Examiners' Report
Principal Examiner Feedback

October 2017

Pearson Edexcel International Advanced in Chemistry (WCH06) Paper 1
Chemistry Laboratory Skills II

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General Information

Some students were very well-prepared for this examination and scored high marks. Some students were able to demonstrate that they had carried out some practical work and could apply this to the questions with just a few errors or omissions. A significant number students would benefit from much more experience in carrying out experiments so they are familiar with laboratory apparatus, understand the reasons for carrying out a procedure in a particular way, and can interpret, analyse and evaluate their results.

Question 1

Overall, the responses for this question were poor.

The majority of students scored marks for giving the formulae of two cations that are green in aqueous solution. Some students gave incorrect charges eg Fe^{3+} and Cr^{2+}, and a few suggested Ba^{2+}, presumably confusing the colour with the flame test.

Some students were familiar with adding aqueous sodium hydroxide to transition metal ions in aqueous solution and realised that only the green precipitate of chromium(III) hydroxide dissolves in excess aqueous sodium hydroxide to give a green solution, so Cr^{3+} ions must be present. Only a small minority of students could give the formula of the anion in the green solution **C**, with the most common incorrect answer being OH^{-}, but many students gave the formula of another cation. Students would benefit from carrying out these experiments or at least watching a demonstration. They do need to learn the observations and be able to write equations for the reactions taking place.

Some students recognised that the yellow solution in Q1(c) is due to the presence of chromate(VI) ions. A few students suggested chromium(VI) oxide but this is not an ion. The majority of students scored a mark for identifying ammonia as the gas in Q1(c)(ii), with just a few who did not realise that the change in litmus shows that an alkaline gas is formed. The ionic equation was very poorly done, with just a small minority of students showing that ammonia is produced when ammonium ions react with the excess hydroxide ions.

Many students did identity the precipitate as barium sulfate in Q1(d). A few students were able combine the ions they had identified to produce a neutral formula containing all three of the ions.

Question 2

This was also poorly answered, with many students not using the information they were given in the question.

Although many students identified the gas as hydrogen chloride in Q2(a)(i), other gases such as ammonia, oxygen, chlorine, carbon dioxide and sulfur dioxide were not uncommon. Many students did not read the introduction to the question that told them that **D** and **E** are neutral organic compounds so gave answers such as carboxylic acid, a specific group number or even transition metal as the group present in **D**. Carboxylic acid was seen frequently as an answer to Q2(a)(ii) and strange answers such as 'Mn^{2+}', 'tetrahedral' and 'not a metal' were seen. The displayed formula of propanoic acid was accepted as an answer to Q2(b) so that students were not penalised again for not reading the second word of the question. Some students did not use the information about the molecular ion peak so gave an incorrect number of carbon atoms in their formula.

Although many students are familiar with the tests for aldehydes and ketones in Q2(c)(i) and Q2(ii), others would benefit from revising these as answers related to alcohols and other functional groups were seen. Although carbonyl was accepted as an answer in Q2(c)(i), specific reference to aldehyde or ketone is preferred. Just C=O was not accepted as this is present in many other compounds such as carboxylic acids and esters. Many students could draw two ketones with straight chains and five carbon atoms in Q2(d)(i) but a significant number drew structures that were unrelated to the results of the tests in Q2(c). Some students were familiar with the 'iodoform test' to distinguish between the two ketones but some were inaccurate in identifying the reagents, for example, KI in NaOH or just stating iodoform. Students who tried to distinguish between an aldehyde or alcohol and a ketone received no credit as they were writing their own question.

Question 3

Many students found the calculation in Q3(a) difficult. A significant number scored one mark for dividing 20 by 24 or 24 000 but then multiplied by 20 or 20/1000 to give a value of 0.042 so they could not score any further marks as they did not use the mole ratio of hydrogen peroxide to oxygen and presumably assumed the volume of hydrogen peroxide was 20 cm^3. Some answers were just a jumble of numbers and it was difficult for examiners to decide whether to award any marks. Students should be encouraged to set out their answers to calculations clearly, labelling intermediate steps with what they are calculating, so that transferred error marks can be awarded, if appropriate.

Many students seemed unfamiliar with the practical steps for carrying out a titration and Q3(b)(i) to Q3(b)(v) were frequently poorly answered. Many students did not realise that the pipette should be rinsed with the solution it is being used to measure, hydrogen peroxide in this titration, and common incorrect answers included 'wash it with water' and just 'clean it' or 'dry it'. More students realised that the solution should be shaken before it is used. Some students knew that it is important to check that the jet below the burette tap should be filled with solution but a significant number of students wrote about reading the burette instead of the burette itself. Common incorrect answers included: 'take the reading from the bottom of the meniscus', 'check for zero error' and 'read from eye level'. Some answers demonstrated a clear lack of thought eg 'check the burette is clean', 'make sure it is empty', 'fill the burette'. Many students suggested using a burette, pipette or even a volumetric flask to measure the sulfuric acid. Step **4** states that approximately 25 cm^3 of sulfuric acid is needed so a 25 cm^3 measuring cylinder is best and students were not penalised for omitting the size of the measuring cylinder. It was surprising that only a small minority of students knew the colour change at the end point of the titration. A frequent incorrect answer was purple to colourless but other incorrect changes, such as orange to green, were seen. There were many vague answers to the meaning of concordant results, such as the results are the same, similar, reliable or close together. Some students quoted the range as 0.01 or 0.02 cm^3 which seemed to indicate that they had not tried to read a burette and did not realise that degree of accuracy is not possible. Students would benefit from carrying out titrations and understanding the reasons for each step in the procedure.

A higher percentage of students were able to carry out the more familiar calculation in Q3(b)(vii) successfully. Some omitted to scale up to 250 cm^3, giving an answer 10 times too small. Those who did not calculate the correct answer were more likely to receive credit if they set out their working clearly and explained what they were calculating for each of the intermediate steps.

The majority of students calculated the uncertainty in the titre correctly. The most common error was to forget that there are two burette readings so the uncertainty must be multiplied by two.

Many students used the information at the start of question 3 and stated that the hydrogen peroxide would decompose over a period of time but there were many incorrect answers including: implying that it was reacting with potassium manganate(VII), decomposing to form hydrogen (even though the equation for decomposition was given in the question), stating that the hydrogen peroxide or water were evaporating. Students are advised to read the questions carefully and use the information they are given.

Question 4

Some students did realise that ethanol is used as a solvent but there were many incorrect answers, such as, 'it is a catalyst' and 'it neutralises the ester', references to oxidation or reduction, 'to prevent decomposition' and 'to remove impurities'.

Many students seemed to understand the need for heating, although they did not always express this clearly. Vague answers such as 'to provide energy for the reaction' were not accepted. A number of students confused activation energy with enthalpy change and stated that energy was required as it was an endothermic reaction. A significant number of students seemed to relate their knowledge of reflux to the specific reaction of oxidation of alcohols and gave answers such as 'to ensure complete oxidation' or 'to prevent formation of the aldehyde'. Some students did not seem to be familiar with the technique of refluxing and demonstrated a lack of thought, such as 'to clean the condenser'.

Many students scored 3 marks for Q4(a)(iii) but incorrect answers included: fluted filter paper, use of cotton, glass or steel wool and just labelling the arrow as gases out instead of an indication of a pump. Some students thought that suction filtration is used because benzoic acid is flammable, toxic or corrosive. A simple answer of 'faster' is sufficient for the reason.

Some students are familiar with recrystallisation and could describe the first step. Some students missed out one of the important words. They should know that the solvent needs to be **hot** and the **minimum** amount is used to dissolve the benzoic acid. Some students showed confusion as they wrote about using the minimum amount of hot benzoic acid. A few students referred to ethanol as the solvent and did not score the mark as Step **7** states that water is the solvent in this experiment. Some students gave answers that showed that they were not familiar with this technique.

Many students gave 47.4% as the percentage yield and just scored 1 mark for calculating the mass of **X**. However, it was pleasing to see that a significant number could carry out the calculation correctly.

Many students drew two correct possible structures of **X**. However, a significant minority drew two identical structures and could only score 1 mark. Some excellent answers were seen to Q4(c) with clearly labelled protons. Some students identified the correct ester but labelled P and Q the wrong way round and a few just labelled one of the CH_3 groups for peak Q.

Summary

Based on their performance on this paper, students should:

- read the question carefully, make sure that you are answering the question that has been asked and use the information given in the question
- show all your working for calculations and clearly label each intermediate step to state what you are calculating
- practise working out percentage yields
- practise writing formulae of compounds
- carry out as many experiments as you can or watch demonstrations from your teacher or videos so that you are familiar with all the techniques in the specification
- make sure that you understand the reason for each step in the procedure of an experiment

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