Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

January 2023

Pearson Edexcel International Advanced Level In Chemistry (WCH11) Paper 01: Structure, Bonding and Introduction to Organic Chemistry

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General Comment
Many candidates were well prepared for this examination and were able to demonstrate that they had a sound knowledge of the topics in the specification. There was no evidence that candidates ran out of time to complete the paper and the final question was usually attempted.
The mean mark for this paper was 39.3 which is slightly lower than the previous series; this is despite the higher mean mark for the multiple choice questions, and may be due to very low success in Q22(c)(ii), Q23(a), Q23(c)(iii) and Q24(b)(iii). These will be discussed in detail later in the report.

Multiple Choice Questions
The mean mark for Section A was 15, this is higher than in previous series. Despite this, examiners marking whole scripts were suprised to see all the choices left blank on some questions, and centres should be advised to remind candidates that they should attempt all questions. The questions with the highest average marks were Q8 (equation for second ionisation energy), Q15 (hazard symbols), Q1 (number of molecules) and Q6 (particles in an isotope) where 90% or more of candidates scored. The lowest scoring questions were Q19 (free radical substitution), Q20 (*E-Z* isomers), Q5 (ionic equation of a precipitation reaction) and Q2 (concentration of hydroxide ions) where 30% of candidates or fewer gained marks.

Q21(a)(i)
Many students did not read this question correctly and a large percentage of candidates only gave the molecular formula or the name of the isomer. This limited their achievement to a possible one of the two marks. Candidates that stated the molecular formula were usually correct, with occasional slips on the number of hydrogen atoms. Where candidates named the molecule first, some then gave the molecular formula of pentane having worked out the longest chain. Of those candidates that stated the name of the isomer, a common error was to give names to relating each number e.g. 2,2-dimethyl-4-methylpentane. Naming duplicate sidechains on different carbon atoms may need further reinforcement during teaching. There were some that didn't use the lowest numbers i.e. 2,4,4-trimethylpentane and these also did not score.

Q21(a)(ii)
Less that half candidates gave the correct or allowed answers here. A common incorrect answer was cracking, with fractional distillation also being seen regularly. Candidates should be familiar with all three of these industrial processes.

Q21(b)(i)
Though candidates were asked to include state symbols, a significant proportion failed to do so – some even underlined the instruction but then ignored it. Where state symbols were given, the one most frequently incorrect was heptane (with the most common incorrect state aqueous!). The majority of candidates could balance the equation, but some could not give the molecular formula for heptane – hexane was the usual error here. Water was allowed as a liquid or gas and both were regularly seen. Despite

the word “complete” being emboldened in the text, a minority of candidates did give equations for incomplete combustion.

Q21(b)(ii)
Over 80% of candidates gained this mark. Common incorrect answers were carbon dioxide (rarely a product of incomplete combustion), water (not a pollutant) and methane. Methane was not accepted as an answer (gasification is not on the specification) though unburnt hydrocarbons/heptane was allowed.

Q21(c)
This question was not answered well, with only half of candidates gaining any credit. The main reason for this was a lack of justification of answers. For instance, candidates stated “less greenhouse gases causing climate change” without stating that electric cars do not emit CO_2 (from burning fuel). Some candidates stated both variations of the first marking point so only gained one mark. The toxic gases point was most regularly awarded, along with acid rain as the justification. Very few candidates mentioned noise pollution and the benefits of quieter vehicles. Candidates may need familiarisation with the Taxonomy at the back of the specification so they can give answers appropriate to the different types of questions.

Q22(a)(i)
70% of candidates gained this mark. Common incorrect answers related to catalysts for other reactions: various acids, zeolite and iron.

Q22(a)(ii)
Less than half of candidates scored here, which was disappointing. The most common incorrect answer seen was dichloropropane (omitting the numbers), followed by chloropropane.

Q22(a)(iii)
This was poorly answered, with 40% of candidates failing to score any marks. The mean mark was just under one. Many candidates stated “water” and this could not score without the gaseous state symbol, or sulfuric acid to score the first mark. “Acid catalyst” was regularly seen and accepted for one mark. A few incorrect formulae for phosphoric(V) acid were seen. Candidates may need further support with learning the reagents and conditions for the alkene reactions on the specification.

Q22(a)(iv)
Less than 50% of candidates scored this mark. Some gave the alcohol rather than a diol, some drew the 1,3-isomer and a few showed the 2,2-diol. Candidates need to be careful when drawing bonds, ensuring that the carbon connects to the oxygen and and not the hydrogen of the alcohol group. The formation of the incorrect diol does show a lack of understanding of the addition reactions.

Q22(b)(i)
Just over half of candidates scored one mark here. M2 was dependent on gaining the first mark or a near-miss and many candidates failed to show appropriate extension bonds to score M1. The other common error was to

show the polypropene repeat unit as three carbons in a row within the brackets (rather than 2 carbons and a methyl group). Occasionally carbon-carbon double bonds were seen in the repeat unit.

To gain M2 the rest of the equation needed to correct. The “n” should be on the left of the monomer and on the right of the polymer.

Q22(b)(ii)
Half of the cohort scored one mark here, the marks awarded were evenly split between incineration producing toxic fumes and the polymers not being biodegradable / having to go to the landfill. Some candidates failed to score as they wrote about vague statements about degradation instead of biodegredation or mentioned toxic fumes but didn’t link this to burning.

Q22(c)(i)
Over a third of candidates gained all four marks for the mechanism, which is an improvement on previous series. The majority of candidates gained 2 or 3 of the marks available, common reasons for losing a mark were omitting the lone pair or charge on the bromide.

Q22(c)(ii)
This question was poorly answered with many candidates stating that 1,2-dibromopropane **is** a secondary carbocation, instead of saying that it forms from the secondary carbocation or via the 2° carbocation. The same type of error was regularly seen with 1,3-dibromopropane. Some candidates stated that secondary halogenoalkanes are more stable than primary halogenoalkanes and this would not gain credit for either marking point. Candidates need further instruction on the stability of carbocations and identifying the types of carbocations. Some described the Markovnikov rule in detail (this is not on the specification) but did not explain why this occurs in terms of carbocation stability.

Q23(a)
“Temperature” was a commonly seen answer that did not gain credit, unless the command word is “state” candidates should always expect to write more than one word in an answer. Many wrote about one being a gas and the other being a liquid which does not answer the question – a difference to the process of fractional distaillation was required. Less than 25% of the cohort gained this mark, with many of them being the candidates who went on to get the top grade.

Q23(b)(i)
Half of candidates failed to achieve a mark here, though multiple routes were available. Common errors were to confuse when to multiply and when to divide.

Q23(b)(ii)
60% of the cohort gained both marks here. Marks were often lost for miscounting the six electrons in the triple bond or complete omission of the two lone pairs. A small minority drew a diatomic group 7 molecule so had not understood that the question was about nitrogen. The mention of zeolite

in the stem confused a tiny minority of candidates who they tried to draw a nitrogen atom attached to “Ze”.

Q23(c)(i)-(ii)
A third of candidates did not gain any marks for this item. A mean of 2 marks were awarded from the 5 available.

Many candidates started by dividing the volume of liquid oxygen by the molar gas volume. This approach meant that the only mark available was M4, the conversion to m^3. Another common error was dividing by the mass of atomic oxygen instead of the molecular mass. Use of $pV = nRT$ was allowed but only a few candidates tried this route. Some incorrect rounding was seen on this item, and candidates should be reminded not to truncate their answers.

For part (ii) the most common reason for not achieving the mark was a failure to use appropriate significant figures – many gave the 3 decimal places that were shown on their calculator correctly but this did not score.

Q23(c)(iii)
Over 75% of candidates did not achieve either mark here. Common errors were to say the container needed to “withstand the pressure” without indicating that the pressure would be high. Other candidates wrote about the bottle needing to be heavy so that the liquid oxygen wouldn’t “float up into the air” which showed a lack of understanding (especially as they had been given the density at the top of the page).

Q24(a)
In part (a)(i) The main reason for a loss of a mark was to use an inappropriate scale so that the data failed to cover half of the available grid. Candidates need to practice plotting graphs on the grids given for past paper questions as the grid is designed for a suitable scale to fit easily. Where candidates had chosen odd scales they found it much harder to gain M2 for plotting accurately.

Many candidates gained M2 for (a)(ii), for a number in the range allowed for the size of the magnesium ion, this was awarded even if it didn’t match the candidates graph. The mark for a line of best fit was less routinely awarded, but many candidates gained both marks for this part.

In part (a)(iii) most candidates gained at least one mark for the trend in the ion size, though some could not score for describing the trend in “atomic” radius. A minority of candidates directly compared the nitrogen ion and the aluminium ion instead of the trend for the ions shown and this did not gain M1. When a second mark was awarded, it was evenly split between M2 and M3.

The mean mark over all three parts of this item was 4 marks from 7.

Q24(b)(i)-(ii)
40% of the cohort did not gain any marks for this item. The mean mark was 1 from the four available.

In part (i) many candidates used the term ionic but either failed to include the structure or stated molecular or macromolecular. "Linear" was a common incorrect answer, showing that some candidates require more time on the teaching of solid structures.

In part (ii) some candidates tried to explain their answer using electrolysis. This could only gain one mark (M2) unless they also mentioned the solid state with ions in fixed positions. Even among the highest achieving candidates the explanations were poor for this question.

Q24(b)(iii)
This was one of the worst scoring questions on the whole paper with 70% of the cohort not gaining either mark. M1 was scored more frequently than M2, as candidates clearly did not understand the concept of polarisation. Many candidates discussed the size of cations which was irrelevant and very few mentioned distortion at all. Some stated that fluoride had a small size and large charge but others said it was large with a small charge, neither of these answers could score M1.

Q25(a)(i)
Over 60% of candidates gained this mark. The most common incorrect answer was pyramidal and many candidates also gave the bond angle which was not asked for (or required) and was ignored.

Q25(a)(ii)
Many candidates made silly mistakes that cost them marks when drawing this dimer. Common errors were to draw a covalent bond between the two aluminium atoms or to have the co-ordinate bond from the aluminium to the chlorine. Occasionally examples where candidates added extra chloride ions to form co-ordinate bonds were seen, which would not lead to the formation of a dimer. Just over half the cohort gained some credit for this item.

Q25(b)
70% of candidates could write this equation and balance it. Multiples were accepted and as state symbols were not required, they were ignored even if incorrect. Where errors were made it was often in either the number of water and/or hydrogen chloride molecules.

Q25(c)
Candidates made a good attempt at this multistep calculation, with over 50% scoring all 3 marks. Mistakes were often made in calculating the M_r of aluminium hydroxide and using the ratio, less frequent was the failure to convert 150cm^3 to dm^3.

Q25(d)(i)
40% of candidates only scored 1 mark for this item. This was usually awarded for M2, the cations and delocalised electrons. M1 was regularly given, though some candidates lost the mark for not stating that the attraction is strong (as is stated on the specification). M3 was least

frequently awarded marking point, with many failing to tailor their answers to aluminium metal and just gave a general description of metallic bonding.

Q25(d)(ii)
Less than 65% of candidates gained either of the marks for this item. A common error was not to state that it was the delocalised electrons that move when metals conduct. Many candidates only gave one half of the answer or the other so limited their own achievement, which was disappointing.

Summary

To improve their performance, students should:

- read the question carefully and make sure that they are answering the question that has been asked. Good practice would be to underline key words.
- check how many marks are being awarded to ensure they give sufficient detail in their answers.
- make sure that they describe trends rather than make comparisons when asked. Candidates should practise describing trends in class, being aware that a data set isn't necessarily across a period or down the group.
- practise finding molecular formulae of compounds, including organic molecules.
- write formulae, symbols, and numbers carefully, checking their legibility. This is especially important as all the papers will be scanned for marking.
- be careful with the precision of curly arrows in organic mechanisms. Lone pairs and charges should also be clearly shown.
- practise naming organic molecules with multiple sidechains.
- show all working for calculations and give final answers to an appropriate number of significant figures. Candidates should practice using questions to work out what the appropriate numbers of significant figures are.
- practise drawing dative bonds, including the lone pair(s).
- check their understanding of chemical terms in the specification e.g. homologous series, geometric isomer, displayed formula.
- thoroughly revise ionic structures and their properties, including the concept of polarisation.
- use column headings to label graph axes and include units.
- reread questions and answers, where time permits, to avoid careless mistakes.

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