Pearson Edexcel

Examiners' Report

Principal Examiner Feedback

January 2022

Pearson Edexcel International Advanced Level

In Chemistry (WCH16) Paper 01

Unit 6: Practical Skills in Chemistry II

Introduction

This paper proved accessible to well-prepared candidates who were able to demonstrate a sound knowledge and understanding of the chemistry tested and a familiarity with the practical techniques involved. Some candidates appeared to find parts of the paper very challenging and would certainly benefit from greater experience of the common laboratory techniques used at this level and the core practicals required by the specification.

Question 1

The identification of chromium as the transition metal involved in this sequence allowed candidates to focus on the particular species involved. There was a fairly even division of responses to (a) between giving an aqua complex and a chloro complex but finding the correct oxidation state was a problem in both cases. Some candidates failed to note that the formula of a complex ion was required. The precipitate in (b) was often correctly identified; the common errors were incorrect oxidation states and assuming that ligand substitution had occurred giving an ammine complex. While many candidates recognised that an oxidising agent was required for (c), relatively few gave hydrogen peroxide even though this reagent is stated in the specification. The precipitate in (d) was correctly identified only rarely and some candidates who knew it was barium chromate(VI) gave an incorrect formula such as Ba_2CrO_4 or $BaCr_2O_4$. The colours required for (e) and (f) were well known.

Question 2

Very few candidates were unable to deduce the molecular formula of **X**. The sequence of tests in (b) was well known and there were many perfect answers. Some candidates failed to link clearly the results of the tests and their deduction or merged the results of the first two tests. It was not unusual for candidates to refer to various alcohols in their explanation of the second and third test despite having correctly identified the functional group as a carbonyl. This does suggest that the stem of the question had not been read with sufficient care. The deduction of the structure **X** proved challenging but there were many correct answers or structures that scored one mark. Some candidates suggested structures that contradicted their deductions from the chemical tests and / or the NMR data. Almost all candidates correctly identified the functional group in **Y** but candidates then had difficulties in applying the ^{13}C NMR information in deducing the structures or even suggested compounds other than carboxylic acids. While there were a number of excellent answers to (c)(iii), responses often relied an vague generalisations about the numbers of peaks or the peak areas rather than the specific detail required. Most candidates identified **Z** as an ester but often failed to use all the information provided in their answer. Thus the fruity smell was not mentioned or a specific wavenumber was given rather than a range. There were good attempts at drawing the structure of **Z**, probably evenly distributed between the correct structure and the incorrect version with the alkyl groups reversed. Candidates who drew one of these structures were often able to correctly identify the proton environments.

Question 3

The simple idea of mixing the reactants required for (a) was often overlooked, usually in favour of initiating the reaction or ensuring complete transfer of the reagents. Many, although by no means all, candidates realised that the phenol would react with the bromine but far fewer were able to explain the purpose of this in the experiment. The mark for (b)(ii) was more usually scored for red rather than pink; candidates who gave 'brown' as their answer presumably thought that the colour was due to bromine and had failed to realise the bromine would bleach the indicator as soon as it was allowed to accumulate. The importance of ensuring that temperature is constant was not appreciated by a significant number of candidates who often appeared to restate the aim of the experiment in terms of investigating the effect of temperature on rate or the thermicity of the reaction. The overwhelming majority of candidates scored the mark for completing the table. The graph in (c)(ii) was usually completed to a high standard; the most common errors were transposing the axes and drawing the line of best fit so that it curved to include the anomalous data point. Some candidates failed to marked their plotted points with a circle or a cross making it very easy for a point to be overlooked once the line is drawn. The significance of maintaining the volume of the reaction mixture constant was only appreciated by a minority of candidates and once again some quite elaborate explanations were suggested for this simple procedure. The order of reaction with respect to bromide ions was usually deduced correctly and the rate equation written very accurately.

Question 4

Explaining the need for gloves in (a) proved surprisingly challenging; nitrobenzene was often mentioned, even though it is not involved in Step 1 of the procedure, and the hazard due to the inhalation of phenylamine was frequently cited. The role of tin in the reaction was rarely understood, most candidates suggesting that it was a catalyst while few candidates realised that a tin hydroxide would be formed. In (c) the cloudiness of the initial distillate was often explained by the presence of impurities or even by stating that phenylamine dissolved in water. Some candidates were familiar with the role of sodium chloride in Step 5, either from first-hand experience of this type of separation or from earlier examination series, but the majority opted for explanations such as drying or neutralising the mixture. There were some excellent drawings of separating funnels for (e)(i) but it was apparent that for many candidates this was an unfamiliar piece of apparatus. Candidates were much more likely to score the mark for the layers but even here there were many unforced errors, including the omission of one or both labels, layers reversed and two organic layers. The description of relieving the pressure in the separating funnel was usually sufficient to gain the mark although some opened the tap without inverting the funnel. Some candidates suggested the use of a pump, possibly confusing this separation with vacuum filtration. Most answers to (f) were based on neutralisation rather than drying. Most candidates seemed to focus on the method of distillation rather than the method of heating in (g) so the mark for heating to a suitable temperature and evaporating the ether was the one most likely to be scored. The

calculation in (h) was completed correctly by most candidates and those that did not score full marks usually showed a good understanding of the method.

Paper Summary

Based on their performance on this paper, candidates should

- remember to read questions carefully, be familiar with the meanings of command words and be alert for information that might be helpful in formulating their responses
- revise the core practicals in the specification and, wherever possible, review the further suggested practicals
- revise the techniques used in the preparation and purification of organic compounds listed in the specification (20.5) and ensure that they understanding why these techniques are used
- practise drawing the standard apparatus used in organic preparations included in the specification
- be aware that in this examination they will be tested, in part, on their ability to apply scientific knowledge and processes to unfamiliar situations
- show working for calculations know remembering to round the final answer only.