Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

October 2021

Pearson Edexcel International Advanced Level
In Chemistry (WCH16) Paper 01
Unit 6: Practical Skills in Chemistry II

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Introduction

Some candidates were very well-prepared for this examination and scored high marks. Many candidates were able to demonstrate that they had a sound knowledge of some of the topics in the specification and could apply this to the questions with just a few errors or omissions. Other candidates found the paper very challenging and would benefit from much more experience in carrying out or observing the common practical techniques to ensure that they know the basic facts and can express their ideas clearly.

Question 1

Most candidates knew that a blue precipitate is seen when a few drops of aqueous sodium hydroxide are added to aqueous copper (II) sulfate, although some just stated the colour and omitted precipitate so did not score the mark. A few candidates thought that a gas was given off so stated effervescence. Many candidates knew the colour changes when concentrated hydrochloric acid is added to aqueous copper (II) sulfate until it is present in excess, although some omitted that the solution turns green before ending up yellow.

Some candidates thought that green or yellow precipitates would form, and others did not read the question carefully and assumed the hydrochloric acid was added to the blue precipitate from (a)(i). Most candidates knew the test for sulfate ions, although some omitted the acid and others incorrectly added sulfuric acid or barium sulfate solution so did not think carefully enough about the ions they were testing for.

The calculation of $E^{\ominus}_{cell}$ was done correctly by the majority of candidates, although some obtained a negative value and others multiplied the iron (II)-iron(III) value by two. Many candidates identified the three errors in the diagram, but they did not all express their ideas clearly so were not awarded all the marks. Common errors included: replacing the low voltage supply with a high voltage supply instead of a voltmeter, replacing both the copper and iron with platinum electrodes and using potassium hydroxide solution in the salt bridge instead of potassium nitrate.

The equation for the reaction between zinc and concentrated nitric acid was poorly done. Many candidates did not read the question as they were given the names of the products but did not use these in their equation. Many candidates were unable to write the formula for zinc nitrate. The candidates were asked for the most suitable piece of apparatus to measure the potassium iodide solution and the seventh bullet point in the procedure states that this is an excess so they should have realised that a burette, a pipette or a volumetric flask was not needed for this measurement. Many candidates did not know that the starch indicator needs to be added when the solution is pale yellow and many stated ‘at the end point’ rather than

just before the end point. The calculation to determine the percentage by mass of copper in the brass was carried out correctly by most candidates. Common errors included: not using the correct mole ratios from the equations, omitting to scale up from 25.0 cm^3 to 250.0 cm^3, doubling the relative atomic mass of copper and not giving their final answer to 2 or 3 significant figures. There were just a few candidates who rounded numbers incorrectly.

Question 2

The majority of candidates knew that Brady's reagent is a test for an aldehyde or a ketone and Fehling's solution gives a positive result for an aldehyde. Some candidates lost a mark as they gave the formulae of specific carbonyl compounds and some included a hydroxyl group or carboxylic acid. Candidates should use -CHO as the formula for an aldehyde, rather than COH which looks like an alcohol. Many candidates were not familiar with copper(I) oxide as the red precipitate formed with Fehling's solution and some were not awarded the mark as they wrote Cu_2O with the incorrect name of copper(II) oxide..

Most candidates could give the formula of an ion responsible for the peak at $m/z = 29$ and only a small number omitted the charge. A few candidates suggested ions that would not be present in an organic compound. Most candidates identified the molecular ion peak at $m/z = 58$ and many of them were able to give the structure of propanol.

Almost all candidates knew the colour of Universal Indicator in an alkaline solution, with just a few giving red or just green as their answer. Only a minority of candidates were familiar with the use of copper(II) sulfate solution to test for an amine. The most common incorrect answers were amide and ammonia. Those who deduced that **B** was an amine were generally able to give a possible structure for $C_3H_7NH_2$.

Question 3

Many candidates knew that polystyrene is used instead of glass as it is an insulator, some candidates were not awarded the mark as they stated that polystyrene prevents heat loss or there is no heat loss, rather than reduces the heat lost to the surroundings.

Many candidates were able to calculate the heat produced, although quite a few added the mass of lithium chloride to the mass of the solution. Some candidates added 273 to the temperature change, even though the specific heat capacity was given in J g^{-1} °C^{-1}. Some candidates stopped their calculation at that point and did not continue to calculate the number of moles of lithium chloride used and the enthalpy change. Some candidates omitted the negative sign for an exothermic reaction.

Most candidates were able to calculate the percentage uncertainty in the temperature change, with the most common error being to not multiply the answer by two as two temperature measurements are taken.

The answers to part (d) were generally quite poor, with a few exceptions of candidates who were familiar with this procedure. Very few candidates knew that the temperature of the water should be monitored for a few minutes to ensure that it is constant, then the lithium chloride is added, and the temperature continues to be recorded at regular time intervals.

Most candidates suggested plotting a graph of temperature against time but only a small number knew which two lines to draw and how to extrapolate them to determine the maximum temperature rise. Candidates could have drawn a sketch graph to show how to determine the maximum temperature rise to clarify their answers.

Question 4

Many candidates could identify at least one error in the incorrect diagram for distillation and suggest how it should be corrected. Some candidates did not express their ideas clearly enough to score the marks and those that showed the errors on the diagram tended to score higher marks. For example, they knew that the thermometer should not be in the reaction mixture but just stated that it should be higher, instead of moving it so the bulb of the thermometer is level with the entrance to the condenser. Some candidates suggested replacing the test tube to collect the alcohol with a flask but omitted to state that the flask should not be sealed. Some candidates knew that the apparatus should not be sealed but suggested unsealing it at an inappropriate place. Some candidates suggested incorrect errors, for example, removing the anti-bumping granules, incorrect heating or reversing the direction of the water flow in the condenser. A few candidates wrote about four errors and they should be careful as any additional incorrect answers negate a mark.

Many candidates were able to describe a test and observation to show the presence of an -OH group in an alcohol, with the addition of phosphorus(V) chloride being the most common test. Some candidates did not take notice of '**any** alcohol' in the question and suggested an oxidation reaction that would not work for a tertiary alcohol.

Many candidates were able to write a correct balanced equation for the reaction between sodium benzoate and hydrochloric acid, with just a few showing a covalent bond between the oxygen and sodium. Some candidates did not read the question carefully and tried to write an equation between the ester and hydrochloric acid. The majority of candidates realised that the impure benzoic acid needed to be filtered to separate it from the mixture in step **4**, although many other incorrect separation techniques were seen in answers. A few candidates incorrectly stated hot filtration or tried to use a separating funnel for filtration. Many candidates knew the first stage in the recrystallisation process, although some did not mention that the solvent needs to be hot. Some candidates seemed unfamiliar with recrystallisation.

Most candidates were able to score 1 mark for one way in which the melting temperature changes if the crystals are not pure. Some candidates thought that it would increase and decrease depending on what the impurities are so they did not score the mark for the change, however, they could still score a mark for stating that the melting temperature would not be sharp.

The majority of candidates were able to identify the alkyl group R but a few lost the mark as they included a positive charge. Many candidates could draw the structures of the four different alcohols, but candidates should check their work as some drew two identical alcohols, missed out one or more hydrogen atoms or connected the H of the OH group to a carbon atom. Most candidates identified the correct R group from the ^{13}C NMR spectrum information, but they omitted to draw the structure of **X**, the ester.

Summary

To improve their performance, students should:

- read the question carefully and make sure that they are answering the question that has been asked
- check that if they identify a substance with a name and a formula, both must be correct to score the mark
- learn the tests and observations for the common ions and functional groups in the specification
- show all working for calculations and give final answers to an appropriate number of significant figures
- revise the techniques involved in the preparation of a pure sample of an organic solid
- reread questions and answers, where time permits, to avoid careless mistakes.

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