Examiners' Report/
Principal Examiner Feedback

Summer 2013

International GCSE
Chemistry (4CH0) Paper 1CR

Science Double Award (4SC0)
Paper 1CR

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Question 1
A surprising number of students appeared to believe that the colour coding was the only way to tell the gases apart, mentioning that most gases were colourless and therefore coloured cylinders were necessary.
The rest of the question posed few problems, although some students thought that air was a mixture only of elements and that helium was less dense than hydrogen.

Question 2
Most students were able to recognise that heating calcium carbonate caused thermal decomposition.
In (b), the limewater test was well known but many lost the first mark as they did not state that the original solution was colourless. All solutions are clear, regardless of their colour, so this answer on its own is not sufficient.
Quite a few students scored only one mark in (c) for just stating that sulfur dioxide reacts with marble. However, the majority knew that the sulfur dioxide forms acid rain although they did not always state that this was because it reacts with water present in the atmosphere. Some lost the last mark by stating that the acid rain erodes the marble. Students need to appreciate that the effect of acid rain on marble is a chemical process not a physical one, hence corrode not erode.

Question 3
The formulae of barium chloride and barium carbonate were invariably correct, although there was some unnecessary use of brackets, eg $Ba(CO_3)$, which was not penalised.
Most students realised that the barium carbonate would react with the acid in the stomach and form barium chloride, which is soluble and therefore poisonous. Those that did then had no problem in recognising that the insoluble barium sulfate, which would not react with stomach acid, is safe to use in taking X-rays of the stomach.
In part (d), some students failed to mention that barium sulfate is formed and so lost both of the first two available marks. A significant number of students explained the reaction taking place in terms of the greater reactivity of magnesium over that of barium. Although this was ignored it does highlight that there is a misconception amongst many students of the exact nature of a precipitation reaction. The use of phrases such as 'double decomposition' do not help and the examiners strongly recommend that the use of this term is discontinued. The word equation was usually correct although a few thought the products were barium sulfate, magnesium oxide and water. Those who did not read the question and tried to write a chemical equation often got it wrong and so lost the mark. Students should be aware that trying to construct a chemical equation rather than state a word equation, as asked for in the question, runs a greater risk of error.
Part (e) was well answered in general. The most common mistake in (e)(i) was to forget to qualify the reactions as **very** or **extremely** quick. A surprisingly large number of students thought that warm water would be best storage medium for barium and others thought that an airtight container would ensure that there would be no air present. The relationship

between reactivity and atomic number was easy to establish, although some tried to quantify the relationship as directly proportional and were penalised for so doing.

Question 4
Most students realised that the electrodes in aluminium extraction were made of graphite.
In (b), most students were obviously aware of the need for an ionic compound to be molten to be able to undergo electrolysis, but some then failed to mention that the temperature required to achieve this in the case of aluminium oxide would be high because of the high melting temperature of the compound. Some lost the mark by saying that aluminium has a high melting temperature. The use of cryolite as part of the electrolytic mixture is well appreciated, but the reason for its use, as a solvent for the aluminium oxide, appears to be less well known. A common misconception is that cryolite is added to the aluminium oxide and not vice versa. Around 95% of the electrolyte is cryolite and aluminium oxide is continually added during the electrolysis.
Most recognised the reaction in (c) as a reduction, but marks were lost by those who said aluminium, and not the aluminium **ion**, gains electrons. In (d), most knew that carbon dioxide was formed by the reaction of the positive carbon electrode with oxygen, but only a few mentioned that the oxygen involved was that produced by the electrolysis, with many stating that the oxygen came from the air. Surprisingly only a few students managed to score two marks in (e). Often they stated that aluminium is light rather than it has a low density. Some said it was unreactive, which alone did not score, while others said it was strong. The most common correct answer was malleable.

Question 5
On the whole this question was well answered. In (a), most students knew that isomers had different displayed or structural formulae, but some lost the first mark stating they have the same chemical or general formula rather than the same molecular formula. Rather strangely, a number of students who answered (a) correctly failed to identify the structure in (b) that was not an isomer of heptane.
The general formula of the alkenes was well known and most students were able to accurately complete the displayed formula of heptene, although some placed the double bond between the second and third carbon atoms from the left, whilst others drew either all single or all double bonds.
In (d), very few knew that the reaction was addition, but the colour change was usually well known, although once again clear or transparent was given instead of colourless.
The most common error in (e) was to fail to state that in a saturated hydrocarbon **all** of the carbon-carbon bonds are single.

Question 6
The number of electrons in the outer shell of astatine was well known and most correctly predicted the physical state for the element. The most common correct answer for the colour was black but some of those who chose dark grey did not qualify it with **very**. There were also many correct

predictions of the formula and name of the compound formed between hydrogen and astatine.

In (a)(iv), most knew that astatine was less reactive. The explanation expected was that the elements become less reactive with increasing atomic number. The explanation in terms of number of electron shells and ease of gaining an extra electron is not in the specification, but credit was given to those students who produced a correct argument.

The balancing of the equation in (b) was mostly correct and most knew that the litmus paper would be bleached by chlorine. Both turning white and turning colourless were credited, since the paper turns white because the indicator becomes colourless.

In (c), most students correctly chose to add an acid to lower the pH, with the most common answer being hydrochloric acid. The answers to (c)(ii) produced the usual confusion between **reaction** with bromide ions and **displacement** of bromine. Students need to be aware that in a displacement reaction, the correct terminology is to state that the **halogen** is displaced, not the halide ion.

Most students who could write the correct formula for the reactants and products in the two equations were also able to balance them. The most common mistake in (c)(iv) was to write 2Cl.

Part (d) was not well known. Many thought the potassium iodide solution had a colour and that the iodine was dark grey (which they presumably got from the table at the start of the question), but they failed to say it was formed as a solid.

For future reference, the best descriptions of the colours of bromine water and an aqueous solution of iodine are orange and brown respectively.

Question 7

The three most common mistakes in the equation were to quote HCl as a liquid, $CaCl_2$ as a solid and H_2O as a gas.

In (b), only the most able students stated that the cotton wool was there to prevent the acid from escaping. Surprisingly, many students thought that cotton wool will stop the gas escaping, or will stop air from entering the flask.

Part (c) was well answered but, disappointingly, many just stated the reaction was faster and did not refer to the graph, although this was not penalised. Most students managed to recognise that the concentration of the acid used in Experiment C was 0.10 mol dm^{-3} because half the volume of gas was produced.

In (d), plotting and drawing of the best fit line was generally well done with most scoring full marks. A suitable line of best fit that did not go through the origin could be drawn using the correctly plotted points. In this instance, the conclusion that the rate and concentration are directly proportional should not be made, but this was not penalised. The majority obtained the first mark in (d)(ii), but fewer got the second mark for the idea of proportionality.

In (d)(iii), the idea of particle collisions was well known but fewer gained the frequency mark. Some lost the first mark by referring to molecules or atoms of hydrochloric acid. Students are expected to know that the reactions of an acid are those of the hydrogen **ion**.

Question 8
Many answers to (a)(i) were often too vague and the idea of impurities affecting the colour of the flame was often not mentioned. Part (a)(ii) was answered well by most but a few thought that the temperature of the flame was important in a flame test, stating either that a roaring flame would be too hot or that a luminous flame would not be hot enough.
The more able students scored well in (b) but others seemed to just guess rather than use the information in the table. In part (ii), most knew the gas was ammonia but very few realised that the litmus must be damp as water is needed to form the hydroxide ions required to turn the litmus blue. As in previous papers, the examiners were left with the impression that many students are learning the tests for ions and gases by rote and not necessarily understanding the chemistry involved.

Question 9
Most recognised a measuring cylinder and were able to accurately record the volume of liquid in it, although a few lost a mark by not giving the units. In (a)(iii), a number of students failed to divide by 1000 and so lost the first mark.
Part (b) was a good discriminator and only the more able students scored both marks. Many failed to refer to the stoichiometry of the equation and hence thought that hydrochloric acid was in excess as 0.01 is bigger than 0.0075. A number of students referred to the different atomic masses of the two elements, but failed to appreciate the significance of these in terms of the differing amounts of each taken.
The effects of the change from magnesium to zinc on the rate of reaction and the volume of gas given off were appreciated by most.

Question 10
Part (a) was poorly answered with the majority not appearing to appreciate the demands of the question. Some mentioned that the reaction is reversible without going on to state that both reactions are still occurring. Others referred to the effects of temperature and pressure on the equilibrium composition.
There were many good answers to (b)(i), but the explanations given in (b)(ii) were sometimes lacking in detail. The more able students answered this well but many just said the equilibrium moves to the left when temperature is increased and to the right when pressure is increased without stating why. On the positive side, it was very pleasing to see that very few students referred to le Chatelier's principle in their answers, and virtually no one made erroneous statements such as 'the reaction tries to decrease the temperature' or 'the reaction tries to decrease the pressure'.
Part (c)(i) discriminated well, as was expected, and it was good to see that a significant number of students were prepared to interpret the data correctly, and reach the conclusion that the reaction does not reach equilibrium in the Haber process. This was particularly pleasing since many students will have learned mistakenly, from various sources, that it does reach equilibrium.
Most knew the answers to (c)(ii) and(c)(iii), although some lost a mark in part (ii) for not mentioning that the gaseous mixture has to be cooled in order for the ammonia to liquefy.

Since the reaction does not reach equilibrium, it is incorrect to state that the **equilibrium** yield would be decreased by an increase in temperature, but this was not penalised. Very few mentioned the idea of energy costs being higher, with some just stating that the costs would be higher without stipulating energy.

Only the more able students scored full marks in (e). The most common errors were dividing by 14 instead of 28, failing to convert kilograms to grams or not using the stoichiometry of the equation and hence forgetting to double the amount of nitrogen by two to obtain the amount of ammonia. Most got a mark for a correct percentage calculation based consequentially on their answer to part (i).

Question 11

This question proved to be a good discriminator with only the more able students scoring high marks.

In parts (a) and (b) most did not appear to know what to do with the data in the table. In (a) it was very common to mention the mass of fuel burned and the temperature rise achieved, but not to link the two together to obtain the answer. The most common answer to (b) was to say diesel gives the highest temperature rise, with no reference to the amount of fuel burned.

Surprisingly very few students scored both marks in (c) with many focusing on human error instead of inaccuracies in the method used. It was very common to see references to errors in calculation, errors in measuring temperatures, errors in measuring the mass of propanol, etc. Students need to be aware that it is the errors in procedure that should be the focus of their attention when answering questions of this type.

Most scored both marks in (d) with the most common error to give C as the answer to the energy released.

The most able students gave a clear, concise, one sentence answer to (e), which scored all three marks. Others were very confused often with students thinking that energy is taken in when bonds are made and/or that energy is given out when bonds are broken.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
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