Examiners' Report
Principal Examiner Feedback

Summer 2025

Pearson Edexcel International Advanced Level
In Chemistry (WCH15)
Paper 01A Transition Metals and Organic
Nitrogen Chemistry

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General Comments

The paper was accessible to most candidates and responses to the last questions indicated that the paper was not unduly long. However, there were a significant number who had sections completely blank, particularly Q19.
Strong candidates scored very high marks, showing they were well prepared for the examination. The calculations were generally successfully completed. Many had a sound knowledge of the specification and could demonstrate this in questions requiring explanations or descriptions. However, a minority of candidates found this type of question challenging and need to express their understanding of chemistry more clearly.
The mean mark for this paper was 50.

Section A. MCQ
This was generaly high scoring with Q9 being answered correctly least often.

Section B

Question 16
16(a)(i) The majority of candidates managed to draw six ligands but failed to score the mark because there was no attempt at a 3-D octahedral shape.
16(a)(ii) Many candidates correctly stated that the ligands were bonded to the manganese (II) ion by a dative covalent bond but failed to identify that the donation of the lone pair came from the oxygen atom of the water molecule. Some diagrams from (a)(i) included arrows from lone pairs shown on the oxygen of the ligands and this mark could be scored.
16(a)(iii) Most learners showed an understanding of the basic theory of the origin of the colour in transition metal complexes. Marks were lost by a lack of accuracy in the explanations e.g. failing to mention that the presence of the ligands caused the energy level of the d-orbital**s** (not just one) to be split into two. There was also evidence of confusion between the absorption of light energy in the promotion of electrons from a lower level and the emission of light by an electron dropping from a higher energy level as seen in a flame test.
16(**b)** Those learners that recognised that the acidity of the solutions was a result of the release of a proton from the water ligands went on to explain that the deprotonation was due to the polarisation of the bonds in the water ligands by the metal ion. This was then correctly linked to the differing charge density in the metal ions given in the table. Some general links between the charge on the ion and the pH of the solution were not detailed enough to be credited.
16(c)(i) In this question **two** equations were given in Step **1** for the changes observed. Many responses showed that the darkening of the manganese (II) hydroxide precipitate due to the reaction with atmospheric oxygen was well known. This enabled M2 to be scored often. The first observation of the light brown precipitate of the hydroxide was rarely seen. Learners should also note that information given in the paper e.g. the initial pink colour of the manganese (II) ion does not attract a mark.

16(c)(ii) and (iii). This calculation of the concentration of dissolved oxygen in river water was completed successfully by a large proportion of learners. The step most frequently omitted was M2 - the conversion of moles of dissolved oxygen to mass by x 32.
16(d)(i) Responses were sometimes seen with no electrons shown, which was disappointing since "half-equation" was in bold.
16(d)(ii) This was completed successfully by many learners, although balancing the equation, including charges, produced some errors. This aspect of redox chemistry is introduced in Topic 8 so it is disappointing when mistakes are made in this paper. Credit in (d)(ii) could be awarded from an incorrect response to (d)(i) provided the half-equation had been used correctly.
16(d)(iii) Many learners scored both marks for this, even if the preceding equations had been incorrect.

Question 17
17(a) Learners were very clear in their descriptions of the amine group forming hydrogen bonds with water. Unfortunately, they failed to extend their explanation to take account of the interaction of the ethyl group with water and consider the intermolecular bonding of the ethylamine molecule.
17(b) The relative basicity of amines was well known and many learners scored well on this extended response question.
IP1 The trend in basicity was often identified, sometimes implicit over 2 or 3 sentences rather than stated in one line. Some simply restated the trend in pH given in the table which did not score IP1
IP2 A small number failed to score this IP as equations were unbalanced, or included an acid, rather than water.
IP3 Most valid answers mentioned that the methyl group was electron releasing.
IP4 Explanations often lacked clarity but the alternative acceptable answer of the increased electron density helped some learners to score this IP. It was noted that those learners who understood that the donation of the **lone pair** on the nitrogen of the amine group was a key idea, found it easier to score IPs 4 and 5.
IP5 This was often scored but some suggested that the lone pair was donated or the phenyl ring was electron withdrawing, thus making the benzene ring more susceptible to electrophilic attack which did not answer the question.
IP6 was least often scored
17(c)(i) References to sulfuric acid without any indication of concentration or additional SO_3 were often seen.
17(c)(ii) The temperature, was better known than the reagents were.
17(d)(i) These structures were successfully identified by most learners, but quite a significant number included an -OH group in the 4-position.
17(d)(ii) The chemical shifts of the aryl protons were usually quoted within the range allowed but there was some confusion between the N-substituted methyl protons with values for non-aryl protons on phenylamines. Some learners just wrote "1" as a splitting pattern rather than "singlet".

Question 18

18(a) This mechanism has appeared frequently in recent years and there were a very high proportion of perfect answers. For those who did not give a correct equation or showed an incorrect electrophile, the remaining marks were available and scored often.

Some candidates should be aware that accuracy in drawing mechanisms is important. The initial electrophilic attack should come from the π electrons shown as the circle within the hexagon. The 'horseshoe' /arc in the intermediate showing the partial delocalisation should have a positive charge and be drawn over at least three carbon atoms. It should be positioned opposite the site of the electrophile attachment.

18(b) The requirement of an aqueous medium for the nucleophilic substitution of a chloro-group was missed by a surprising number of learners.

18(c) Despite the instructions to refer to three different types of bond, often reference to C-H bonds was absent. Marks were also lost for an incorrect range for the C=O in the acid, often stating 1725-1700 which is the range for alkyl carboxylic acids. Learners were often correct with the wavenumber range for the O-H bond.

18(d) Distillation was often seen, showing an appreciation that the aldehyde product should be removed from the oxidising agent.

18(f) The reaction of carbonyl compounds with Grignard reagents (note the spelling) was well known with the correct structure of 1-phenyl ethanol seen often.

18(g) The structure of the polymer proved difficult for some learners who incorporated the benzene ring into the backbone of the polymer, rather than as a pendant group.

Section C

Question 19

19(a)(i) Naming the amino acid was unexpectedly difficult for many learners.

19(a)(ii) The majority of learners did not appreciate that the significant difference between the melting temperatures was due to the zwitterion formation in the amino acid. Many tried to compare the hydrogen bonding and managed thereby to score M1.

19(a)(iii) The identity of the reference substance in carbon-13 NMR escaped many learners, despite its appearance in the tables of chemical shift in the Data Booklet.

19(a)(iv) Responses to this question showed a lack of care in the identification of chemical shifts from the Data Booklet with some peaks being outside the allowed ranges. Frequently, learners omitted to label the peaks, although this was only penalised once.

19(a)(v) The presence of a chiral carbon was identified by most candidates, though many went on to describe of how a chiral carbon is formed through the mechanism of a planar carbonyl group being attacked from above and below. There was often confused language around the non-superimposable mirror images or a restatement of the presence of two optical isomers which failed to score M2. Learners who included a sketch of a pair of mirror images frequently scored both M1 and M2.

M3 also showed poor communication skills with most realising that it had something to do with the rotation of plane polarised light, but referred just to 'light' or missing the rotation.

19(b)(i) The structure of the dipeptide was correct in most cases.

19(b)(ii) This molecular formula calculation was answered correctly by the vast majority of learners.

19(c) The first structure was correct in most responses but some learners found it easier to identify a molecule without a chiral centre than one with two.

Paper Summary

Based on their performance on this paper, candidates should:

- Read the questions carefully and use the information provided, including the marks available, to help you frame your answer.
- Set out calculations clearly.
- Practice drawing three dimensional molecular shapes.
- Check that equations balance for both species and charge.
- Practice writing half-equations from given information. Remember to include H^+ if conditions are acidic or OH^- if alkaline
- Take care when reading data taken from the Data Booklet.

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