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# Examiners' Report/ Principal Examiner Feedback

## January 2015

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

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## Introduction

The WCH02 paper had questions which were straightforward and so was accessible for students from the whole ability range. However it also included questions of a more challenging nature and so provided opportunities for the more able students to demonstrate their understanding. As in previous series, there was no evidence of any shortage of time.
Students continue to show limited knowledge of practical techniques and it was disappointing to read many responses to questions created around the theme of 'How Science Works'. However it was evident that some centres do focus on practical chemistry and their students demonstrated a keen grasp of the topic area.

## Question 19

The opening question on oxidation numbers in (a) was generally well-answered, with the most common error being the omission of the sign with the number. It was surprising that the definition of free radical in (b) presented difficulties, with a significant number of students referring to plural electrons. This definition led on to the dot and cross diagram of such a species, but a significant number of students did not seem aware of this 'follow on' despite the comment in the stem and drew a diagram with both atoms having a full octet. This is a clear reminder for students to read the context of the question.
The safety precautions required in (c) were rather generously marked although "face masks" were not credited. The justification needed to match the precaution and vague answers referring to toxicity in general were frequently seen but not given credit.
The drawing of a Maxwell-Boltzmann diagram in (d) is not new but it is concerning that the drawing often features a concave-shaped curve as the line leaves the origin. This was penalised, along with a failure to start from the origin and where the line touched the x axis. Centres would be well advised to encourage practice of these drawings to avoid such errors. The lowering of the activation energy by a catalyst was well-known but only the more able went on to state that the proportion of particles that have or exceed this energy thus increase.
Only the more able students had sensible ideas of how catalysts work in gaseous reactions. These students knew of the absorption of the reactants to the catalytic surface but few then made the point that this weakens the bonds in the reactant or makes collisions more likely. The most common response was to give the standard definition of a catalyst, which did not gain any credit.
In (f)(ii), a practical suggestion was required for a way to prove that oxidation does not need oxygen. The cursory statement 'remove the oxygen', without detail, was frequently seen but did not gain the mark. The most common acceptable response given was to conduct the experiment in a vacuum, although the better answer of carrying it out in an atmosphere of an inert gas, such as nitrogen or neon, was occasionally seen. The majority (68%) were able to apply their knowledge of other dichromate(VI) compounds to correctly deduce the colour change for the novel compound quoted. This gained the mark for (f)(iii).

## Question 20

Given the considerable amount of time and effort spent on the wording of exam questions, students should spend a commensurate amount reading and answering them. In (a) it was evident that the majority did not do this. The question required all of the bonds in the reactants and products to be drawn and the word 'all' was in bold but it was rare to see this aspect fulfilled. In addition the question instructed that the symbol [O] be used for the oxidizing agent but on occasion an $O_2$ was

used. The challenge of providing a balanced equation was another differentiating factor and so this question was an effective grade discriminator.
The explanation in (b)(ii) of why the distillation apparatus yields the ethanal rather than ethanoic acid was another good discriminator. It really tested the students' ability to communicate clearly which was not always done successfully. Also it did reveal some misconceptions. For example, the first marking point was for the volatility or the low boiling temperature of the ethanal. However a significant number of students referred to ethanal having a lower boiling temperature than ethanoic acid, which although technically correct, was penalised because the apparatus is designed to prevent the formation of the carboxylic acid and so this compound should not be present. It is the fact that the aldehyde has a lower boiling temperature than the alcohol that is the true contrast.
Part (c)(i) was either known or not and so a score of one out of two was rare. In (c)(ii) the positive charge is still being omitted from many students' responses which is disappointing. However, the feature from the infrared spectrum was much more frequently identified correctly, with an appropriate bond absorption stated.
The incomplete combustion equation required in (d)(ii) allowed students to choose from a number of possible alternatives and this served as another effective grade discriminator, with the full range of marks being seen. One of the most common errors and one that students could learn from, is that of the need to carefully balance equations. The three oxygen atoms in the alcohol were frequently 'missed', meaning the number of moles of oxygen required for the combustion equation was consequently too high. A small minority of students simply did not give an observation despite the clear rubric.
The reaction mechanism of (e)(ii) should have been a straightforward question for the students. However, there were some very weak attempts at this. It was also surprising to see a significant number of students writing mechanisms which produced alcohols, such as 2-methypropan-2-ol, with the name clearly stated, even though the question specifically asked for the production of ethanol. The question also clearly stated that dipoles and lone pairs be drawn and this was another area that tended to be lacking. In view of the halogenoethane required in this question, an SN1 reaction mechanism was penalised. Hence this question served as another effective discriminator with the full mark range being seen but only approximately 10% gaining all three marks.

## Question 21

The laboratory apparatus required for the thermal decomposition of a Group II carbonate in part (a) should have presented few problems but the opposite proved to be the case. Students are often tested on their drawing of experimental apparatus and so should be practicing these. The first mark awarded was for the Magnesite being heated and labelled. Occasionally the Magnesite was not labelled or drawn in solution with an acid. The second mark was for any suitable means of collecting the gaseous product and the most common errors here were the drawing of a closed system and the delivery tube not reaching the limewater. The effect on the limewater was the third mark for observation and this was obtained by the majority.
Part (b) was a good discriminator, giving the full spread of marks. It was relatively common to see hydrogen gas as a product, which revealed a lack of understanding of the topic. Oxygen included as a reactant demonstrated a failure to understand the question. The state symbols mark was generally obtained only by the more able students, and the most common error was the designation of magnesium hydroxide as aqueous.
There were very few responses seen that gained all three marks for (d). The more competent students were able to deduce the correct formula for magnesium nitride for the first mark, and then refer to the need for the reaction to occur in pure oxygen for the second. The third mark was for the energy release from the

magnesium and oxygen reaction resulting in the nitrogen triple bond breaking for nitride formation. This is an example of a 'stretch and challenge' extension activity that can be used for the higher-ability students when teaching this topic area.
The description of electronic transitions in (e) was a high-scoring question. There were some incorrect references to atoms being promoted or atoms releasing energy but generally this was an improvement on previous years. The fourth marking point was for the description of the energy release from the magnesium cation being outside the visible region. This was the major discriminating mark, with some thinking that magnesium doesn't have any electrons excited.
Over half of the students failed to score any marks for the (h)(i) calculation question, possibly reflecting the weaker cohort. The next most common response was for the student to calculate the number of moles of water and magnesium sulfate and then to stop there. This gained one mark. Some students had difficulty with this step and used the wrong mass (the residual mass) for the water molar calculation or used the whole starting mass for the anhydrous magnesium sulphate, despite it being clearly hydrated. If the student was able to progress further, the remaining issue was for the giving of the final answer to three significant figures as stated in the question. Only the more diligent and conscientious scored all three marks.
Improving the accuracy of a practical result as tested in (h)(ii) is an important skill for students but remains a challenge for most. The need for 'heating to constant mass' was only rarely seen. A large number of students stated that a larger mass should have been used to reduce percentage error, which presumably came from past questions of this type. This particular situation would actually be made worse by the use of a larger mass, but one mark was awarded for awareness of the general issue.
A wide range of bond angles was suggested in part (i) and incorrect reference was frequently seen to lone pairs. The stock answer of "maximum separation and minimum repulsion" is still being given without mentioning the molecule in the question and so this was not credited. The planar reference in the introduction was missed by many and so the tetrahedral angle was given, but one mark was awarded if there was a suitable statement about repulsion being due to four bonded pairs.
The final question (j) showed that a surprising number of students thought that the magnesium would react with the oil or that magnesium was unreactive, despite the stem stating that magnesium is very reactive.

## Summary

As seen from the commentary above, there were a number of questions where it was evident that the students had not read the question carefully. It is essential that students make sure that they have time to re-read their answers and to double-check that they have answered the question as set.

Chemistry is very much a practical subject and so there will always be questions that have a practical aspect. Hence it is crucial that students get the opportunity to either carry out practical work themselves or to see it carried out. This is extremely beneficial as they will have a much more enjoyable experience and learn much more than just reading on the topic from a textbook.

The application of chemical concepts to 'real-life' situations or to common chemical reactions and demonstrations are very good ways to illustrate the importance of chemistry. They also highlight how relevant it is to young people today. Therefore as previously highlighted, it is advised that this be a reoccurring theme in the delivery of the specification.

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