Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel International Advanced Level In Chemistry (WCH16) Paper 01: Practical Skills in Chemistry II

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General Comment

It was clear that there were some very well-prepared candidates who were able to give a clear demonstration of their practical chemical knowledge and understanding. However, it was also evident that there were many candidates who appeared not to be fully prepared for the demands of a paper designed for candidates at the end of their A Level programme. The lack of precision and clarity in a large number of responses resulted in less marks being awarded than obviously was hoped for. Candidates would certainly benefit from more practice and answering the question as set.

Question 1

Completion of the table in part (a) was generally an opportunity for candidates to gain marks at the start of the paper. The vast majority of candidates correctly identified the copper(II) ion in part (a)(i).

The formulae required in part (a)(ii) proved more challenging but it was pleasing to see that a significant number of candidates knew that there hydrated zinc hydroxide has four water molecules. However the simple formulae of zinc hydroxide was sufficient and the inclusion of water was indicative of candidates often adding unnecessary and occasionally incorrect data. The zinc complex ion formed in excess ammonia is a tetrahedral species and so the hexaamine formula did not score. A formula of a complex ion with four ammonia molecules and two water molecules is incorrect since this is of an octahedral complex ion. This formula was given by a sizeable number of candidates and so this highlights the need for candidates to learn the correct formulae of the metal ions formed from the addition of both dilute ammonia and sodium hydroxide.

The provision of transferred error in part (a)(iii) proved helpful to many candidates. The colour of the precipitate formed by iron(III) ions was not always correct for M1 but reference to 'the precipitate did not dissolve in excess' or 'no change' was creditted irrespective of the colour quoted.

Part (a)(iv) was the least well-known and another reminder of the need to learn the different colours observed with the transition metal ions. However the majority of candidates understood that the type of reaction occuring was oxidation and so gained the mark in (a)(v). The most common incorrect answers seen were ligand exchange and deprotonation which are understandable given the topic area but obviously are incorrect.

The confirmation of the halide ions required in part (b) produced a good spread of marks. Some candidates appreciated that the silver chloride precipitate is white and the silver bromide precipitate is cream but failed to relate this to the point of the question, namely that "the student was not certain" of their identity due to the similarity of their colours. Nevertheless the remaining two marks for the addition of dilute ammonia and the sole dissolving of the silver chloride were frequently awarded. Further, it was not unusual to see references to silver iodide despite this not being part of the question and undoubtedly too unnecessary time from candidates.

Part (c) proved a good test of candidates deducing that the anion of compound C was the sulfate ion and then writing the formula of the compound with the iron(III) ion given in part (a)(iii). At times the sulfate anion alone was seen which indicates a mis-reading of the question.

The requirement for an anion in part (d) also seemed to be missed by many, despite bold font being used to make the word 'anion' stand out. This was evident from the fact that many suggested the ammonium cation.
This test for the nitrate ion is not expected to be known by candidates and so the mark was awarded for any nitrogen-containing anion. It was pleasing that a large number of candidates could deduce from the production of ammonia gas that the anion had to contain nitrogen and so suggested a possible ion. It was disappointing to occasionally see the wrong charge on an ion or the wrong formula but this was rare.

Question 2

In part (a) the vast majority of candidates were able to correctly draw the structure of propanal but a significant proportion of candidates gave the positive result of Fehling's reagent instead of Tollens'.

Another reminder of the importance of answering the question as set was clear from (b)(i) where the 'name' of the functional group was emboldened as being essential. Hence any structures given were ignored. There was also evidence of some candidates not reading the information correctly and gave the name of the functional group formed rather than identified by the test.

The question of part (b)(ii) was rather demanding and aimed at the more able. The formula of the alcohol was required for M1 and the labelling of the two carbon environments for M2. A structure was almost always attempted but not so for the labelling which seemed to be missed by some. Nonetheless those candidates who did add labels were quite inventive in their labelling and provided this was clear the mark was awarded. It was important that all three carbons were labelled, showing that two were in the same environment.

In part (c)(i) the most common score was one mark for the (pale) yellow precipitate. The second mark for the antiseptic smell was less frequently awarded. Part (c)(ii) gives another important reminder. The question requires a name or a formula and not both. If both are given then each of them has to be correct. It was not unusual to see a name given and not just one formula but multiple. Whilst it is true that for the most part these were all correct, this is not good practice. For example, it can be very easy to omit one hydrogen from a displayed formula or to insert an extra one. It needs to be stressed to candidates that they should only submit one answer.

The displayed formula was essential in part (d) and names or other formulae were ignored. Responses were marked somewhat generously in that a formula which had all bonds displayed except for the O−H bond were awarded the mark. This was a high-scoring question.

Question 3

The answers to part (a)(i) were rather disappointing and frequently showed a lack of basic chemistry understanding. For example, it was not unusual to see an answer stating that sulfuric acid was a catalyst in the reaction but then affirming that the rate would not be increased by the sulfuric acid.

It was pleasing to see more correct answers to part (a)(ii), with a sizeable number of candidates giving an ionic equation for the reaction between zinc and acid. Common incorrect answers omitted any reference to the effect of the zinc and focussed on the vanadium.

The majority of candidates correctly understood that heating the flask would increase the rate of reaction. Rare incorrect answers referred to the reaction going to completion.

It was also very pleasing to see how the candidates answered part (a)(iv). It was clear that the colours of the vanadium ions in different oxidation states is well-known. Although it was not required, many excellent answers referred to the colour change to green as the yellow vanadium(V) ion was being reduced to the blue vanadium(IV) ion and so both coloured ions would be present in the reaction mixture.

As a reminder, the use of the command word 'suggest' means that candidates are not expectected to know the answer but have to apply their knowledge and understanding to a particular problem. This was the case in part (b)(i). Whilst some good answers were seen, many candidates did not express themselves in a clear way or compared the two methods of producing sulfur dioxide. References to the toxicity of sulfur dioxide were frequent but did not warrant the mark.

The equation required for part (b)(ii) was usually given correctly. Occasionally unbalanced equations and the production of hydrogen rather than water were seen.

In part (c)(i) it was surprising to see distillation frequently being given for the removal of tin. Perhaps candidates were getting confused with previous questions from past papers but it is always important to consider the context and requirement of each question. The removal of a metal such as tin is never likely to be distillation. The use of a magnet was also suggested but tin is not magnetic and the use of tongs is not appropriate. The expected answer was filtration and the common inclusion of reduced pressure or reference to suction filtration showed that the candidates did not really understand this part of the experiment. However the mark was still awarded for any type of filtration.

The calculations seen by examiners continue to have poorly laid-out working and this was the case for part (c)(ii). The first mark for the moles of vanadate(V) ions and manganate(VII) ions were straightforward and clear but the use of these molar quantities was then often confused or confusing. The candidates final oxidation state frequently seemed to appear from no where. For the most part, if the candidate's final answer was correct then the marks were awarded but there was the situation when the moles obtained for M1 were subtracted from each other and this value was used to give the final oxidation state. In this situation, only M1 was awarded because the correct answer was obtained incorrectly. Candidates are reminded that on the front page of the exam paper the instruction is clearly made to "Show all your working" and this instruction was repeated for this question (c)(ii). Hence the comment that 'a correct final answer scores all the marks' is not always true.

The final part of question 3 was often poorly expressed by candidates. It was not unusual to see answers referring to vanadium rather than vanadate(V). This is an A2 exam paper and so candidates should be aware that vanadium is a metal and so answers that refer to vanadium being reduced are incorrect. It seems obvious that this is not what the candidate meant and is 'just' writing the incorrect term but it is important to take care. Also, there were different, correct ways to answer the question given that the tin could have either reduced the vanadium(V) ions present or reduced the manganate(VII) ions added in the titration. Answers given along either of these approaches were awarded credit. There was some lack of understanding evident since a correct comment such as just stated was occasionally accompanied by an incorrect statement that the titre would then decrease.

Question 4

In part (a) the question required reference to 'both' columns of data which was often not addressed. At this stage of the A level programme it is expected that candidates would do more than simply refer to phenylamine having four hazards compared to only two for phenylammonium chloride. Detail of the particular hazards were required. The more able candidates did answer in this way and so scored more marks. The most common reason for the credit being given for the preference for use of a solid was the greater likelihood of spilling a liquid. It was not enough to just refer to a liquid being easier to store.

Candidates found the calculation in part (b) accessible and generally gained credit. The question required some means of showing that ethanoic anhydride was in excess, which could simply have been a 'greater than' sign such as >. The third mark was not awarded unless some indication of this type was given.

Although part (c)(i) was a novel question, it addressed a very common experience in the laboratory when carrying out suction filtration/filtration under pressure. The majority of candidates found it difficult to express themselves clearly or had entirely the wrong idea. For example, it was not unusual to see comments relating to the solvent or the solid being 'trapped' in the curled up sides of the filter paper. The more observant candidates did refer to the likelihood of the solution getting in between the sides of the funnel and the filter paper and so would not be filtered. However it was very rare to see an answer which scored M1 for the reference to all of the holes being sealed when the setup is correct. This question illustrates the need for candidates to be fully familiar with all aspects of their practical work.

The question in part (c)(ii) served as a reminder to candidates to give careful thought to which part of the practical procedure is being referred to. It was not uncommon for candidates to comment on the need for a small volume of solvent to be used to ensure maximum crystallization but that was the next step so gained no credit here. The point needed to be made that the impure solid was being washed to remove soluble impurities and a small amount of solvent was used to avoid washing the crystals away.

Part (d) was an immediate follow on from the previous part and required the reference to "insoluble" impurities. It was not sufficient to just refer to impurities or to give generic answers about purity and percentage yield.

It is worth reminding candidates that the demand of questions often increases as they progress through the paper and the question part (e) nicely illustrates this. The question required "two effects" but only one mark was awarded. Hence both aspects were required but oftentimes a response only addressed one aspect so did not get the mark. On this occasion it was allowed for a candidate to refer to the melting temperature to not be sharp but really it should be more clearly expressed that the range becomes wider. The use of numbers also requires careful thought because the other important aspect required was that the melting temperature decreases but if a temperature range is given which did not show this then the mark cannot be awarded.

Part (f) was generally answered well with many candidates scoring two or more marks. Nonetheless the point needs to be made that the question required "reference to the infrared data" and this was not always the case. In addition candidates must refer to **both** the bond and the wavenumber range when answering questions of this type. The mark scheme was adapted to make some allowance for the many candidates who omitted any reference to the bonds involved but they did not score all three marks. Hence an important reminder for future exams. Annotations on such spectra are to be encouraged but the caution is that any lines drawn must be vertical and not 'stray' because this can lead to incorrect values being stated that can lose marks.

Summary

To improve their performance, candidates should:

- make sure that all necessary details are included in an answer, such as the labelling of carbon environments or stating the bond involved when referring to infrared data
- be careful to strictly follow the rubric of the question so that if a name is required then give the name or if both columns of data need to be compared then do so
- learn the relevant colours and formulae of the anions, cations and compounds referred to in the specification
- practice calculations ensuring that the layout of working is clear and including a comment on the answer if needed
- make time to read and then re-read the question to make sure that they are answering the question being asked
- always check the mark allocation of the question so that the depth of the answer given and the number of points being made matches the demand of the question
- keep in mind the stage or part of the experiment being referred to so that the answer given does relate to that particular step
- practice use of the Data Booklet, especially the infrared information
- only give one answer to a question which requires just one answer
- take time to check an answer is fully correct and that all chemical terminology used is correct in its context

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