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# Examiners' Report
# October 2025

Pearson Edexcel International Advanced Subsidiary Level in Chemistry
WCH12/01

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## General comments

Section A was often a very successful section of the paper for learners, showing a good breadth of understanding and that this style of question has been well rehearsed. For most calculations learners are often presenting their workings in a way that enables examiners to award transferred error marks, however approaching a familiar calculation from an unfamilar angle led to confusion that resulted in a more scattered approach. Good attempts were made at questions worth 3, 4 or 5 marks with many showing an understanding of the topics involved, but a lack of depth within the responses prevented the awarding of full marks in the majority of cases. Justifying the conditions used and purpose for organic reactions was a weaker area for a number of learners.

## Question 19

Balancing the equation given did not seem to pose a problem, especially with the moles of oxygen being fixed, however determining the state symbol for CaO seemed to be more of a challenge. It is also worth reminding learners that state symbols can be written full size rather than subscript, which may help distinguish between (s) and (g), as these can often look similar making it difficult for examiners to judge whether the mark can be awarded.

Many excellent descriptions of how a flame colour forms were seen, though some learners misinterpreted the question and instead described how to carry out the practical steps of a flame test. The most common misconception seen was that the photons are emmited when the electron is promoted to the higher energy level, and many learners narrowly missed out on the 3$^{rd}$ marking point as they simply stated that 'light' is emmited without reference to 'energy' or 'wave'.

Learners who were able to deduce the formula of the compound formed when calcium reacts with an element in the air had to first identify that nitrogen was the element in question, before then determining the correct formula of the compound formed. This sustained line of reasoning to arrive at the correct answer was something seen mostly from learners with a strong performance across the paper as this was one of the most challenging questions.

Using data from a back titration appeared to be difficult for many learners. Many missed the step that involves subtraction to evaluate the number of moles of HCl that reacted, and a significant number missed out on the first mark by failing to calcualte the number moles of HCl used to react with the CaO (0.2). There were many opportunities for transferred error to be awarded, which allowed learners to get marks for performing the correct operations and this was aided by the clear workings seen in many of the responses.

Learners found it straightforward to identify one error and correction to the explanation in part (d), commonly answering that the nitrate ion is polarised by the calcium ion rather than the other way around. Correcting the second error proved more challenging; whilst it was fairly common for the 2nd error to be identified, many then stated that the bond between the two ions would become stronger. Some focused on the distortion of the electron clouds as the error, suggesting that the electron clouds around the calcium ion were distorted rather than that around the nitrate ion.

## Question 20

As is often the case with mechanisms, learners appear to be familiar with the mechanism for the reaction of a halogenoalkane with a hydroxide. There is disparity between stronger responses which are clear with a keen eye for detail, and weaker responses that contain numerous avoidable errors and are not accurate with the origin and end point of arrows. Errors include the incorrect placement of the lone pair of electrons on the oxygen of the hydroxide ion, missing the charge on the hydroxide ion, and a covalent bond between the potassium and hydroxide ions 'K-OH'. Learners should be advised to make full use of the space given, as it can be difficult for examiners to judge accuracy of dipole charges for example when they are very small.

The rest of question 20 seemed more challenging. The reasons for using specific reactions, such as forming a nitrile, and for using conditions such as using anhydrous calcium chloride are not well understood. A number of learners understood that the drying agent was there to remove water, however their terminology was incorrect as they referred to dehydration rather than drying. Identifying the correct reaction conditions needed to react a halogenoalkane with ammonia was slightly more successful, though many learners suggested reflux. It was common for answers to mention ethanol as a solvent, though this information had been provided already in the question stem.

Learners made a good attempt to draw skeletal formulae for the isomers, with very few using displayed or structural. It was common for 2 of the same isomer to be drawn in different orientations, or with different bond angles. Success for this part of the question relied on learners realising that alkenes are produced by an eliminaton reaction. Those who did were often able to identify at least 2 of the isomers, typically the 1st and 3rd on the mark scheme, with stronger responses then giving both the E and Z structures. Those who did not start their line of reasoning from an elimination reaction occuring often included Cl or OH groups in their structures.

## Question 21

The disproportionation reaction was correctly identified by most learners, though many struggled to spell the word disproportionation. It was common to see learners writing oxidation numbers above each element in the equation given in the question stem, it should be noted that this is worthy of credit and is considered good practice. The majority of missed marks were for ommissions rather than incorrect answers or lack of understanding; those not achieving full marks often did not link oxidation or reduction to the relevant changes in oxidation number, despite understanding the term disproportionation and correctly calculating the oxidation number of each species. There was occasionally confusion surrounding the coefficients of the equation and assigning oxidation states, for example giving the number of Cl in 5NaCl as -5 rather than -1.

A wide range of denominator values were seen when learners attempted to calculate atom economy, however the transferred error mark was commonly awarded for dividing 106.5 by their denominator. An incorrect answer often seen was 58.1% which resulted from only using 1 $H_2O$ and 1 NaCl when calculating the total mass of the products.

The most successful element of the extended response question was identifying the products formed in each reaction from the observations given in the table, though the rotten egg smell was attributed to sulfur or sulfur dioxide by a significant number of learners. It was rare to see IP6 for the correct balanced equation, though interestingly there were some learners who were able to give the equation but nothing else. Iodide was successfully identified as the stronger reducing agent by many, however only the stronger responses included IP4 and IP5 to explain why. Despite the requirement within the question stem to use changes in oxidation number to justify choosing iodide, weaker responses attributed this decision to a comparison of the number of products formed in each reaction. Learners should be mindful of the precision of the language used when referencing ions and oxidising / reducing agents. It was common to see iodine / iodide and chlorine / chloride used interchangeably, and reference to the oxidation number of compounds or ions rather than the constituent elements.

## Question 22

Learners are very familiar with this style of question and most made a good attempt at answering, though some gave responses that did not fit with the context and conditions given in this question. The effect of high temperature and pressure on rate was given in nearly all attempts at a response, and the explanation with regards to collision theory was generally correct if given, but evidence of this marking point was less common. Whilst there was sometimes confusion about the direction of equlibrium shift, it was common to see good descriptions of the effect of each condition on the yield of product. Many responses narrowly misssed out on these

marking points due to incomplete statements eg 'the yield increases because the equilibrium moves to the right' without 'as this is the side with fewer gas particles'. A misconception was also evident within some responses, with learners classifying 30atm as a low pressure rather than high pressure, perhaps not understanding the difference between atm and Pa / kPa. The least commonly awarded marking points were those for discussing the impact each condition has on the cost; whilst learners were generally aware that high temperatures and pressures are an expense it was rare for this to be linked to the energy required for the high temperature or the specialised equipment for pressure. It was rare for responses to refer to the balance of advantages and disadvantages leading to a compromise.

Most learners are aware of how a catalyst increases the rate of a reaction, often the mark for part (b) was not awarded due to lack of detail within answers rather than a lack of knowledge. Both 'lower activation energy' and 'provides an alternative route' were needed to score, many answers only gave one of these statements.

## Question 23

A lack of clarity with the language used was often a reason for learners not gaining a mark when defining the term secondary alcohol. Most understood what the term means and there were many clear definitions seen, but a significant number of responses referred to the 'hydroxide ion' or 'OH-' rather than the hydroxyl group, suggested that the OH group was itself attached to two carbon atoms, or that the OH group was on the second carbon atom in the chain.

The procedure used to oxidise alcohols seems familiar with most learners, and there was a good rate of recall of the colour change seen during this reaction. Whilst a high proportion of learners seemed to understand that reflux was required for the oxidation to occur, naming the equipment needed for this as a condenser was far more challenging. Other components of reflux apparatus were commonly seen such as anti-bumping granules, and other common answers included a bung or simply 'reflux'.

The majority of learners were able to interpret the data from the data book to give the relevant wavenumbers of the peaks involved for part (b) (iii), however many narrowly missed out on getting both of the first two marks available as there was not a clear enough reference to appearing or disappearing. The fingerprint region or the peak due to C-O was rarely discussed for M3.

A wide range of responses was seen for the first of the calculations in this question, and once again examiners looked to award transferred error for learners who carried out the correct operations within their response. Use of the 85% seemed challenging, with many learners multiplying rather than dividing by 0.85, leading to a common incorrect final answer of 1792. There was some confusion surrounding the unit conversion needed for the first marking point, with varying factors of 10 seen.

Responses to part (ii) showed that 100% atom economy is often thought to mean that only one product is made during a reaction, very few responses deduced that phenol could also be a useful product. Many guessed that the phenol could be recycled or converted into propanone.

Most learners were aware that propan-2-ol forms hydrogen bonds, therefore marking point 2 was commonly awarded for part (d). Beyond this however, it seemed challenging for learners to clearly express themselves and score the rest of the marks available. There were many narrow misses when it came to awarding marking point 4 due to the lack of reference to energy or sometimes a lack of comparative language. Learners are generally aware that hydrogen bonds are strong but too often did not compare the strength to the other intermolecular force(s) identified, or more commonly did not relate this strength back to the energy required to break them. The most challenging aspect of this question appeared to be explaining the solubility in water as this was often totally ignored, with little evidence of any attempt to explain it in a large number of responses.

A significant number of learners approached part (e) by attempting to combine the calculation steps, instead of breaking it down into individual stages. This often led to mistakes when expanding the brackets and rearranging for x, and made it difficult for examiners to award transferred error marks. Other errors commonly seen were a failure to convert from kJ into J, using the mass of fuel rather than the water, and using a value of 58 rather than 60 when calculating moles of biopropanol. Overall this was a challenging calculation for learners; whilst the equation used is familiar, using the enthalpy change to calculate the temperature rather than the other way around was not as straightforward as previous questions from this topic.