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# Examiners' Report/
# Principal Examiner Feedback

January 2016

Pearson Edexcel International A Level in Chemistry (WCH02) Paper 01

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## General

The paper had questions which addressed the whole ability range and so was accessible to all students. There was no evidence of any shortage of time. There were a few calculation questions on the paper which were generally done well by all, but these also enabled distinctions to be made between students of differing ability. Many students showed limited knowledge of practical techniques and the responses to the questions on these aspects proved to be very discriminating. The most demanding questions were those which required the application of chemical concepts and principles.

## Question 21

Part (a), surprisingly, was not attempted by quite a few students. For those who did, however, the main error was in identifying compound **A**. Instead of being drawn as a ketone, it was frequently shown containing a carboxylic acid group, with a pentavalent carbon atom.
Compound **B** was often identified correctly as cyclopentane, with just a few students displaying a bond between a nickel atom and one of the carbon atoms in the ring.
Compound **C**’s structure was frequently shown as the correct cyclic dibromoalkane, although by contrast a number of structures showed only one Br atom. Other responses predicted that a Br atom and an OH group would be added across the double bond, which would have been correct if bromine water, rather than liquid bromine, was the reagent. A very high proportion of students correctly gave the colour change in (b).

In (c)(i), obtaining all three scoring points proved elusive for many. The most common errors were to include a lone pair of electrons on the hydrogen atom of the $OH^-$ ion, rather than the oxygen atom, or to omit the dipoles on the atoms in the C−Br bond. Also, the co-product was often shown incorrectly as ‘NaBr’ or ‘HBr’, instead of the required bromide ion, $Br^-$. Parts (c)(ii) and (c)(iii) were generally higher scoring than (c)(i).

## Question 22

In (a), the majority of students drew a correct displayed formula for the repeat unit of the polymer, but a large number failed to score the first marking point, usually by omitting an “n” from in front of the monomer or by placing it after its formula as a subscript. Almost all students were awarded the third scoring point, for inclusion of the two continuation bonds. There were, however, some students who thought that this process involved hydrogenation and so placed an extra “$H_2$” molecule on the left-hand side of their equation.

In (b), the correct response to this question was known by the majority of students, with the most frequent answer being that “only one product is formed”.

Part (c) was answered well by the majority of students. In (c)(i), most students correctly linked the shift in the position of equilibrium to the exothermic nature of the forward reaction.
In (c)(ii), there were more variations in the range of responses. A number of students stated, incorrectly, that the equilibrium shifted to the right and then attempted an explanation in terms of rate of reaction and collision theory.

In (d)(i), the labelling of the axes was accurately done by many, though there was a sizeable minority who only labelled the first graph. In part (d)(ii), the curve for $T_2$ was usually drawn correctly, though some failed to draw a line for the activation

energy on their graph. The explanations for the increase in rate of reaction, as temperature increased, that did not make any reference to the term 'activation energy' were not awarded the third scoring point.
Generally, those students who had done well in (d)(ii) tended to be those who did equally well in part (d)(iii), though a sizeable number who mentioned the fact that a catalyst provides an alternative route of lower activation energy were unable to show this clearly on the graph.

## Question 23

Part (a)(i) proved to be a straight forward start to this question, with the majority of students able to predict a suitable value for the pH of limewater. In (a)(ii), the correct species were often given, but the state symbols were not always accurate.

Part (b) confounded many, with a significant proportion of students misinterpreting the requirements of both the questions. These students tried to calculate the number of ions in (b)(i), and the number of electrons in (b)(ii), by using the Avogadro constant, rather than calculating the number of moles in each case.

In (c), there were several answers which involved an incorrect reaction between calcium carbonate and water, with the accompanying equation giving calcium hydroxide and carbon dioxide as the products. Marks were also lost when describing the addition of water to calcium oxide, by suggesting the use of heat or dissolving the calcium oxide in an excess of water. These errors are a reminder to students of the need to read each question carefully, as it was clearly stated that two stages were required for the process and that **solid** calcium hydroxide was the required final product.

In (d)(i), the state symbol mark for a 'near miss' equation was frequently awarded, as a consequence of the equation given often not having been balanced correctly. The students who were not awarded the state symbol mark either showed water in the gas state or the dilute sulfuric acid product was given the state symbol (l), rather than (aq).
Part (d)(ii) was found to be very challenging, with only a very small minority identifying calcium oxide as a base. Instead, the term "reducing agent" was frequently seen, as was the notion that "calcium is higher in the reactivity series than sulfur". Arguments linked to the high surface area of the powdered calcium oxide were also offered as answers.
Part (d)(iii) was answered well by the majority of students, with carbon dioxide and its responsibility for global warming being by far the most popular choice of substance and its effect on the environment.

## Question 24

Part (a)(i) proved to be a demanding question, as very few students managed to write the ionic equation correctly.
The majority of students did not multiply the second equation by five in order to cancel out the electrons; instead, they simply added the two half-equations together as given to obtain $IO_3^- + 6H^+ + I^- + 4e^- \rightarrow I_2 + 3H_2O$. Some students who did multiply the second half-equation by five, and added their resultant equation to the first half-equation, then did not calculate the total number of moles of iodine correctly (ie 3 mol $I_2$).
In (a)(ii), very few were able to give both the formula for the oxidising agent and a justification in terms of electron transfer. Instead, changes in oxidation number were often cited, rather than addressing the demands of the question set.
Although the majority of students correctly identified iodine in (b)(i), part (b)(ii) proved to be extremely challenging. The key was to identify the correct species

present in order to construct the ionic half-equation, by application of knowledge of redox chemistry.

Part (b)(iii) proved difficult, with many students only being awarded the stand-alone mark for the oxidation number of sulfur in sulfuric acid. The most frequent incorrect answer was sulfur dioxide, $SO_2$, for the identity of compound **X**. It was, however, surprising to see many students suggesting ammonia or hydrogen iodide as compound **X**, despite having been told in the question that it contained sulfur.

In (c)(i), the calculation proved very difficult for the majority. The key step was to calculate the number of moles of iodide ions correctly. Those that did were able, in two lines of working, to give the correct final answer to three significant figures.

In part (c)(ii), many answers were too vague to be awarded the mark. For example, it was frequently stated simply that potassium iodide was harmful, without any mention of ingestion to excess.

Other responses referred to iodine and/or potassium atoms, instead of the compound potassium iodide, which underlined the necessity for good Quality of Written Communication. The majority of correct answers referred either to the idea that people should have a choice as to whether the potassium iodide is added or that iodide ions were already available from other food sources. A range of answers was seen for (d)(i).

Pleasingly, many students related their answer to a comparison of the strength of the intermolecular forces in the two substances and so scored the third marking point straight away. The presence of London forces between chlorine molecules, $Cl_2$, and permanent dipole-dipole forces between iodine monochloride molecules, ICl, was identified by many students. However, only a minority commented on the fact that the London forces between ICl molecules are stronger than the London forces between $Cl_2$ molecules, because there are more electrons per molecule in ICl. A substantial number of answers contained the misconception that covalent bonds were broken on melting one or both substances.

For (d)(ii), there were many well-drawn diagrams. Dot-and-cross notation was needed to clearly identify the electrons from each atom. The most frequent error by some students was to leave out at least one of the two lone pair of electrons on the central iodine atom, whilst others did not show all three lone-pairs of electrons on each chlorine atom. Pleasingly, only a few students tried to show the bonding in iodine trichloride as ionic.

In (e), most of the marks scored were for a correct ionic equation in (e)(i) and the justification at the end of (e)(ii). Very few students completed the two calculations correctly in (e)(ii). The main error was to assume that the moles of iodine and bromine produced would be equal. Some statements confused the reducing power of the halogens with that of the sodium halides and so were not awarded the mark.

## Hints for revision

- Try to practise as many of the different types of calculation question found in this unit
- Make sure that you accurately identify the types of interaction that are broken when different substances are melted
- Make your writing clear. If the examiner cannot decide whether you have written "s" or "g" when a correct state symbol is required, you will not get the mark
- Practise drawing reaction mechanisms, paying close attention to the accuracy of any 'curly arrows' that are required and the formula of any co-product
- When drawing dot-and-cross diagrams, remember to include any lone pairs of electrons around each atom, as appropriate
- Remember that ionic half-equations have to balance both for species and for charge

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