the temperature required for a successful fermentation, with many quoting values well in excess of 200 °C, which would of course lead to the enzyme being denatured.
The calculation in part (b) produced the full range of marks, with only about a quarter of the candidates scoring all four marks. Many lost marks by not including all of the bonds broken and/or made in their calculations. Some who made this mistake were, however, then able to continue with the calculation by correctly subtracting the sum of the bonds broken from the sum of the bonds made, although when this lead to a positive value many did not include the + sign in front of their final answer. The overall enthalpy change of a reaction has a sign as well as a magnitude, and this must be included.

The calculation in part (c)(i) was performed well by the majority of candidates. Some quoted an incorrect value for the relative molecular mass of methanol, but then correctly multiplied their value by 15.6 to score the second mark.
The question in part (c)(ii) has been asked before, so it was surprising to see only seven percent of the candidates scoring both marks. Of those that scored one mark, the most common correct answer given was to keep the mass/volume/amount of water constant. Those that scored the second mark did so for recognising that the distance between the flame and the copper can needed to be the same.
When asked to consider the difference between experimental values obtained by students in the laboratory, and values obtained from data books, as in part (c)(iii), candidates need to focus on procedural errors in the experiment, and not to consider mistakes that the student may have made in performing the experiment. Unfortunately, many chose the latter route to answering this question and hence received no credit for their efforts. This question has been asked before, so it was surprising to see that only five percent of the candidates scored both marks, with well over half scoring zero.

Question 7

The easiest route to solving the problem set in (a)(i) was to work out how many moles of magnesium carbonate are required to react with the hydrochloric acid, and to then compare this with the number of moles of magnesium carbonate supplied. Many chose this route, but other, equally acceptable routes, were also seen. A significant number of candidates calculated the mass of magnesium carbonate taken (4.2 g), but then compared this with the mass of hydrochloric acid taken (2.92 g), rather than with the mass of magnesium carbonate required to react with the acid (3.36 g).
Forty percent of the candidates correctly calculated the volume of carbon dioxide obtained in part (a)(ii) as 960 cm^3. Twenty percent failed to halve the moles of acid and arrived at an answer of 1920 cm^3, to score one mark. The rest appeared to have little idea how to solve this problem.
The calculation in part (b)(i) was not straightforward and produced very few fully correct answers. Errors in calculating the relative formula mass of hydrated magnesium chloride were very common, and many of those who correctly calculated it as 203 did not then know how to use this figure to obtain the theoretical maximum mass of crystals that could be formed, so were unable to calculate the correct percentage yield.
Part (b)(ii) was very poorly answered. A significant number of candidates stated that not all of the magnesium carbonate reacted, despite the question stating that the acid was in excess. Of the three possible acceptable answers listed in the mark scheme, the only one seen was that the magnesium carbonate was impure. It would appear that candidates did not appreciate that crystals are obtained by crystallisation, and that not all of the product crystallises when a hot saturated solution is cooled; some will always remain in solution.

Question 8

For a question that has been asked several times before, it was surprising that, in part (a), very few candidates knew that the two features of a reaction that is in dynamic equilibrium are 1) the rate of the forward and backward reactions must be equal, and 2) the concentrations of the reactants and products remain constant. Common mistakes were stating just that the forward and backward reactions are equal, without any reference to rate, and that the concentrations of reactants and products are the same.
The majority of candidates were able to recognise, in (b)(i), the point on the curve where the reaction reached equilibrium. Very few, however, were able to recognise that the number of moles of product at the beginning is zero, and hence failed to start their curve at (0,0). Of those that did start their curve there, many finished it at the same level as the original curve, failing to appreciate the information given in the question, that at equilibrium there is **more** NO_2 than N_2O_4.

In part (c), it was very pleasing to see that there were far fewer references to Le Chatelier’s principle. Questions of this type are relatively straightforward to answer as long as the candidate focuses on the change in position of equilibrium and the significance of this change. In this case the equilibrium position shifts to the left, so the backward reaction must be endothermic, since an increase in temperature shifts the position of equilibrium in the endothermic direction. Candidates would do well to remember that the one word to avoid at all costs in their answer is ‘favours’.