Examiners' Report
Principal Examiner Feedback

January 2025

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

General comments

This paper seemed to provide a broad test of knowledge and skills. Both the standard deviation and comments from examiners suggested that the questions assessed across the full ability range.

Many students seemed well prepared for the examination. Knowledge of chromium chemistry, deductions from organic qualitative tests, and processing of data from a continuous monitoring rates experiment were particular strengths.

More challenging aspects included the ability to justify parts of an experimental procedure, such as in 2ciii, 2civ and 4av.

The mean performance on the paper was around 29 marks.

Question 1

The ability to link the dissolving of chromium(III) sulfate to appropriate observations and formulae was clear in (a)(i), (a)(ii) and (b)(i), with nearly 80% of students able to access the marks.

Anecdotally, examiners felt that the quality of diagrams in (b)(ii) was slightly better than seen in previous series. However labelling, especially of the filter paper, was sometimes ambiguous, as was the position of the perforations relative to the filter paper. A number of students produced diagrams that showed the funnel and the flask as a single piece of glassware, so whilst the apparatus seemed sealed, the use of a bung was not evident. Others simply drew the funnel on top of or hovering above the flask, so missed the seal mark. Those who drew a side arm generally made a correct reference to a pump or similar, though a minority showed the side arm from the stem of the funnel rather than the flask.

Most students recognised that filtering under reduced pressure was faster in (b)(iii). Identifying that more of the solvent was removed, or the product was drier were less evident, but still known by many.

Most students were able to describe at least one relevant observation based on the unfamiliar equation in (c), most commonly recognising the orange solution due to the formation of dichromate(VI) ions. A number of students also referred to a pale pink colour due to the Mn^{2+} ion. This was not given credit as with the naked eye, a solution of $Mn^{2+}(aq)$ is effectively colourless, and in this context would be masked by the formation of the orange solution. A direct reference to solids dissolving was less commonplace, even though it could be clearly deduced from the equation. Some students tried to **explain** what was happening in the reaction, so discussed the equation in terms of redox reactions rather than describing what they would see.

The formula of the chromium complex in (d)(i) was less well known than those in (a) and (b), with around 60% of the cohort giving a correct alternative. The anion $[Cr(OH)_6]^{3-}$ was by far the most common suggestion, but a small number lost out by allocating a positive charge or misplacing the '6' inside the parentheses. The majority of candidates, often after giving a correct answer to (d)(i), gave ligand exchange, rather than deprotonation, in (d)(ii).

Question 2

Many students were familiar with some of the ideas behind (a) with around 60% scoring at least one mark. Sometimes a lack of precision regarding the position of the lone pair prevented the award of the first mark. For instance, comments such as 'the lone pair on the hydroxide group delocalises into the benzene ring' was not enough to score without clarification that the lone pair originated from the oxygen atom.

Part (b) provided a degree of discrimination. Many students were able to point out a mistake with the water in / water out labels, though some thought that one should be on the left-hand side of the condenser, the other on the right. The 'problem' mark in this case tended to be allowed for the idea of less efficient condensation of this vapour, but a more complete response would have linked this to the reduced cooling effect of the water. The second mistake was nearly always linked to the thermometer, but a large number thought that it was the position of the thermometer relative to the liquid that was the issue, rather than the fact that its use sealed the apparatus. A few noticed the absence of anti-bumping granules and were able to link this to the absence of smooth boiling.

Very few candidates were able to give the systematic name of HNO_2 , but the allowance of nitrous acid as an alternative meant that around 50% of candidates scored a mark in (c)(i). A similar proportion recognised the unstable nature of the acid in (c)(ii), though some answers stopped short of credit by noting the difficulties in transporting the acid, without a relevant reason why. Although the reaction to make an azo dye seemed familiar in (c)(iii), several students framed their answer as though the question was 'why is the reaction carried out at 5°C?' rather than the focus on Step 1 of the procedure demanded by the wording of this question. A number of those who realised the importance of prevention of decomposition, incorrectly linked their answer to the instability of the azo dye rather than the diazonium ion.

Many students found it challenging to explain key parts of the recrystallization process in (c)(iv). A number did appreciate that the hot ethanol would dissolve more of the azo dye, but very few noted that the azo dye in Step 4 was impure, so did not consider the solubility of these impurities. It was common to see the use of 'minimum' linked to the formation of a saturated solution, but only a small proportion could say why this was a key feature of the process. The best responses followed a clear narrative through the answer, focusing on the command word explain, as well as the guidance in bold. Such students were then able to keep away from a disordered description of the process, which did little more than repeat information from the question.

Most candidates could state how to dry the azo dye in (c)(v), though a few simply stated the words ‘filter paper’ without any sense of what should be done to achieve dryness e.g. ‘pat between pieces of filter paper’.

Knowledge of the hazard symbols in (d) was secure, and most candidates were able to link the corrosive and toxic nature of phenylamine to the use of gloves and a fume cupboard respectively. Use of masks was commonplace, and whilst this did not prevent the award of the mark linked to fume cupboards, masks on their own would not be considered a suitable precaution in a school laboratory. The ‘hazardous to the environment’ symbol was well known, but students sometimes struggled to express what a relevant precaution would look like. Only a tiny number of students appreciated that minimising the amount of a hazardous chemical used would also reduce any associated risk.

Question 3

Most students were able to make at least two relevant deductions based on the qualitative data in (a). Correct deductions from the tests with Brady’s reagent and Fehling’s solution were the most common creditworthy responses. Many were also aware that the iodoform test was linked to the presence of a ketone functional group but sometimes omitted to note that the positive result was dependent on a methyl ketone. A surprising number felt the smoky flame was due to carbon dioxide production.

The students who correctly determined the empirical formula of **X** in (b) invariably went on to deduce its structure in (c). Examiners saw a variety of methods followed in the calculation. Those who used the proportions of carbon in CO_2 and hydrogen in H_2O to find the masses of carbon and hydrogen respectively nearly always went on to score full marks. However, those who started by determining the amounts of CO_2 and H_2O in moles often struggled to make further significant progress.

Question 4

Approximately half of the cohort correctly suggested colorimetry as the most suitable technique in (a)(i). The most common answers not worth credit tended to focus on quenching and / or titrations.

Graphs were generally well drawn in (a)(ii), with sensible scales and smooth curves regularly seen. A few students omitted units or mislabelled one of the axes, avoidable errors that a quick check might have prevented.

Only a small number of students didn't have some idea of the concept of a half-life in (a)(iii), but a notable minority measured the value of the second half-life incorrectly. This invariably involved starting this measurement from y = 0 and resulted in finding a value approximately twice that of the true value. Such students found it difficult to justify an order in (a)(iv).

Part (a)(iv) proved challenging, with only around 25% of the cohort able to link the method used to produce the experimental results to the lack of an overall order. Those who did tended to note that the hydroxide ions were in excess, but far fewer recognised this would mean a negligible change in the concentration of hydroxide ions during the experiment.

The calculation in (b)(i) proved accessible for many. However, the need for both an appropriate number of significant figures and correct units meant a number of otherwise excellent answers did not score full marks. A small number ignored the negative nature of the gradient and calculated a negative activation energy. There is an expectation that students should realise that activation energies will be endothermic, so a slip such as this ought to result in a revisit of the working to resolve the sign issue.

Many students appreciated that the value of ln(collision factor) is linked to the intercept of the y axis in (b)(ii), but just under a 1/6th of the cohort noted that this should be at x=0 , so most agreed with the value. A small number of student creatively answered the question by using their gradient to solve the equation to find ln(collision factor) to show they disagreed with student in the question.

A number disagreed with the value by arguing it should be quoted to greater than two significant figures, despite that data given on the y axis of the graph.

Based on their performance on this paper, students are offered the following advice:

- take care when drawing diagrams of apparatus to correctly show how apparatus is sealed with a bung
- practice using Stock notation when naming compounds containing elements whose oxidation state can vary e.g. nitrogen
- ensure you can explain how key processes, such as recrystallization, work, rather than only being able to describe how to carry them out
- use emboldened words to help you structure your answer to a free response question
- recognize that a smoky flame on burning an organic compound is most likely to be an alkene or an arene, within the context of this specification
- practice using the proportions of C and CO_2 and H in H_2O to find elemental masses, when processing combustion analysis data
- check graphs to ensure axes are labelled appropriately