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Examiners' Report
October 2025

Pearson Edexcel International Advanced Level in Chemistry
WCH15/01

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Introduction

Many learners were well prepared and handled factual recall questions effectively but struggled more with extended questions requiring explanations of unfamiliar topics. This was particularly true for Question 14(e)(iii), about lack of colour in transition ions, Question 14(e)(ii) origin of colour in transition ions and Question 13(c)(ii), solubility of indicators.

Section A

The most accessible questions were Question 2 (Kekulé isomers), Question 4(d) (Friedel-Crafts intermediate), Question 5(a) (numerical value for entropy change) and Question 1 (equation for phenol reacting with bromine). The least scored questions were Question 10 (amine substitution product), Question 6(c) (percentage yield) and Question 9(a) (polymerisation types).

Question 11(a)

Learners found this question more challenging than anticipated and may benefit from more practise in lessons on this type of calculation. This could include improving the presentation of their calculations.
Weaker responses often calculated the number of moles of carbon dioxide and water rather than focussing on the appropriate elements. This meant that they were unable to progress to the later marks as they used a mass for hydrogen of 0.05. The final step of deducing the ratio was often not done well, learners need to remember to scale rather than round their answers for empirical formulae at A-Level.

Question 11(b)(i)

Some learners omitted the bonds, though these were asked to be identified in the question. A common error was to state the wavenumber for C=O in K as 1720-1700cm^{-1} (the range for an alkyl ketone, rather than an aryl).

Question 11(b)(ii)

Learners found this part challenging. Many could identify the M fragment, with HCO^+ and $HCOOCH_2^+$ being the most frequent answers, but fragment N was rarely identified correctly. The most common incorrect answer was $COOH^+$ (54, this could be formed by both molecules). Some responses just gave numbers or just fragments without linking the two so couldn't gain both marks. A small minority of responses were negative or neutral species so learners may need the positive nature of mass spectroscopy fragments reemphasised.

Question 11(b)(iii)

Learners made a good attempt at this question, with many able to identify the bond and the chemical shift. However, a minority of responses stated chemical shift values just outside the acceptable range e.g. 1.5 for P, so didn't gain both marks. Many responses used the structures from the data booklet (as seen in the additional guidance) rather than describing the environment in words.

Question 11(b)(iv)

This question was not well answered. Responses regularly featured molecule N or O, but many learners left this part blank. When the correct compound was selected, the equations were often not balanced as the water was missing. A minority of learners lost the mark for incorrect connectivity in their products e.g. OH-COH for methanoic acid. Learners need to ensure they revise all reaction types, including hydrolysis.

Question 12(a)

Many learners found this question challenging and weaker responses showed that learners need more practise drawing 3D diagrams of transition metal ions. Connectivity of water ligands was a particular problem - with many showing the hydrogen forming the bonds - though incorrect use of lines, dashes and wedges was also common. Bond angles were regularly omitted or incorrect. Even when learners described a complex as tetrahedral it was often drawn as square planar. Weaker responses often included incorrect examples of transition complexes e.g. $Cu(OH)_4^{2-}$ as tetrahedral and $Cu(NH_3)_6^{2+}$ as octahedral.
The most frequently awarded indicative point was IP6, for the type of bonding. IP5 was the least frequently awarded, as it was often not attempted or learners did not try to explain the difference in terms of ligand size. Weaker responses sometimes stated that water is a smaller ligand than ammonia or used NH_2 as a ligand.

Question 12(b)(i)

Weaker responses identified an incorrect metal so could not gain any credit. Incorrect answers were diverse, including iron, magnesium, manganese, vanadium, nickel and zinc and their ions. Where silver was correctly identified, most learners could correctly calculate the values and comment on the feasibility. It is important to emphasise to learners that E_{cell} values calculated should always have a positive or a negative sign shown. Occasionally, learners omitted the final part of the answer and didn't explain why there is no further reduction so couldn't score M3.

Question 12(b)(ii)

Learners need to ensure they revise the role of vanadium(V) oxide in the contact process as often no answer or a single equation was given for this part. Many learners overcomplicated this question and wrote out half equations involving VO_2^+ rather than V_2O_5. The vast majority of learners could correctly state the oxidation numbers and changes, but few linked this to the redox processes taking place.

Question 12(c)

This question was not well answered, and some learners described a heterogeneous catalyst rather than the action. Only the best responses described all five marking points to give a full answer to the question. A minority of weaker responses referred to absorption rather than adsorption so could not score M1. Learners should be encouraged to refer to the surface of a heterogeneous catalyst when describing the mechanism.

Question 12(d)(i)

Learners found this part challenging, with many not identifying the necessary ions from Step 1 that must feature in the second step. A few issues were seen with balancing the equation but often this part was left blank.

Question 12(d)(ii)

Learners did not answer this question well. Where marks were awarded, they were almost evenly divided between M1 and M2. Where responses did not gain M1 it was often due to learners failing to mention the slow rate at the start. M2 was regularly not attempted, or reference was made to the Mn^{2+} being used up rather than the reactants. In general, learners need to give a more detailed response when describing autocatalysis and be precise in their language referring to rates. For example, "the rate of reaction slows near the end of the reaction as the reactant concentration decreases" rather than "the rate slows when the reactants are used up".

Question 12(e)

This question was well attempted, but some common errors were seen when drawing out a labelled diagram of the apparatus. Learners should be reminded to label all the parts of the diagram, as some lost credit for only labelling one electrode. The least frequently awarded mark was for the two iron compounds in the right-hand half-cell and where compounds were stated some learners did not gain credit as they used iron(III) sulfate without amending the concentration to 0.5 mol dm^{-3}. Weaker responses had difficulty with the hydrogen electrode delivery tube and the arrangement of the electrode within, a minority did not show the tube entering the

acid. Other common errors included an iron electrode for the right-hand half-cell, omitting the gas conditions and not completing the circuit. Learners should be reminded to revise the core practicals for all papers and not just WCH13 and WCH16.

Question 13(a)(i)

The majority of learners made a good start on this part, and most were able to score M1. M2 was rarely awarded for the reacting ratios, this step was often omitted completely or just a multiplication by 2 or 3 was seen. A very common error was to multiply the moles by the mass of MnO_2 (86.9) rather than 54.9. The conversion from tonnes to grams was also an issue for weaker responses.

Question 13(a)(ii)

This question was not well answered. Many learners just stated that potassium manganate[(VII)] was purple or turned pink. Others gave an incorrect colour change or referenced reacting with acid or alkali rather than a redox reaction. Suitable colour changes were given credit, but brown was a common incorrect answer. Very few responses referred to the end point of a titration, this is essential when discussing an indicator.

Question 13(b)

Learners found this extended calculation challenging. Most learners gained M1 for the moles calculation, but weaker responses did not use both ratios correctly so could not score M2 and M3. A minority of responses used 16 instead of 32 as the mass of oxygen so could not score M4. Quite often M5 was scored as a transferred error because the units were converted correctly, though learners should be encouraged to show their working for each step and not just the final answer.

Question 13(c)(i)

The majority of responses gained M1 for the equilibrium shifting to the right, but far fewer learners achieved M2 for the explanation, linking an increase in alkalinity to a decrease in H^+ ions. One common misconception was that it was an increase in concentration of water that would lead to the equilibrium shifting. A minority of learners mentioned colour changes as the equilibrium shifted but these were ignored as they were not asked for in the question. Learners need to ensure they understand the effects of different conditions on equilibria.

Question 13(c)(ii)

This is an unfamiliar context and few learners picked up the reference to aqueous solutions. Where solubility was mentioned, some learners gained M1 but others just

referred to the compounds as soluble and insoluble. Many responses were too superficial for M2 and just mentioned that ions are more soluble. Learners were expected to apply their knowledge of inter-molecular forces to this question and the strongest of responses did this well, detailing the extra bonds that the sulfonate ion could form. A small minority of weaker responses incorrectly discussed the barium ion forming precipitates or flame colours.

Question 13(d)

The context of this question was unfamiliar and many learners had difficulty applying their knowledge to this part. The most commonly awarded mark was for identifying the colour violet and a relevant wavelength. Many responses didn't continue after this part of the answer. Learners need more practise in describing why colour is seen, especially as light being reflected/transmitted rather than emitted. In part (ii) many responses answered in terms of electronic structure of d-orbitals, instead of the wavelengths absorbed so could not score.

Question 14(a)

This question was well answered, with the majority of responses gaining multiple marks. Learners often carried out the steps in a different order to the mark scheme. While mathematically correct, this doesn't make much sense in terms of chemistry. It may help learners to write a commentary of what they are calculating when they practise calculation questions. One common error seen in weaker responses was to divide 70,000 by 450.

Question 14(b)

Learners answered this question well; the majority identified the carboxylic acid proton but fewer correctly circled the phenol protons. Many incorrect responses included one or more from the ring structure on the left. A minority of learners included carbon atoms in their circles, and these could not gain credit.

Question 14(c)

Responses to this question showed good understanding. Many incorrect responses to M1 were multidentate or polydentate; learners need to be precise in their use of terms from the specification. Fewer learners gained M2, often as it wasn't attempted. As many descriptions of dative covalent bonding were seen as named bond types - though some learners just stated "two bonds formed", and that was insufficient for the mark.

Question 14(d)

Most learners were able to identify the correct groups on the molecule, so could gain one mark though fewer were able to describe the proton transfer to form the zwitterion. The identification of protons in part 14(b) lead to many learners discussing the loss of protons from phenol groups and these were given credit. Weaker responses just described a zwitterion without referring to the groups on the molecule at all or referred to the hydrogen ions as "H". Learners should be discouraged from referring to "neutral ions".

Question 14(e)(i)

This question was challenging for learners. Though many could correctly read the value off the graph, converting to ppm was more challenging. Only the strongest of responses showed that mg kg^{-1} is equivalent to ppm.

Question 14(e)(ii)

Learners did not apply their practical knowledge to this question and only a minority gained both marks. The question asked for a reference to the data range shown in the graph but weaker responses stated that the range was too small or there were too few readings. Learners were expected to state that the range on the graph that showed a linear relationship and explain that any relationship past the 75 mg kg^{-1} / 1.75 absorbance point has been extrapolated so there is no evidence that this is correct. Learners may need more time in practical lessons to reflect on the strength of evidence that they have collected.

Question 14(e)(iii)

This question was poorly answered, and many weaker responses tried to define both the words "solvent" and "extraction" without any indication that they had met the technique before. Learners need to revise all the techniques from this part of the specification more thoroughly.

Question 14(f)

Some learners may have been under time pressure at the end of the paper and some blank responses were seen. For M1, many learners omitted the reflux but had the other conditions correct. Please note temperatures are not expected to be quoted for reflux experiments. Where the structures of X and Y were attempted, these were usually correct - though common errors were to omit the methyl group from the ring or the wrong nitrogen atom having the positive charge. M5 was often awarded when seen, though some learners lost the mark for incorrect connectivity of the phenol group (either written as O–H– or attached to the wrong carbon). Weaker responses had the steps in the wrong order or the reagents linked to the wrong step.