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Examiners' Report/
Principal Examiner Feedback

January 2016

Pearson Edexcel International GCSE
in Chemistry (4CH0) Paper 1C

Or

Pearson Edexcel Certificate
in Chemistry (4CH0) Paper 1C

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Question 1

Parts (a)(i) and (a)(ii) were answered correctly by the majority of candidates. The most common mistake in (a)(ii) was response C, Ca.

Over 95% recognised, in (b)(i), that the element is in Group 3, but slightly less than two thirds of the candidates were able, in (b)(ii), to successfully explain the reason why. A general statement such as 'the group number is the same as the number of electrons in the outer shell' did not score; it was necessary to state that there were three electrons in the outer shell. A similar situation occurred in the answers to (b)(iii) and (b)(iv). To score in (b)(iv, it was necessary to state that the atom had three shells occupied with electrons; it was not sufficient to merely state that the period number is the same as the number of shells occupied. The majority of candidates had no problem in identifying the element as aluminium in part (b)(v).

In part (c), most were able to recognise that an atom of fluorine has an electronic configuration of 2.7, although some gave it as 2.5.

Question 2

In part (a), very few candidates were unable to recognise that the group 7 elements are called the halogens.

A number of candidates scored only one mark out of the two available in (b)(i) because they stated that isotopes are **elements** that have the same atomic number but different mass numbers, instead of stating that isotopes are **atoms**. The table in (b)(ii) was successfully completed by the majority of candidates, but some stated that the number of neutrons were 79 and 81 respectively.

In part (c), the candidates were informed in the question that the colour of bromine water is orange, and yet a significant number still referred to it as being either brown or yellow in their answers. Some gave the observations the wrong way around and therefore failed to score either mark.

Question 3

It was very surprising to see, in part (a), that only a third of the candidates were able to work out that gas Z was nitrogen.

Also surprising was that, in part (b), only just over half were able to complete correctly the word equation for the complete combustion of octane.

In part (c), the reason for the formation of carbon monoxide was well understood by most, but some confused its formation here with that in the blast furnace, and stated that it was a result of the reaction between carbon with carbon dioxide.

The chemical equation for the formation of nitrogen dioxide in part (d)(i) brought the usual mistakes of 'N' for nitrogen and 'O' oxygen. As a result only just over a quarter of the equations seen were correct. The most common mistake was $N + O_2 \rightarrow NO_2$. By contrast, nearly two thirds were able to state, in (d)(ii), that nitrogen dioxide was a cause of acid rain. References to nitrogen dioxide being a greenhouse gas or contributing to global warming did not receive credit. Some candidates also mistakenly believed that nitrogen dioxide was involved in the destruction of the ozone layer.

Question 4

Surprisingly, only about sixty percent of the candidates knew, in part (a), that water is the substance that turns anhydrous copper(II) sulfate blue. Oxygen was the most common incorrect answer seen. By contrast in (b), three quarters of the candidates knew that carbon dioxide causes limewater to turn milky.

Only half of the candidates failed to score any marks in part (c). Of those who correctly identified that the copper was reacting with oxygen, fifty percent were able to gain the second mark by stating that the compound formed was copper(II) oxide. A common mistake was to assume that carbon dioxide was reacting with copper.

Question 5

A majority scored either two or three marks in part (a) for the plotting and drawing of the curve of best fit. The most common way to lose one mark was to join up the points 'dot-to-dot', even incorporating the anomalous point, either freehand or with the aid of a ruler.

Many correct identifications of the volume that produced the anomalous result were seen in (b)(i). However, in (b)(ii), although around two thirds were able to identify that the magnesium carbonate has fully reacted once 35 cm^3 of acid has been added, very few linked this to the fact that the volume of gas produced was the same when both 35 cm^3 and 40 cm^3 of acid were added. Reading from the graph in (b)(ii) and (b)(iv) was well done, but fewer candidates were able to read the graph accurately in (b)(iv).

Question 6

The usual mistakes were seen in the equation in (a)(i), namely 'O' for oxygen and Hg_2 for mercury, presumably from attempts to balance the equation. Candidates would do better if they adopted the approach of writing correct formulae for both the reactants and products **before** attempting to balance. $Hg + O_2 \rightarrow HgO_2$ was a fairly common mistake despite the formula for mercury(II) oxide being given in the question. In part (a)(ii) around sixty percent of candidates were able to identify the type of reaction, most stating that it was (thermal) decomposition.

Very few candidates were able, in (b)(i), to identify the piece of apparatus as a tap funnel. Burette was the most common incorrect answer, which is surprising since no graduation lines are shown. Thistle funnel was another fairly common incorrect answer, which was not allowed since a thistle funnel does not have a tap. It was disappointing that, in part (b)(ii), less than ten percent were able to state that the first sample of gas collected would contain air from the apparatus.

In part (c), it was disappointing that half of the candidates failed to score any marks and also that it was extremely rare to see all four marks scored. The question asked to **describe a method**. Candidates should realise that the use of this command phrase means that relevant practical procedures must be included in their answer. Of the candidates who chose to answer this question by considering the effect on the rate of reaction, many scored the mark available for stating that the reaction should be carried out both with and without manganese(IV) oxide, but many then failed to mention that the conditions need to be kept constant for each reaction, and descriptions of how the rate of reaction is monitored were often too vague. Those candidates who chose to show that the manganese(IV) oxide is not used up in the reaction usually scored marks for measuring the mass before adding, and stating that the mass is the same at the end of the reaction, but failed to mention how the manganese(IV) oxide would be recovered and that it needed to be dried before re-weighing.

Very few correct equations were seen in answer to part (d)(i). Sulfuric acid was often given as the product without oxygen included as a reactant. Part (d)(ii) was better answered although some failed to explain the correct answer for the colour change by stating that the solution produced was acidic.

Question 7

In part 7(a), most were able to identify curve A and to state that the reaction was faster, but few linked this to the steeper curve.

Similarly in (b), most were able to identify curve C but failed to be specific in linking the mass of zinc used to the volume of hydrogen produced.

Question 8

In part (a) a number of candidates referred to only one of the reactions of Y. To score the mark it was necessary to state that Y produced a precipitate with **both** X **and** Z. A few chose the equally acceptable alternative of stating that X and Z produced no change when added together.

Many candidates failed to appreciate that, in (b), they were required to identify **both** X and Z. Some correctly identified the two coloured precipitates but the failed to relate these to X and Z. A few candidates got the colours the wrong way around so thought that X was sodium chloride.

Part (c) was another low scoring question. Some candidates recognised that chlorine does not react with sodium chloride, but many who had some idea of the reaction between chlorine and sodium iodide simply stated that chlorine displaces iodine without giving a relevant observation. Candidates need to appreciate that in order to be able to explain how observations can be used it is first of all necessary to state what the observations are if they are not given. A number of candidates highlighted sodium chloride as the significant product of the reaction between chlorine and sodium iodide, but many who attempted an observation thought that iodine solution would be purple or grey, while others thought that the precipitate produced would be brown. A significant number of candidates failed to read the question and continued to give answers relating to reactions with silver nitrate.

Question 9

Part (a) asked for the names of the **raw materials**, so answers such as carbon, instead of coke, and calcium carbonate, instead of limestone, were not accepted.

The standard equation for the reduction of iron(III) oxide by carbon monoxide, asked for in part (b)(i), was not well known. A common mistake was to write Fe_2

for iron, presumably in an attempt to balance the equation. Another, surprising, common error was to have FeO as a product, despite the question stating that the iron(III) oxide was converted into iron in the reaction. Most managed to score at least one mark in (b)(ii) for realising that the element reduced was iron, although some stated that iron(III) oxide was reduced. Many then subsequently stated correctly that the reason was the loss of oxygen, but some who tried to answer this in terms of electrons stated that iron atoms, and not the iron(III) ions, were gaining the electrons.

Most managed to produce a correct equation in (c)(i), but some still insist that the formula for carbon is C_2. Only half of the candidates recognised in (c)(ii) that the reaction was a neutralisation, with all of the distractors featuring as choices.

Part (d)(i) was well answered with most knowing that both water and oxygen are needed for rusting. However, (d)(ii) was surprisingly less well answered with many candidates not being able to express their answer clearly. Some thought that the paint would offer sacrificial protection to the iron rather than simply acting as a barrier, so that water and oxygen cannot come into contact with it.

In part (e)(i), just over half of the candidates knew that coating iron with zinc is called galvanising. Most knew, in (e)(ii), that zinc is more reactive than iron but not all of these went on to state that the zinc reacts/corrodes in preference to the iron. Some failed to score this second mark by stating that the zinc rusted. There were some answers along the lines of the zinc transferring electrons to the iron, but unfortunately most of these stated that the electrons would be transferred to iron atoms instead of any iron(II) ions that may have formed as a result of the iron being exposed.

Only a small minority appreciated, in part(f)(i), that aluminium is more reactive that carbon. Some stated that aluminium is more reactive than carbon monoxide, which did not score since carbon monoxide is not in the reactivity series of elements. Some either knew, or guessed, that carbon monoxide can reduce aluminium oxide but that a very high temperature is required. Part (f)(ii) was very poorly answered, with very few candidates appreciating that electrolysis is expensive because of the high cost of electricity.

Question 10

The majority of candidates knew, in part (a), that unsaturated meant that at least one double bond is present in the molecule. There were a number of references to the molecule not containing the maximum number of hydrogen atoms or being able to undergo addition reactions. Both of these statements were ignored so it is in the candidate's interest not to include them.

Most managed to score the mark in (b)(i), but some did not read the question correctly and gave hydrocarbons other than octane and ethene. Part (b)(ii), however, was not so well answered with more candidates scoring zero. Some answers were too vague, simply stating that a high temperature and a catalyst are required. There is no reference to pressure in the specification so any mention of pressure in the answer was ignored.

In (c)(i), most had learned the definition of isomers and were able to state it accurately. Some got the types of formulae the wrong way around whilst others used the term 'chemical' instead of 'molecular' to describe the formula that was the same. Some candidates contradicted themselves by stating that isomers had the same structural formula but different displayed formulae. The answers to (c)(ii) were not as good as expected, with many simply redrawing one of the original structures in a different way. Some did produce the required structure of but-1-ene whilst others drew *trans*-but-2-ene, which also scored.

It was surprising, in (d)(i), that over a third of the candidates did not know the name of the polymer formed from propene. The most common mistake was poly(propane), although poly(ethene) and just propene were also given as answers. The structure of the repeating unit was given correctly by most, although many unnecessarily included brackets and the subscript 'n', so effectively giving the structure of the polymer and not the repeat unit, which was not penalised on this occasion. Some lost one mark by giving more than one repeat unit whilst others failed to include the extension bonds.

About one third of the candidates were able to produce a correct structure for the monomer in part (e). Some candidates lost marks by drawing the bond from the right-hand carbon atom to the oxygen of the $COOCH_3$ group or to the nitrogen atom of the CN group. The use of lower case letters and the incorrect use of the subscript '3' in the CH_3 group were also penalised.

Question 11

Part(a) was answered well with many candidates being able to link the negative charge of the chromate ion to its migration to the positive electrode where the solution went yellow. There was confusion for some between anion and cation.

Most of the candidates were, in (b)(i), able to provide the correct stoichiometric coefficients for the equation. Surprisingly, (b)(ii) was not answered well with the majority choosing an answer other than HCl(aq).

In part (c)(i), the stem of the question stated that potassium chromate and lead(II) nitrate were aqueous and yet there were quite a number of candidates who used 'l' and even 'g' for their state symbols for these reactants. Others did not link the formation of a precipitate of lead(II) chromate with the state symbol 's' in the equation. It was a surprise to see that just as many candidates scored zero in (c)(ii) as scored all three marks. Some candidates chose to evaporate the filtrate after filtration, instead of washing and drying the residue. No credit was given to those who chose to heat the mixture to remove the water, since this would produce a solid containing both lead(II) chromate and potassium nitrate.

Question 12

The majority managed, in (a)(i), to calculate the amount of sodium carbonate that reacts, but far fewer were then able to use this value to calculate the molar volume of carbon dioxide. Common mistakes were multiplying 110 by 0.005 instead of dividing and to introduce 24 000 into the calculation, typically multiplying it by 0.005.

Part (b) was poorly answered with many candidates focussing on potential mistakes made by the student rather than on the procedural errors of loss of gas by not being able to replace the bung before the reaction starts and by some of the carbon dioxide dissolving on the water. Unsupported statements such as 'some of the gas escaped' were not credited. The majority of candidates appeared to have little idea of how to tackle this question resulting in less than ten percent obtaining both marks. Candidates need to practice answering these types of questions in order to improve their score in these papers.

Question 13

Surprisingly only just over half of the candidates were able to select a metal that is extracted by electrolysis in part (a). A number gave copper as their answer. Whilst copper is purified by electrolysis, it is mot extracted from its ore by electrolysis.

Many good answers were seen in part (b) making direct comparisons with both magnesium and zinc. Some, however, thought that uranium would not react and some made a comparison with only one of the metals listed, eg bubbles produced faster than with zinc.

In part (c)(i), most realised that the compound formed is potassium hydroxide, with the most common mistake being potassium oxide. Rather less were able to give a correct formula of magnesium oxide in (c)(ii), and some gave the formula for magnesium hydroxide. Candidates should be aware that if, in this type of question, they give an equation for the reaction and there is more than one product, they must make it clear, eg by underlining or circling, which product they wish to be considered as their answer.

In part (d)(i), most knew that the more reactive element was carbon but many did not score the mark because they did not give a reason, or they gave an unacceptable reason such as 'it displaced oxygen' rather than it displaced zinc. By comparison, (d)(ii) was better answered with a variety of acceptable answers being given for the explanation of why carbon is acting as the reducing agent.

Question 14

Part (a) was poorly answered with a significant number of candidates failing to score any marks. Many of those candidates who did identify that more nitrogen dioxide was being produced then relied on arguments based on le Chatelier's Principle to justify their answer. Statements such as 'If the pressure is reduced the reaction tries to increase the pressure' do not gain credit, as either do statements such as 'The backward reaction is favoured'. If candidates are never exposed to le Chatelier's Principle then they are not likely to use arguments based on it in their answers.

A similar argument applies to part (b)(i), where candidates simply had to state that the position of equilibrium had shifted to the right and then link this to the fact that a decrease in temperature shifts the equilibrium in the direction of the exothermic reaction. Candidates should be aware that a decrease in temperature does not favour the exothermic reaction; a decrease in temperature favours neither reaction since the rate of both reactions decreases. It could be argued, however, that a decrease in temperature favours the exothermic reaction **relative** to the reverse reaction, since the decrease in rate of the exothermic reaction is less than the decrease in rate of the endothermic reaction. Such a detailed discussion, however, would not be expected at this level.

Question 15

In part (a) many lost both marks since they were unable to give the correct formula of magnesium nitride, with the most common incorrect formula being Mg_3N. Most of those who gave a correct formula for magnesium nitride were then able to correctly balance the equation.

It was very surprising to see that almost half of the candidates did not know how to test for ammonia gas. Some lost both marks since they unnecessarily added sodium hydroxide to the reaction mixture and then did not make it clear that they were subsequently testing the gas and not the solution. Some candidates lost one mark by not stating that red litmus must be used. Some of those who chose the alternative test of mixing with hydrogen chloride to produce a white solid, unfortunately stated that the gas should be added to hydrochloric acid.

The majority of candidates scored both marks in (b)(ii) for calculating the amount of lithium nitride used in the reaction and then subsequently were able to calculate correctly, in (b)(iii), the amount of lithium hydroxide formed. Most candidates who knew how to tackle (b)(iv) used their answer to (b)(iii) despite the typographical error in the question asking them to use their answer to (b)(ii). However, many failed to divide their previous answer by two before dividing by 0.5. Some candidates calculated an answer in cm^3 and then gave dm^3 as their unit, and some did the opposite. Candidates who based their calculation in (b)(iv) on their answer to (b)(ii) were given equivalent credit.

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